The World Without Us

ALSO BY ALAN WEISMAN

An Echo in My Blood

Gaviotas: A Village to Reinvent the World

La Frontera: The United States Border with Mexico

THE WORLD WITHOUT US

ALAN WEISMAN

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In memory of
Sonia Marguerite

with lasting love
from a world without you

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Das Firmament blaut ewig, und die Erde
Wird lange fest steh'n und aufblüh'n im Lenz.
Du aber, Mensch, wie lange lebst denn du?

The firmament is blue forever, and the Earth
Will long stand firm and bloom in spring.
But, man, how long will you live?

—Li-Tai-Po/Hans Bethge/Gustav Mahler
The Chinese Flute:
Drinking Song of the Sorrow of the Earth
Das Lied von der Erde

CHAPTER 18

Art Beyond Us

BEHIND A CONVERTED Tucson warehouse that houses the Metalphysic Sculpture Studio, two foundry workers don rough-hide jackets and chaps, gloves of asbestos and stainless-steel mesh, and hard hats with eye shields. From a firebrick kiln, they remove preheated ceramic molds of the sculpted wings and body of an African white-backed vulture, which, once cast and welded together, will form a life-size bronze for the Philadelphia Zoo by wildlife artist Mark Rossi. They position these, sprue channels pointed upward, in a sand-filled turntable that slides on a track over to a drum-shaped, steel-clad liquid-propane furnace. The 20-pound ingots they loaded inside earlier have decomposed into 2,000°F bronze soup, sloshing on the same heat-resistant ceramic used for space shuttle tiles.

The furnace is tilt-mounted on an axle, so little effort is required to pour molten metal into the waiting molds. Six thousand years ago in Persia, the fuel was cordwood, and the molds were cavities in clay hillsides, not ceramic shells. But except for the copper-silicon alloy favored today over the copper-arsenic or copper-tin blends the ancients used, the process of immortalizing art in bronze is essentially the same.

And for the same reasons: Copper, like silver and gold, is one of the noble metals, resistant to corrosion. Some of our ancestors first noticed it oozing like honey from a piece of malachite near a campfire. When it cooled, they found it malleable, durable, and quite beautiful. They tried melting other rocks, mixed the results, and man-made metal alloys of unprecedented strength were born.

Some of the rocks they tested contained iron, a tough base metal, but one that oxidized rapidly. It proved more resistant when mixed with carbon ash, and even stronger after laborious hours of pumping a bellows to blast out excess carbon. The result was just enough forged steel for a few prized Damascus swords but not much else until 1855, when Henry Bessemer's high-powered blowers finally turned steel from a luxury into a commodity.

But don't be fooled, says David Olson, head materials scientist at the Colorado School of Mines, by massive steel buildings, steamrollers, tanks, railway tracks, or the shine on your stainless cutlery. Bronze sculpture will outlast all of it.

"Anything made of noble metals likely will exist forever. Any metal that comes from a mineral compound like iron oxide will go back to that compound. It was there for millions of years. We've just borrowed it from the oxygen and pumped it to a higher energy state. It all falls back there."

Even stainless steel: "It's one of many fantastic alloys designed to perform a specific service. In your kitchen drawer, it stays beautiful forever. Leave it in oxygen and salt water, it's on its way out."

Bronze artwork is doubly blessed. Scarce, expensive noble metals, like gold, platinum, and palladium, combine with nearly nothing in nature. Copper, more plentiful and slightly less regal, forms bonds when exposed to oxygen and sulfur, but—unlike iron, which crumbles as it rusts—the result is a film, two-thousandths to three-thousandths of an inch thick, that protects it from further corruption. These patinas, lovely in their own right, form part of the allure of bronze sculpture, which is at least 90 percent copper. Besides adding strength and making copper easier to weld, alloys can simply make it harder. One icon of Western culture that Olson expects to last long will be pre-1982 copper pennies (actually, they're bronze, containing 5 percent zinc). Today, however, the U.S. cent is nearly all zinc, with only enough copper to memorialize the color of money once worth its face value.

