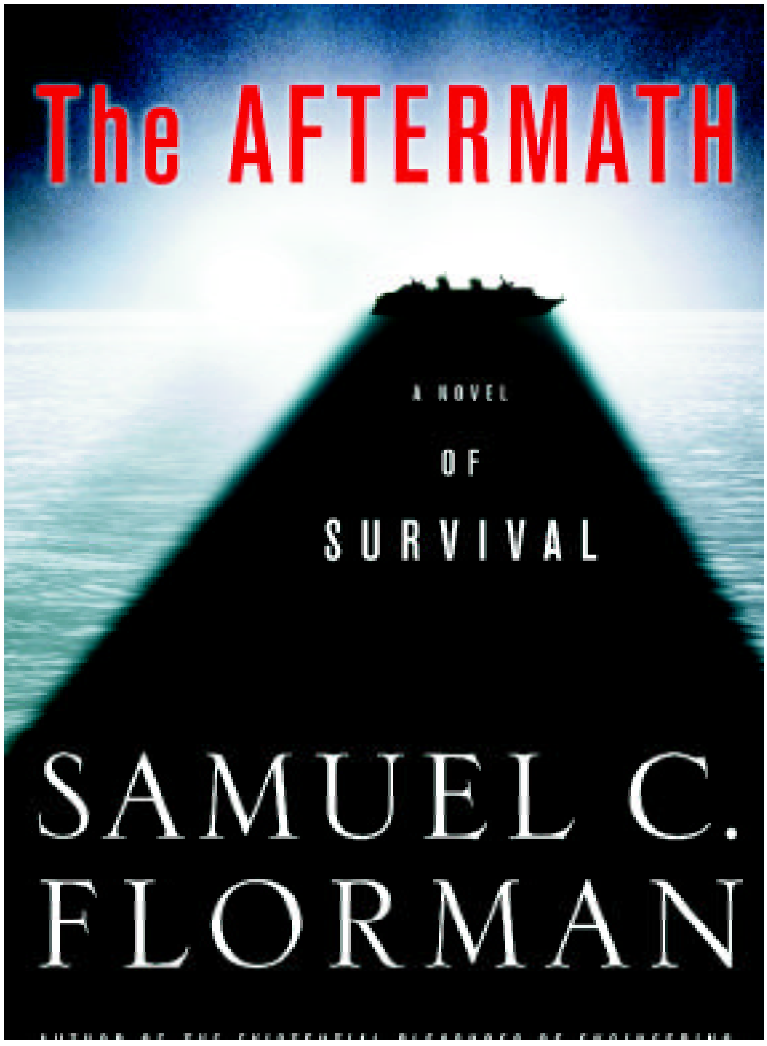

From the Journal of Wilson Hardy, Jr.

WHEN the comet struck, I was on a cruise with my father. It may sound ludicrous, irresponsible even, to be off on a cruise when the world blows up, but how else can I put it? That's the way it was, just a year ago tomorrow, a date for the history books yet to be written—if we ever print books again—December 25, 2009.

Can you imagine the world being destroyed on Christmas? In olden days, when children hung stockings by the fireside expecting presents from St. Nicholas, some parents would fill the stockings of naughty kids with coal to teach them a lesson. Maybe that's what has happened to the human race. Some lesson!

But then why, you might ask, wasn't I incinerated, pulverized, or drowned with the rest of the human race? I guess everyone who survived has been wondering the same thing. How many of us are there? About 2,500 from the cruise ship—1,500 passengers and roughly 1,000 crew—plus approximately 25,000 people who were already residents of the place in which we find ourselves. That is not very many out of a world population that had recently passed seven billion.

As for the Event, the odds against it ever happening in the first place are even more remarkable. The experts used to say that the chance of encountering a comet or an asteroid 10 kilometers wide—like the one that hit near the Yucatan peninsula 65 million years ago, supposedly killing off the dinosaurs and two thirds of all other species—was once in a hundred-million years. Not only was last year's comet larger than that infamous monster, but it was the second such projectile to come hurtling toward the earth in just two years. It makes you think that someone, or something, out there was not happy about what was going on here.

When I say out there, I should really say *way* out there, because that's where comets come from—a far, far, almost unimaginably far distance. Like many people, I used to confuse comets with asteroids; but, as I now know only too well, they're very different things. An asteroid is a solid piece of rock, sort of like a small planet. It travels around the sun in nearby circles, and we can keep an eye on it—on them, for there are many thousands. A comet is more mysterious, coming from the outer reaches of the solar system, beyond the planet Pluto, formed—so the astrophysicists tell us— in a remote molecular mist called the Oort cloud.

