Once upon a TIME in San Rafael
Not even the breakdown of civilization as we know it will keep the Clock of the Long Now from ticking

BY JOY LANZENDORFER The Pacific Sun, September 15th 2006

Monuments of past civilizations, like the Egyptian pyramids and Stonehenge, tell us a lot about the people who built them. Along with saying what was important to them—their government, their religion, a particular king's ego—it reveals their outlook as well. They saw the future as something they could reach into and leave a mark upon.

In San Rafael, at a place called Rand Machine Works, is the start of something that could become our own mark on the future. The project, The Clock of the Long Now, is a giant timepiece that will be installed in a mountain in Nevada. There, it will quietly tick away the days, years, centuries and finally millennia for the next 10,000 years.

Designing a 70-foot clock that will measure time for 10,000 years may seem like an ambitious goal, but the project has big minds and even bigger pockets behind it. The idea is that since human history can be traced back 10,000 years (at least as far as pottery fragments and tools can tell us), the Clock of the Long Now will measure the next 10,000 years.

The first prototype of the clock was completed on New Year's Eve 1999. It is now on display at the Science Museum in London. Work on the next prototype is about to begin. There is no deadline for the installation of the final clock and it is at least a decade away.

For many, the clock itself is not the point. The real point of the project is to make us think about the future.

"Whether or not the clock gets built, the fact that it generates conversation is what makes it important," says Chris Rand, owner of Rand Machine Works. "It's sort of an icon for a big discussion about how our actions will impact future generations."

The Clock of the Long Now is the brainchild of Danny Hillis, former Disney Imagineer and co-chairman of Applied Minds based in

Glendale. While an undergraduate at MIT in the 1970s, Hillis made a computer out of Tinkertoys that could beat people at tic-tac-toe. Later, he made a "Connection Machine" that used 65,536 processors firing all at once, similar to how neurons act in the brain. It was the model that most supercomputers are based on today.

The Clock of the Long Now came, in part, from Hillis's desire to try something different.

"Hillis was intrigued with building the world's slowest computer after working on the world's fastest computers," says Simone Davalos, who works for the Long Now Foundation in San Francisco, an establishment created to helm the clock project and encourage long-term thinking.

In the 1980s and '90s, Hillis was struck by how the year 2000 acted as a barrier to future planning. Many people simply didn't think beyond that date. It got him thinking about our perceptions of time. He told Wired magazine he wanted to "build a clock that ticks once a year. The century hand advances once every one hundred years, and the cuckoo comes out on the millennium." Hillis's friend, music producer Brian Eno, named the project "The Clock of the Long Now."

The clock was part geeky fantasy and part statement—a way to look into the future simply by measuring it.

"One of the reasons he chose a clock is because it's a pretty benign object," says mechanical engineer and project designer Paolo Salvagione. "It's tough to say a clock would be influenced by any particular part of society—religious or secular or otherwise."

Since then, The Clock of the Long Now has gotten steadily more elaborate. Instead of a tick, Eno and Hillis designed a chime mechanism that can generate a different chime sequence each time the clock is visited. Now the clock can chime for 10,000 years and never repeat itself.

In the end, plans call for the project to be installed in rooms dug into the side of a mountain in Nevada that the Long Now Foundation has purchased. Visitors will walk through the rooms and

see a series of displays showing the solar system, calendar systems and the procession of the equinoxes, as well as the clock itself.

“Danny has taken the original idea of the clock and elaborated on it,” says Salvagione. “He is still imagining the core devise, which is basically a time-keeping device, but now there will be a series of ancillary displays too.”

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RAND MACHINE WORKS is in an obscure warehouse in San Rafael. Inside, among the machines, stands the project that lately has been occupying the minds of Chris Rand and Paolo Salvagione.

It’s not the next prototype of the clock itself. That will come later. Instead, this is a prototype for the orrery, one of the ancillary displays that will be in addition to the clock. Named after the Duke of Orrery, this device shows the positions of the planets in the solar system.