That new, 97.6 percent zinc penny will leach away if tossed in the ocean, dooming Abe Lincoln's visage to be filtered by shellfish within a century or so. The Statue of Liberty, however, which sculptor Frederic Auguste Bartholdi hammered from copper sheeting not much thicker, would oxidize with dignity at the bottom of New York Harbor should glaciers ever return to our warming world and knock her off her pedestal. In the end, Liberty's sea green patina will thicken until she turns to stone, but the

sculptor's aesthetic intention will still be preserved for the fish to ponder. By then, Africa's white-backed vultures may also have vanished, except in Mark Rossi's bronze homage to them, in whatever is left of Philadelphia.

Even if the primeval Białowieża Puszcza forest spreads anew across Europe, the bronze memorial to its founder, horseback King Jagiełło in New York's Central Park, will probably outlast it one distant day when the aging sun overheats and life on Earth finally winds down. In their Central Park West studio northwest of his statue, Manhattan art conservators Barbara Appelbaum and Paul Himmelstein coax fine old materials to remain in the high-energy state to which artists have taken them. They are acutely aware of the lasting power of things elemental.

"What we know of ancient textiles in China," says Himmelstein, "is because silk was used to wrap bronzes." Long after it disintegrated, the fabric's texture remained imprinted in the copper salts of the patina. "And all we know of Greek textile is from paintings on fired ceramic vases."

Ceramics, being minerals, are as close to their lowest energy state as things get, says Appelbaum, who has high-energy dark eyes framed by short-cropped white hair. From a shelf she produces a baby trilobite, mineralized in faithful detail by Permian mud, exquisitely readable 260 million years later. "Unless you smash them, ceramics are virtually indestructible."

Unfortunately, that happens, and tragically, most of history's bronze statues are also gone, melted down for weapons. "Ninety-five percent of all artwork ever made doesn't exist anymore," says Himmelstein, a knuckle stroking his gray goatee. "We know little of Greek or Roman painting—mainly just what writers like Pliny tell us about it."

On a masonite table lies a large oil they are repairing for a private collector, a 1920s portrait of a moustachioed Austro-Hungarian noble with a jeweled watch fob. It had sagged and begun to molder after years in some dank hallway. "Unless they're hanging in 4,000-year-old pyramids with zero moisture, within a few hundred years of neglect, paintings on canvas will be a dead issue."

Water, the stuff of life, is often the death of art—unless the art is submerged in it.

"If space aliens show up after we're gone and all the museum roofs

have leaked and everything inside has rotted, they should dig up the deserts and dive underwater," Himmelstein says. If the pH isn't too acidic, the lack of oxygen can even preserve waterlogged textiles. Removing them from the water can be perilous—even copper that lies for millennia in chemical equilibrium with seawater may develop "bronze disease" outside of it, due to reactions that turn chlorides into hydrochloric acid.

"On the other hand," says Appelbaum, "we tell people who ask advice about time capsules that good-quality rag paper in an acid-free box should last forever, as long as it never gets wet. Just like Egyptian papyrus." Immense archives of acid-free paper, including the world's largest collection of photographs, owned by the stock photo agency Corbis, have been climatically sealed in a former limestone mine in western Pennsylvania, 200 feet below ground. The vault's dehumidifiers and subzero refrigeration are guaranteed to secure them for at least 5,000 years.

Unless, of course, the power goes off. Despite our best efforts, things do go amiss. "Even in dry Egypt," notes Himmelstein, "the most valuable library yet assembled—a half-million papyrus scrolls in Alexandria, some of them Aristotle's—was perfectly preserved until a bishop lit a torch to expel paganism."

He wipes his hands on his blue pinstriped apron. "At least we know about them. The saddest thing is that we have no idea of what ancient music was like. We have some of the instruments. But not the sounds made on them."

Neither of these esteemed conservators figures that music as it is recorded today—nor any other information stored on digital media—has much chance to survive, let alone be apprehended by any sentient being that might puzzle over a stack of flimsy plastic disks in the distant future. Some museums now use lasers to etch knowledge microscopically on stable copper—a good idea, assuming the mechanisms to read them survive with them.