How and why these strange entities are formed, nobody really knows. But once they take shape and start to move, they are gravitationally bound to the sun. Unlike planets and asteroids, however, they travel in extremely elongated orbits, disappearing from our view for years at a time—for centuries at a time. Some of them are familiar to us—like our good friend Halley, who shows up every 75 to 80 years, and whose comings and goings we can calculate with great accuracy. But others can appear at any moment, coming from any direction, and usually going undetected until they are practically upon us. I remember back in 1996, when I was in elementary school, the comet Hyakutake was first sighted less than eight weeks before it passed by the earth. Less than eight weeks! And then it came within nine million miles of the earth—a tenth of the distance between the earth and the sun—practically a stone's throw in cosmic terms.

Studies have shown that the nucleus of a comet consists of sand and small bits of rock embedded in ice, mostly frozen water, but also frozen gasses such as carbon dioxide, methane, and ammonia. As this dirty snowball enters the central part of the solar system, the sun's heat vaporizes some of the ices, creating the spectacular coma, or "tail." A big asteroid can do just as much damage as a big comet. But the comet, vividly aglow like an avenging angel, has a more fearsome aspect.

Yet, when I think back to before the Event, fear hardly entered the picture. That may seem hard to believe. But the first comet was handled so effectively, with near-pinpoint nuclear blasts, that it looked as if the problem was nicely under control, now and forever. The technique had been worked out carefully, first in computer modeling, then in testing with nearby asteroids. The concept was simple enough—just a slight nudge to a charging assailant, sort of a technological judo maneuver. But the geometry of interception had to be exact, the timing had to be exquisitely precise, and the power of the bombs had to be increased far beyond anything previously employed.

One bomb would have done the trick, but using four was part of an elaborate fail-safe program. It also provided a political and public relations bonanza for the governments of both nations, along with acclaim for the engineers, scientists, and military leaders who led the effort.

Early in the new millennium, the U.S. Congress—at the request of a new president and with months of political debate and horse trading—had authorized the Department of Defense, NASA, and the Department of Energy to proceed on a crash program of intercept technology, using ion-propulsion rockets, massive new computers, improved radar and lasers, and radically new techniques for nuclear explosion. One feature of the new methodology was to use the neutron flux from the bomb explosion to heat a portion of the surface of the intruder. The suddenly heated surface layer would blow away from its home sphere, generating a powerful recoil. This, plus the force of the nuclear blast itself, would achieve the desired change in direction. Until it all worked with a genuine threat, a certain amount of trepidation was inevitable. But, with that first comet, everything functioned perfectly. It was, as they say, a piece of cake.

When the time came, the Americans and the Russians each sent two nuclear bombs out into space and exploded them together near the monstrous mass, nudging it to one side, sending it harmlessly off on a slightly altered course. One bomb would have done the trick, but using four was part of an elaborate fail-safe program. It also provided a political and public relations bonanza for the governments of both nations, along with acclaim for the engineers, scientists, and military leaders who led the effort.

When the second comet was sighted a few months later, there was hardly any public anxiety at all, merely anticipation of another exciting media event. Our cruise was already planned, and there wasn't any discussion about canceling it. On our luxury ship we would be able to get all the news via television and the wireless Internet, and thus not miss any of the excitement.

A few people in our group, members of the American Institute of Aeronautics and Astronautics, had to drop out because of their work with NASA, both as full-time employees and as consultants. Although the methodology for diversion of comets and asteroids was now established and tested, the agency nonetheless wanted all of its people on hand. Nobody else on the passenger list thought that there was even the remotest reason to change plans.

I guess I haven't mentioned that our cruise was being held to commemorate the 30th anniversary of the American Association of Engineering Societies—AAES—which meant that many of the 1,500 passengers were engineers of one sort or another. To be more specific, about 600 of the passengers were engineers, the other 900 spouses, significant others, and children of engineers. That's where I come in.

Call me Ishmael. No, I'm just kidding. My name is Wilson Hardy, Jr.—known to friends as Wil, with a single "l"—and I was born and raised in Atlanta. But when I think about bearing witness to an appalling disaster, I cannot help but think about Melville's great American novel, and Ishmael: the survivor as narrator. We were discussing *Moby Dick* in a graduate school seminar at Georgia Tech, just before I left for Christmas vacation last year. Actually, I left Atlanta several days early in order to go on the cruise. I was worried about falling behind in my work. That's a laugh. I guess I won't have that Ph.D. to hang on the wall. In fact, I'm lucky to have a wall . . . .