This is the second prototype of the orrery that Rand and Salvagione have built. So far, only the guts of the machine have been completed—wide, circular stacks of what look like giant gears. On top of this, they will install the display of the six planets that are visible to the human eye. Small spheres representing each planet will be suspended on rings so that the whole thing will look like a large model of an atom. The spheres will be made from natural stone: Mexican calcite for the sun, meteorite for Mercury, orange calcite for Venus, Chilean lapis for the Earth, jasper for Mars, banded sandstone for Jupiter and banded onyx for Saturn.

The completed part of the orrery looks almost antiquated, as if it should be in a museum—except that it also has the gleaming copper-penny aura of a movie prop. It looks like something you would see in The Illusionist or Wild Wild West.

In some ways this makes sense. Chris Rand, who used to work for Industrial Light & Magic, made props for many movies, including E.T., Poltergeist, Indiana Jones and the Temple of Doom and The Nightmare Before Christmas.

But the half-made machine is no facsimile—it's a fully functional mechanical binary computer that was designed and patented by Hillis. Most computers use the on and off of electricity to indicate the ones and zeros of binary code. This computer uses levers. If the lever is on one side of the track, it indicates zero; if it is on the other, it indicates one. Once the track makes a single revolution, it adds the value of a number (determined by the planet's orbit) and hits a device called the Geneva wheel, which changes the display on the orrery.

This technology, called a serial-bit adder, is just one of many innovations that Hillis has created for the clock. The first clock prototype also used the serial-bit adder, at least judging by a poster of the clock that hangs on the wall of Rand's office.

In fact, the core of the 9-foot-tall clock prototype is similar to the half-built orrery now in the shop, except that it is narrower and the tracks are gold-colored. A base sticks out below the clock like short, squat legs, and on top is the clock's face, which is tilted outward so that it seems to be looking at the person observing it. It has a broad silver-and-copper outer edge, and its center is black with white specks and a swirly design on top, suggesting the universe.

Rand holds out an intricately carved paper model of the clock, which sits on the palm of his hand. It looks remarkably like the prototype, only the face is looking up at the ceiling, not out at the viewer.

"This is how the first model was going to be. We were pretty close to having it finished like this too, and then Danny said, 'You know, I really want the face to be like this,' " says Rand, while tilting the paper model ever so slightly outward.

"That little change threw a four-month detour into the project," he says chuckling.

Still, the prototype was completed by New Year's Eve 1999, when it bonged twice at midnight. Theoretically, it could last several hundred years—not thousands because the parts are smaller and will wear out faster. However, when they shipped the clock to

London and reassembled it at the Science Museum, it wouldn't start. Rand believes it was probably dropped in transit to London.

"We ended up spending a couple of long nights taking it apart and reassembling it, trying to get it to run right," he says. "Basically, we ran out of time. The queen was coming for this big unveiling of the new wing of the museum, so it was never 100 percent fixed. It does work, but it's not perfect. It ended up being more of a concept model."

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AS THE ENGINEER, Salvagione has the job of implementing the concept. Along with discussing the overall design, he researches details such as which materials will last the longest and how to scale up each prototype.

Because of this, the problems he solves today are different from the ones he dealt with for previous engineering projects.

"Most of my peers are making electronic devices that get thrown away inside of a year and a half," he says. "So I'll go to lunch with them and they'll be trying to figure out how to get a small battery with lots of power into something teeny and I'm trying to figure out how to get two things that rub against each other to last for 10,000 years."

The clock uses principles designed to help it last a long time. Among these: It will be made out of extremely durable metal—monell, an alloy of nickel and copper originally found in asteroids, is the current favorite. It should be big, because big parts tend to wear out more slowly than small parts, and it shouldn't move much, because that also means less wear and tear.

Durability considerations for a 10,000-year clock might seem obvious, but Salvagione has to be even more creative when planning for the Long Now's long haul. For instance, it shouldn't be made out of any precious metals or anything that may attract thieves, and it should be transparent so that someone could figure out how it works just by looking at it.

“If the chain was broken and our civilization returned to a medieval time, one would hope that by making most of the components obvious as to what they do, people could deduce how it works and maybe get it started again if it had stopped,” says Salvagione.

