
December 5, 1999

Built to Last

On Jan. 14, The New York Times Magazine convened a panel of experts to talk about the practical issues involved in building a time capsule. The discussion, intended to cover a lunch, lasted past 5 p.m. Here are excerpts.

The Panelists

Mary Turner Baker. Research chemist, Smithsonian Center for Materials Research and Education. Baker is a materials scientist and an expert on preserving plastics and recording media.

Gregory Benford. Professor of physics at the University of California, Irvine. Benford is the author of "Deep Time: How Humanity Communicates Across Millennia." He developed "deep time" messages for the 1997 Cassini satellite mission to Saturn and the 1999 Mars Polar Lander.

Ronald Garner. Manager, Westinghouse, government technical services division. Garner runs the facility that builds metal and plastic containers used to ship and store nuclear waste.

Margaret Maclean. Conservation planner, consultant. Former director of documentation and special initiatives, Getty Conservation Institute. MacLean helped organize "Time and Bits: Managing Digital Continuity," a conference sponsored by the Getty and the Long Now Foundation.

Dianne Van Der Reyden. Head of the paper conservation lab, Smithsonian Center for Materials Research and Education. Van der Reyden was previously chief paper conservator at the Museum of American History.

Frederick Stumm. Project chief, United States Geological Survey, water resources division, New York metropolitan region. Stumm is an expert on the hydrology and geology of the New York metropolitan area.

Writing in Invisible Ink

The Times: We're delighted that you could attend today and help us embark on a project well outside our usual business. Our time capsule began merely as an editorial conceit, but eventually we came to think that it would be more interesting if we actually built one, to be opened in the year 3000. We're not that interested in a conventional time capsule. A box full of stuff buried in a hole seems old-fashioned. We're leaning instead toward some sort of digital capsule. What do you think?

Margaret Maclean: Digital is a problem. Digital storage media -- floppies, compact discs, whatever -- don't have a long life span. A few decades at most. Analog is the way you should go.

The Times: What's analog? How exactly does that differ from digital?

Gregory Benford: Digital information is stored as zeroes and ones -- you need a computer to read it, whether it's on a compact disc, a computer file or a digital videotape. So-called analog information, on the other hand, is a direct representation of information: a photographic print, the sound grooves on an LP, the frames of a movie.

Maclean: Digital storage is an all-or-nothing proposition. Once the zeroes and ones that make up the digital record start to break down, the entire disk or tape becomes unreadable. Analog is different. When an old photo deteriorates, you can still see some of it. But when a digital image deteriorates, you lose the whole ball of wax. One more thing -- reading a digital record requires electronic translation of the zeroes and ones into text or pictures or sound. If you don't have the right hardware or software, you're out of luck. This happens now after a couple of years. Some of NASA's early images of the earth are no longer readable. We've been using the equipment in a state of faith, not fact. In 1,000 years, who will understand such strange, ephemeral technology? It's already hard enough to find a disk drive for 5 1/2-inch floppies.

Dianne Van Der Reyden: Right now, your only option is to "migrate" the digital data -- keep copying it over into the latest format. But that's a lot of work. Besides, the whole point of a time capsule is that people aren't supposed to be able to see what's in there. That's the difference between a time capsule and a library.

The Times: So for our purpose, analog is better than digital?

Maclean: A million times better. Keep in mind, however, that both are fragile. The musician Brian Eno tells a story about storing his music on a kind of analog recording tape that was a big deal about 15 years ago. One day, while listening to some of these tapes, he happened to walk around to the side of the player. He noticed that the oxide on the tape was falling off into little piles of dust. He stopped the reels, realizing that he could play his tapes only once.

The Times: But if we can't use a CD, and we can't use a tape, how do we preserve sound recordings?

Mary Turner Baker: Put it on a record, but not a vinyl record -- it won't last. Instead, enclose the metal master used to stamp out the vinyl copies.

Maclean: There's another long-term analog storage medium that you could consider. We were looking for ways to preserve text that avoid the problems of digital technology. We found this company called Norsam Technologies, which makes HD-Rosetta disks, metal plates that are inscribed with microscopic text and images. You can put up to a thousand pages on one disk and still read it with a high-school chemistry lab microscope. It's an analog format, like microfilm.

Van Der Reyden: While we're talking about ways to preserve words and images, don't forget about paper. Some papers have lasted for more than a thousand years. Under the right conditions, acid-free paper can last for a long time.

The Times: Records rather than CD's. Acid-free paper and HD-Rosetta disks instead of computer files. What about photos?

Van Der Reyden: Photos have to be printed on good quality paper. Black-and-white silver-gelatin photographs last longer than color photographs. If they're kept in stable conditions -- no direct sunlight, stable temperatures, no moisture -- there's a good chance most photos will be fine. Keep in mind, however, that we don't know for sure how long they will last. We can only do accelerated-aging tests.

The Times: What about organic materials: seeds, for example, or a lock of hair? Would the hair contain DNA that could be read in the year 3000?

Van Der Reyden: Yes, so long as you got the hair follicle as well. You should put them into little glass vials. You could also put seeds in vials, or any other kind of organic material.

The Times: What kind of container do we use for all this stuff? Should we build the capsule out of plastic or metal? Or something else?