My field of specialty is the history of technology. If my father had prevailed, I would have followed in his footsteps and become an engineer. Actually, that came close to happening. I kind of liked the tinkering, but calculus and physics got me down. Also, the profession seemed awfully austere, somehow too forbidding for what I like to think is my blithe spirit. Maybe I have known too many engineers throughout my life. My father is a pretty good egg, but even he will admit that he's a bit stuffy. And he is practically a laugh riot compared to some of his colleagues. Of course, engineers have changed a lot in recent years, what with computer whiz kids in blue jeans transforming attitudes in the workplace. But my father is from the old school, and I suppose I will always think of him as typical of the profession.

Not that my choice of career was determined by negative factors. I've always liked storytelling and thinking about faraway places and long-ago times. One summer during high school I read through all of those Will and Ariel Durant books about civilization, which my parents had bought ages before from a book club, probably for just a few dollars. And I have a passion for dates: 1066, 1492,

1776— that kind of stuff. So I ended up studying history. Putting that together with my liking for gadgets—and maybe the engineering genes in my family—the history of technology seemed a likely choice. If things had gone differently I would have been in Atlanta right now, writing my thesis on the development of machine tools in early nineteenth-century England. Instead, here I am on a foreign shore, wondering how I can possibly write down the story of what has happened.

When our seminar group was reading *Moby Dick*, we spent a lot of time talking about the technology of whaling. That part was pretty cool; but in a more cosmic sense the image of that ship made its way deep into my inner landscape (or seascape, I should say). The sailing vessel *Pequod*, captained by the mad Ahab, off in search of the white whale, sinister symbol of a hostile universe, and with a crew that represents the human race—wow, what a ship, what a story! When, shortly after the Event, my father told me that the Governing Council had chosen me to be its recording secretary—and incidentally the official historian for our community—my first thoughts were of Ishmael, the sole survivor, telling the tale of that unearthly journey. Now here am I, a mundane historian—actually a student trying to become a historian—designated to record happenings even more inconceivable.

The most I have been able to do in these pages is summarize the events in bare outline. I hope some day to take my notes, along with the minutes I've kept at many meetings, add in such materials as I can glean from other survivors, and put together a more complete chronicle. But even that will be just a beginning. A host of historians and philosopher-poets will be needed to bear witness to the phenomenon through which we have lived in the past 12 months. Luckily, there were aboard our ship, the *Queen of Africa*, a few journalists, sages, and leaders—political, commercial, artistic, and religious—many of whom have been keeping their own diaries. I'm sure that the same is true among the Inlanders, the local inhabitants.

In this slight journal, I have interwoven my private experiences with the historical facts, jotting down what I see and hear, and a little bit of what I feel. My history professors would not have approved. They discouraged expressions of personal sentiment in academic papers. And if my father knew that I was commingling my personal memoirs with his officially commissioned history, he would not be at all pleased. But for now, he is much too busy to think about such a minor matter.

I should explain that my father, as president of the AAES, is sort of provisional co-ruler of our group, along with the captain of the ship. The local folk—we call them Inlanders since that's where they live in relation to us, settled as we are along the coast—they have political leaders of their own. Matters of common concern are managed by what we call the Coordinating Committee, about which more later.

I cannot say enough about how wonderfully the people have behaved. I had seen it many times on television or read about it in books—survivors of floods, fires, or earthquakes working together bravely and steadfastly. Well, now I've experienced it firsthand. There is something about common danger—and shared tragedy—that brings out wondrous human qualities. It can't last forever, of course; but for a year now the group's conduct—with few exceptions—has been exemplary. The ship's crew, established in functional units, with a formal, military-type chain of command, performed splendidly, and the rest of us pitched in as needed with a minimum of selfishness or malingering. Since the passenger list was comprised mainly of AAES people, we have a ready-made corporate structure. Nobody talks very much about exercising authority, but the organizational chart has come in handy. We used it in the earliest days for distributing information, food, and shelter, and for matching volunteers to appropriate tasks. It was convenient that AAES is a "society of societies," thus providing communities within communities.