And yet, of all human creative expression, it happens that music may have the best chance of all to echo on.

IN 1977, CARL Sagan asked Toronto painter and radio producer Jon Lomberg how an artist might express the essence of human identity to an

audience that had never seen humans. With fellow Cornell astrophysicist Frank Drake, Sagan had just been invited by NASA to devise something meaningful about humanity to accompany the twin Voyager spacecrafts, which would visit the outer planets and then continue on through interstellar space, possibly forever.

Sagan and Drake had also been involved with the only other two space probes to leave the solar system behind. *Pioneer 10* and *Pioneer 11* were launched in 1972 and 1973, respectively, to see if the asteroid belt could be navigated and to inspect Jupiter and Saturn. *Pioneer 10* survived a hot 1973 encounter with radioactive ions in Jupiter's magnetic field, sent back images of Jovian moons, and kept going. Its last audible transmission was in 2003; at the time, it was nearly 8 billion miles from Earth. In 2 million years, it should pass, but not dangerously near, the red star Aldebran, the eye in the constellation Taurus. *Pioneer 11* whipped around Jupiter a year after its sibling, using its gravity like a sling to propel it past Saturn in 1979. Its escape trajectory sent it in the direction of Sagittarius; it won't pass any stars for 4 million years.

Both Pioneers carry 6-by-9-inch gold-plated aluminum plaques bolted to their frames, bearing line etchings by Sagan's former wife Linda Salzman that depict a naked human male and female. Next to them are graphical depictions of Earth's position in the solar system and the sun's location in the Milky Way, plus the cosmic equivalent of a phone number: a mathematical key based on a transitional state of hydrogen, indicating wavelengths where we're tuned in, listening.

The messages carried by the Voyagers, Sagan told Jon Lomberg, would go into much more detail about us. In an era preceding digital media, Drake had contrived a way to record both sounds and images on a 12-inch, gold-plated copper analog disk, which would include a stylus and, they hoped, intelligible diagrams on how to play it. Sagan wanted Lomberg, the illustrator of his popular books, as the recording's design director.

The notion was boggling: conceive and choreograph a showcase that would be a work of art in itself, bearing what might likely be the last remaining fragments of human aesthetic expression. Once aloft, the gold-anodized aluminum box containing the record, whose cover Lomberg would also design, would be exposed to weathering by cosmic rays and interstellar dust. By conservative estimates, it would last at least a billion

years, but probably much longer. By then, tectonic upheavals or an expanded sun might well have rendered any signs of us left on Earth down to their molecular essence. It might be the closest that any human artifact would get to a chance at eternity.

Lomberg had only six weeks to think about that before launch. He and his colleagues polled world figures, semioticians, thinkers, artists, scientists, and science-fiction writers on what might possibly penetrate the consciousness of unfathomable viewers and listeners. (Years later, Lomberg would also help design the warning to trespassers of buried radioactive peril at New Mexico's Waste Isolation Pilot Plant.) The disk would carry recorded greetings in 54 human languages, plus voices of dozens of other Earth inhabitants, from sparrows to whales, and sounds such as a heartbeat, surf, a jackhammer, crackling fire, thunder, and a mother's kiss.

The pictures included diagrams of DNA and the solar system, as well as photographs of nature, architecture, town and cityscapes, women nursing babies, men hunting, children contemplating a globe, athletes competing, and people eating. Since the finders might not realize that a photo was more than abstract squiggles, Lomberg sketched some accompanying silhouettes to help them discern a figure from its background. For a portrait of a five-generation family, he silhouetted individuals and included notations conveying their relative sizes, weights, and ages. For a human couple, he made the woman's silhouetted womb transparent to reveal the fetus growing within, hoping that communion between an artist's idea and an unseen viewer's imagination might transcend even enormous time and space.

"My job was not just to find all these images, but to sequence them in a way that added more information than the sum of the individual pictures," he recalls today in his home near Hawaii's observatory-studded Mauna Kea volcano. Beginning with things a cosmic traveler might recognize, such as planets as seen from space or the spectra of stars, he arranged images along an evolutionary flow, from geology to the living biosphere to human culture.