Ronald Garner: You could use polyethylene. It's a plastic with a very high carbon content, which makes it almost impervious to sunlight. And you can seal the seams with nothing more than heat. They've done some accelerated-aging tests on it; unfortunately, the best data I can find doesn't go beyond 75 years. You could also use stainless steel. It takes a long time to corrode and is extremely durable. In the United States, we use it to store plutonium.

The Times: How can we make sure that everything remains stable in our box?

Baker: You might consider pumping it full of nitrogen or an inert gas like argon. And you should group materials by classes, with a separate compartment for each. Similar kinds of papers in one, plastics in another, other substances in a third.

A Sacred Place or a Priesthood?

The Times: Where do we put this thing once we've packed it? And how do we make certain that people will open it in a thousand years?

Benford: That depends which strategy you choose. Do you hide it and hope someone finds it? Or do you leave behind a marking system? If you bury it, you should create a pattern of iron magnets around the capsule. That will suggest some kind of purpose to anyone who stumbles upon it.

Maclean: But who's going to know that this is a time capsule that's meant to be opened by people in the year 3000?

Frederick Stumm: That's a problem. You need to convey the message that people in the future have to wait until 3000. But people in the future might not understand.

The Times: You don't think they are going to be able to read English? We can understand texts that were written in the year 1000.

Benford: Try reading "Beowulf" now. The guy who digs this up may not be a classical scholar.

Baker: For all we know, people in the year 3000 may be primitive and ignorant and destructive. The capsule may be opened in a dark age when people don't understand or are afraid of information.

The Times: That problem aside, how do we make sure the capsule doesn't end up lost?

Benford: That's difficult. Imagine 1,000 years from now: the United States doesn't exist and there's debris all over. Every goddamn President and major literary figure and editor of The New York Times has got a monument somewhere. It's going to be difficult to find a capsule buried amid all that clutter.

Stumm: Also, let's say you leave behind a record of its exact latitude and longitude. That will shift over the next thousand years, thanks to changes in the earth's axis and continental drift. As the plates in the earth's crust move apart, Europe and America will drift away from each other. By the year 3000, the coordinates of the capsule will have shifted by as much as 60 feet. You'd have to project what the future coordinates would be.

The Times: Let's talk a bit more about where we're going to put the capsule. Is the water table a problem if we bury it a few feet underground or put it in an abandoned tunnel?

Stumm: There are significant fractures beneath the island of Manhattan. It's therefore difficult to know the elevation of groundwater in any given place. At the present time, we have to pump groundwater out of some of the subway stations. In a couple hundred years, an abandoned tunnel may fill up with water and destroy the capsule's contents.

The Times: What's the future of the water table here in Manhattan?

Stumm: Well, today, near Central Park, the water table is about 43 feet above sea level. It's estimated that the sea level will rise about eight feet over the next thousand years. The consequent change in the water table may saturate fractures in the bedrock and flood your capsule if you fail to bury it in rock that is above the future water table. I would instead suggest that you bury it above that -- that is, drill sideways into an outcrop of bedrock in Central Park. That would insulate the capsule and keep it relatively dry into the future.

Benford: I'd also recommend Central Park, or some other sacred ground like the Revolutionary War-era graveyard near the World Trade Center, which has remained largely undisturbed for centuries. You should place your bets on the few spots that have been relatively untouched, the ones that are time-honored. On the other hand, if you put it in your own basement at The Times, you'd save money.

Maclean: Your building may look permanent to you, but I can tell you from experience, architecture doesn't last that long. And how can you control the ownership of the building?

Stumm: Keep in mind, too, that at least four earthquakes have hit this area since 1500. Two of them were substantial enough to damage some buildings. The likelihood of an earthquake should be factored into the capsule's design and location.

Maclean: If you handed over stewardship to an institution that would persevere for a thousand years, then you wouldn't have to worry as much about earthquakes and changes in the sea level. A stable institution like a synagogue or a museum would protect it and move it when they go.

Benford: What you really need is a "priesthood" -- people who will worship and take care of the capsule.

The Times: So find some institution to act as a priesthood and hitch a ride with them?

Maclean: You can count on cultural institutions to be conservative and last the longest. Think of weddings and funerals. Traditional events like these connect generations. Cultural institutions play a similar role in preserving memory.

Benford: If we're trying to command the respect and care of a priesthood, beauty has been one device for achieving that. Take illuminated manuscripts, for example. Something like the Book of Kells.

But let me caution against making it out of something valuable, like gold. You need to protect it against your typical grave robber. Your toughest problem is attracting attention without making it seem that there's something worth stealing. You make it pretty, somebody will steal it. But at the same time, you've got to make it worthy of preservation. Face it: these are two contradictory objectives. There is a spectrum of choices. In the end, you have to make one, almost on faith. But in this climate, I wouldn't count on anything lasting if you just leave it to nature. Sometimes, beauty is the best defense.

Photos: Designed to survive a nuclear war, the HD-Rosetta disk, shown here slightly larger than actual size, holds tens of thousands of microscopic pages etched on polished nickel. (Mikako Koyama); Choosing what to put into a time capsule is the easy part; coming up with a box that will last for a thousand years is more difficult. From left to right, Dianne Van Der Reyden, Ronald Garner and Mary Turner Baker. (Eddie Keating/The New York Times) Destined for the dustbin: Modern recording media, digital or analog, are highly perishable. Most won't last more than 25 years. (Photodisc)