Unlike doctors, lawyers, and other professionals, American engineers have never had a single, central organization to which individual members of the profession belong. Since the founding of the American Society of Civil Engineers in 1852, the main organizing thrust of the profession has been along the lines of separate technical disciplines—civil, mechanical, electrical, chemical, and so forth. Efforts to join together continually ended in failure, often in acrimony. Even after the creation of the AAES in 1980, there were quarrels and disaffections, almost dissolution. The gala cruise on which we embarked last Christmas season was to celebrate not only the thirtieth anniversary of the founding of the AAES, but also the commitment of more than 50 engineering societies to a new era of cordial collaboration.

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In planning this extravagant venture, however, my father was inspired by a vision that far transcended the realm of professional organizations. His grand conception was to bring together the most talented, creative engineers in the world and to have them, as a council of experts, consider the state of technology as we moved forward in the new millennium. His recruiting efforts were incredibly successful. We have among us an array of engineering talent that could not be matched anywhere.

It was no great trick to enlist the ruling cliques of many of the constituent societies, the presidents, executive directors, and trustees. These people thrive on board meetings and professional get-togethers. They were sure to greet the idea of a seminar cruise with delight. But my father is wise enough to know that these organizational leaders, astute as they may be, are not the

world's greatest engineers. The prodigies, the geniuses, the true pacesetters were all too busy with their technical activities, not likely to be running volunteer associations.

Acting with a committee, but doing most of the work himself, my father compiled a list of the engineers best qualified to make the seminar an event of global significance. His most important decision—especially considering how things turned out—was not to rely upon the elders of the profession, but rather to seek out people at the so-called cutting edge. He began by inviting the 100 engineers, ages 30 to 45, who were selected competitively by the National Academy of Engineering to attend a "Frontiers of Engineering" meeting in Irvine, California, the previous year. Hailing from industry, academe, and the government laboratories, these individuals are by definition at the forefront of technological activity. Then further nominations were solicited worldwide, from national academies, professional societies, corporations, and universities.

The selection committee sought representation from all the major engineering disciplines, and also from the various engineering career tracks, such as research, development, manufacturing, and teaching. They also looked for ethnic diversity and gender equity (although they had to deal realistically with the fact that only 10 percent of the world's engineers are women). My father was determined to have international representation, and even though the organization being celebrated is American, about 20 percent of the participants were from nations outside the United States.

Compiling the list of invitees, while of course challenging, was simplicity itself compared with the seemingly insurmountable difficulty of arranging for them to attend. How is one to persuade several hundred of the busiest, most productive people in the world to take 17 days out of their lives to attend a seminar on a cruise ship? Here my father came up with an idea so wondrous, and carried it out with such mastery, that I have never ceased to marvel at his accomplishment.

He took as his theme the desperate need for technologists to address, in an integrated way heretofore unknown in human history, the scourges of hunger, disease, and privation. He dreamed of engineers joining together in an effort to ameliorate the age-old calamities of poverty, war, and injustice, and the relatively new menaces of environmental degradation and large-scale terrorism. Bring our best technological minds together, he argued, and let them devote their attention to the big picture, looking up for a brief period from the concerns of their workaday world.

What should we be doing about energy, food, water, health care, education, disarmament, communications, urban blight, population pressures, and fanatical terrorists . . . ? This was the time for a holistic, interdisciplinary review of our engineering abilities vis-à-vis our most vexing human problems. This was the time for such a new beginning, just as the end of World War II was the time to found the United Nations. In the first decade of the new millennium, the world was free from cold war and superpower tensions. We had grown rich—at least some of us. Computers, the Internet, and genetic engineering had put powerful new forces at our disposal. Engineers could accomplish much, not just by meeting and talking but by having the world take note of their meeting.

Dad took his vision to the Pacific Coast, to Bill Gates and his zillionaire colleagues and competitors. To fund the proposed conference, my father sought an outlandish amount of money. But in the larger scheme of things, and especially in the high-flying, high-tech world, the sum was relatively insignificant: a mere $30 million. He had in mind a group of 1,500 people at a cost of $20,000 each, which covered the cost of the trip, including $5,000 per head for spending money. Only with an extravagant gesture, he argued, can we attract the best and brightest to our enterprise. And only with the best and brightest can the enterprise succeed.

He sold this vision, incredible as it may sound. My father, an aging civil engineer, senior partner in a firm that designs dams, tunnels, and bridges—something of a hardhat, despite his doctoral degree—sold this vision to the slickest, sleekest techies in the world. He sold them on the idea that all professional engineers, from muddy boots builders to geniuses of software application, are linked in a fellowship, and that this fellowship has the genius, the opportunity—and the obligation—to ease human suffering.