Similarly, he orchestrated the sounds. Although he was a painter, he sensed that music had a better chance than images to reach, and maybe even enchant, the alien mind. Partly, because rhythm is manifest throughout physics, but also because for him, "other than nature, it's the most reliable way to get into touch with what we call spirit."

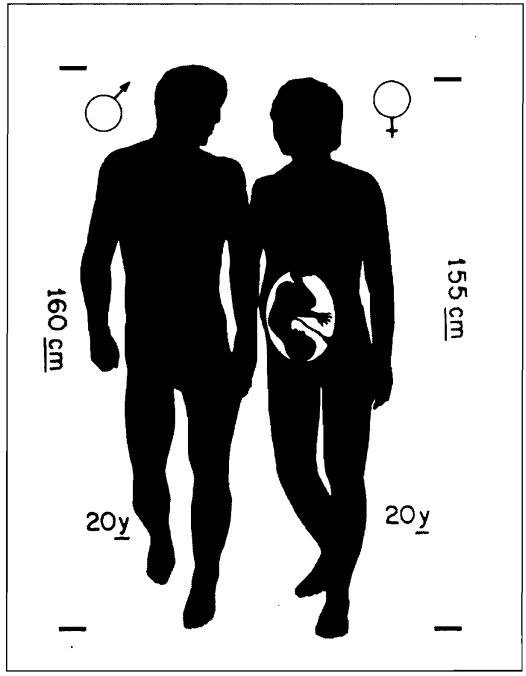

Diagram of male and female, drawn by Jon Lomberg for the *Voyager* Spacecraft Golden Record.

The disk contains 26 selections, including music of pygmies, Navajos, Azerbaijani bagpipes, mariachis, Chuck Berry, Bach, and Louis Armstrong. Lomberg's most cherished nominee was the Queen of the Night's aria from Mozart's *The Magic Flute*. In it, soprano Edda Moser, backed by the Bavarian State Opera Orchestra, displays the upper limit of the human voice, hitting the loftiest note in the standard operatic repertoire, a high F. Lomberg and the record's producer, former *Rolling Stone* editor Timothy Ferris, insisted to Sagan and Frank Drake that it be included.

They quoted Kierkegaard, who had once written: "Mozart enters that small, immortal band whose names, whose works, time will not forget, for they are remembered in eternity."

With Voyager, they felt honored to make that truer than ever.

The two Voyagers were launched in 1977. Both passed Jupiter in 1979 and reached Saturn two years later. After its sensational discovery of active volcanoes on Jupiter's moon Io, *Voyager 1* dipped below Saturn's south pole for our first glimpse of its moon Titan, which flipped it out of the solar system's elliptical plane and off toward interstellar space, actually passing *Pioneer 10.* It is now farther from Earth than any other human-made object. *Voyager 2* took advantage of a rare planetary alignment to visit Uranus and Neptune, and now is also leaving the sun behind.

Lomberg watched the first Voyager launch, with the record's gilded sleeve bearing his diagrams of its birthplace and what to do with the disk inside—glyphs that he, Sagan, and Drake hoped that any space-navigating intelligence would be able to decipher, though there was little chance it would ever be found, and even less that we would ever know about it. Yet neither the Voyagers nor their recordings are the first man-made entities to travel beyond our planetary neighborhoods. Even after billions of years of relentless space-dust abrasion wears them to dust themselves, there is yet another chance for us to be known beyond our world.

DURING THE 1890S, a Serbian immigrant to America, Nikola Tesla, and an Italian, Guglielmo Marconi, each patented devices capable of sending wireless signals. In 1897, Tesla demonstrated sending ship-to-shore pulses across bodies of water in New York, even as Marconi was doing the same among various British isles—and, in 1901, across the Atlantic. Eventually they sued each other over the claim, and the royalties, to the invention of radio. No matter who was right, by then transmission across seas and continents was routine.