The location was chosen to stack the odds in the clock’s favor. To pick the spot, the designers looked at a map of the United States at night and wrote a list of the darkest areas (i.e., with the smallest degree of manmade light sources), figuring that remote places would take longer to fill up with people. Then they looked at how much geological movement and moisture those areas experienced.

As a result, the foundation purchased Mt. Washington near Ely, Nevada. The clock would be built inside white limestone cliffs some 10,000 feet above the ground. Mt. Washington is part of the Yucca Mountain Range, one of the most stable in the world, and next to Great Basin National Park, home of the world’s oldest living things—bristlecone pines, which can live up to 5,000 years.

However, while time, moisture and geology take their toll, it is humanity that has worn down ancient relics the most.

“The joke is that if you want something to last that long, you hide it or lose it—just say, ‘Whoops, it’s gone!’ “ says Salvagione. “Or do what they did with the pyramids—kill off everyone who worked on it so that nobody knows how it works or how to get into it.”

Yet a clock like this won’t have much of a point if nobody ever sees it. So, while the designers will put the clock in a remote location, they may also make part of it dependent on human interaction. They are thinking of making it so that the displays will only show the last time someone visited the clock. When people visit it, they would wind the clock, perhaps by stepping on stairs that slightly compress or by going through a turnstile. Then, before their eyes, the clock would go up to the current date and stop.

“So if a century has passed, the person would get to see the displays move from when the last person was there up until the present moment,” says Salvagione. “And as it gets to the present moment, the faces will no longer continue to update. So the idea is that the person will have this moment of understanding that we’re

in the now, and [where the faces were before] was the last time people visited."

The designers still have to decide on other unsettled details, such as how the clock will be powered. At this point, Hillis favors using temperature changes. When the temperature rises in the daytime and cools at night, a metallic spring will bend one way or the other to slowly lift a big weight.

In the long conversation about how to make a clock like this, work progresses slowly, and with no exact end in sight. When I ask Salvagione and Rand if they think they will see the final clock installed in their lifetime, they look at each other for a moment.

"I hope so," says Salvagione.

"I think so," Rand says. He looks at Salvagione. "Do you think we'll be alive for the final installation?"

Salvagione nods. "We'll probably see the installation in Ely."

"You think so? Yeah?" Rand says.

"I think we will," insists Salvagione. "That doesn't mean all the ancillary things we want will be built, but the heart of it will be there."

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AT THE LONG Now Foundation, there is a lot of talk about people "getting" the clock. Most people, they say, simply don't understand it at first.

"People sometimes think this is a crackpot project to build a giant clock on a mountain," says Davalos. "They ask all these questions about how it will work and how it will last and seem hung up on the clock itself. But when they are asking those questions, they are already thinking thousands of years into the future without even realizing it."

The Long Now Foundation has started several other projects based on long-term thinking. One, the Rosetta Project, is attempting to

collect and preserve all the languages in the world. Another, the Long Server, will begin to preserve digital data, which currently doesn't last beyond five years.

The primary mission of the foundation is to shift our cultural propensity to only look a few years down the line.

"We're trying to put ourselves out of business," says Davalos. "If people will start regularly thinking how some action will impact people 50 or 100 years down the line, we will have done our job."

At its core, The Clock of the Long Now is about human survival and posing such questions as: Will we survive? What will our future be like? How can we change so that our future will be a good one? Having a good future, the project suggests, is entirely up to us. First, we have to start imagining it.

"Our parents' science fiction was a very positive, a clean kind of future with rocket cars and things like that," says Salvagione. "But the science fiction children are reading today is very dark and post-apocalyptic. That's important, because if you don't really believe you have a future, the way you act is really different than if you believe you have a wonderful future. So we want to put something out there that says: No, the future isn't a radiation place where we're all trapped and there's no sun. Because if that's what people imagine it to be, it's almost a self-fulfilling prophecy."

PHOTO OF CHRIS RAND AND PAOLO SALVAGIONE BY ROBERT VENTE