And among the invitees, who could resist? A fully paid luxury cruise aboard a brand-new ship on an exotic, seldom-traveled route, partway around the coast of Africa! Bring your family, including children (up to the age of 30, as long as they are still enrolled students), and pocket $5,000 spending money for everyone in your party. More important than the money and the travel, how about the excitement of being with talented peers who are seeking the Holy Grail of human salvation? The inevitable attention of the world's media to this remarkable enterprise was also a plus for career builders.

Most of the people who were invited accepted enthusiastically. With 1,500 passengers aboard, we were a veritable village. It is hard to believe that we embarked, in such high spirits and with such high hopes, just a little more than a year ago.

Today, we are indeed a village, although not at all like a village that any of us has ever seen before. But we have survived, and the mood of crisis that prevailed for so many months has recently begun to lift. It seems as if we can now look ahead to more than a few days at a time.

Yes, we have survived. But our magnificent ship is sunk, and the few precious objects that we were able to salvage from it don't really amount to very much. Complex appliances—a radio, a few flashlights, a laptop computer—only mock us now. Most of our batteries were quickly used up, and we have few sources of new energy—no fuel, other than wood and a little coal, no electricity, yet. We have the use of animal power, most notably herds of powerful oxen. And we have ample running water in nearby rivers, which we have already put to use with a number of rudimentary waterwheels. Also, we have embarked on an ambitious program of technological recovery. But we have had to start

from such primitive circumstances—from so far back—that one has to wonder about our long-term prospects.

I recall in one of my history courses reading about Curtis E. LeMay, longtime commanding general of the Strategic Air Command, who eventually became chief of staff of the U.S. Air Force. A darling of right-wing extremists, and known as a zealous proponent of carpet-bombing, he retired from the military and in 1968 ran for vice president with George Wallace on the American Independent Party line. During the Vietnam War, LeMay proposed telling the North Vietnamese that unless they put an end to their aggression, we would "bomb them into the Stone Age."

Well, yes indeed, General LeMay. Not exactly the circumstances you had in mind, but it happened very much like you suggested. We're living proof. Bombed into the Stone Age!

In the course of just a few hours we were transported back to Neolithic times, before 4,000 B.C., when the first copper was smelted in Sumeria. Like our Neolithic ancestors, we could cultivate crops and domesticate animals. Those two talents—momentous in the history of *Homo sapiens*—date to about 10,000 B.C. We could make lots of clever devices out of stone, wood, and bone. We could manufacture pottery and cloth—not very well, but we knew the basic principles and could develop the skills. Indeed, some of our Inlander neighbors, who had in the past been less reliant than we upon modern machines, turn out some very good pottery, and serviceable cloth from wool, cotton, and miscellaneous plant fibers. These skills are, come to think of it, remarkable, bespeaking a natural human genius for adaptation and survival. It took hundreds of thousands of years for hominids to progress from the first stonecutting tools to the Neolithic revolution of agriculture and animal domestication.

Then it took 6,000 years of Neolithic living to bring us to where we are—or rather, where we were 12 months ago. Thinking of this passage of multiple millennia, what hope has our small group to make its way back to the modern age? Assuming—as seems so far to be the case—that a return to the modern age is the course we wish to pursue.

Samuel C. Florman, P.E., is co-chairman of Kreisler Borg Florman Construction Company in Scarsdale, NY. A featured speaker at Tau Beta Pi's 1984 Convention, he was awarded the Ralph C. Roe medal by the ASME in 1982 in recognition of the individual who has contributed most effectively to a better understanding and appreciation of the engineer's worth to contemporary society.

Mr. Florman earned his B.S. in 1944 and his C.E. in1946 from the Thayer School of Engineering at Dartmouth and a master's degree in English literature from Columbia University in 1947. His more than 200 articles dealing with the relationship of technology to the general culture have appeared in many professional journals and scholarly magazines. He has been a contributing editor to *Harper's* as well as a columnist with *Technology Review*. He is the author of six books, including: *The Civilized Engineer, Blaming Technology,* and *The Existential Pleasures of Engineering*.

He serves as a trustee for the New York Hall of Science and for the Hospital for Joint Diseases Orthopaedic Institute, and was an overseer for his engineering *alma mater*. He has served on the National Research Council's board on engineering education and on its commission on engineering and technical systems. A registered professional engineer, he is a member of the National Academy of Engineering and a fellow of the American Society of Civil Engineers.

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