And beyond: Electromagnetic radio waves—waves much longer than poisonous gamma radiation or ultraviolet sunlight—emanate at the speed of light in an expanding sphere. As they move outward, their intensity drops by a factor of one over the distance squared, meaning that at 100 million miles from Earth, the signal strength is one-fourth what it was at 50 million miles. Nevertheless, it is still there. As the sphere of a transmission's surface expands through the Milky Way, galactic dust absorbs some of the radio radiation, attenuating the signal further. Still, it keeps going.

In 1974, Frank Drake beamed a three-minute radio greeting from the largest radio dish on Earth, the 1,000-foot, half-million-watt Arecibo Radio Telescope in Puerto Rico. The message consisted of a series of binary pulses that an extraterrestrial mathematician might recognize as representing a crude graphical arrangement, depicting the sequence 1 through 10, the hydrogen atom, DNA, our solar system, and a human-shaped stick figure.

The signal, Drake later explained, was about a million times stronger than a typical TV transmission, and was aimed at a star cluster in the constellation Hercules, where it wouldn't arrive for 22,800 years. Even so, due to the subsequent outcry over possibly having revealed Earth's whereabouts to superior, predatory alien intelligences, members of the international community of radio astronomers agreed to never unilaterally expose the planet to such a risk again. In 2002, that accord was ignored by Canadian scientists who directed lasers heavenward. But as Drake's broadcast has yet to elicit a response, let alone an attack, the chance that anything might cross their tight beams can't be meaningfully computed.

Besides, the cat may long be out of the bag. For more than a half-century, we've been sending signals that by now would take a very large or very sensitive receiver to collect—yet, considering the size of the intellect that we imagine might be out there, it's not impossible.

In 1955, a little more than four years after leaving a TV studio in Hollywood, signals bearing the first sound and images of the *I Love Lucy* show passed Proxima Centauri, the nearest star to our sun. A half-century later, a scene with Lucy disguised as a clown sneaking into Ricky's Tropicana Night Club was 50-plus light-years, or about 300 trillion miles, away. Since the Milky Way is 100,000 light-years across and 1,000 light-years thick, and our solar system is near the middle of the galactic plane, this means in about AD 2450 the expanding sphere of radio waves bearing Lucy, Ricky, and their neighbors the Mertzes will emerge from the top and bottom of our galaxy and enter intergalactic space.

Before them will lie billions of other galaxies, over distances we can quantify but can't really comprehend. By the time *I Love Lucy* reaches them, it's unclear how anything out there would be able to make much sense of it, either. Distant galaxies, from our perspective, are moving away from each other, and the farther away they are, the faster they move—an astronomical quirk that appears to define the very fabric of space itself. The

farther radio waves go, the weaker they become, and the longer they appear. Out at the universe's edge, 10 billion-plus light-years away from now, light from our galaxy seen by some superintelligent race would appear shifted to the red end of the spectrum, where the longest wavelengths lie.

Massive galaxies in their path would further distort radio waves bearing the news that in 1953, a baby boy was born to Lucille Ball and Desi Arnaz. It would also increasingly compete with the background noise from the Big Bang, the original birth cry of the universe, which a consensus of scientists dates to at least 13.7 billion years ago. Just like Lucy's broadcast shenanigans, that sound has been expanding at the speed of light ever since, and thus pervades everything. At some point, radio signals become even weaker than that cosmic background static.

But however fragmented, Lucy would be there, even fortified by the far more robust ultrahigh-frequency broadcasts of her reruns. And Marconi and Tesla, the most gossamer of electronic ghosts by now, would have preceded her, and Frank Drake after them. Radio waves, like light, keep expanding. To the limits of our universe and our knowledge, they are immortal, and broadcast images of our world and our times and memory are there with them.

As the Voyagers and Pioneers erode away to stardust, in the end our radio waves, bearing sounds and images that record barely more than a single century of human existence, will be all the universe holds of us. It's hardly an instant, even in human terms, but a remarkably fruitful—if convulsive—one. Whoever awaits our news at the edge of time will get an earful. They may not understand *Lucy,* but they will hear us laugh.