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TOMORROW'S EXPLORERS

***Introduction to Michael Bensons's Beyond (2003)
as previewed in The Believer magazine (October 2003)***

When Michael Benson first came to see me in my home in Colombo, Sri Lanka, in December of 2001, he asked me about a theme that has reappeared throughout my work—that our species is in its childhood and that a next step of evolution has arrived with space travel. Why hadn't the promise of that little film that Stanley Kubrick and I put together in the sixties, *2001: A Space Odyssey*, been fulfilled? Michael quoted something I had written at that time:

Only the creatures who dared to move from the sea to the hostile, alien land were able to develop intelligence. Now that this intelligence is about to face a still greater challenge, it may be that this beautiful Earth of ours is no more than a brief resting place between the sea of salt and the sea of stars. Now we must venture forth.

I shared his sense of disappointment with the progress that has been achieved. When it comes to crewed space-flight, this is especially true: There is still no Hilton Hotel in orbit (despite the arrival of the first millionaire space tourist to the International Space Station), nor is there a thriving Moon base filled with explorers likely to discover a mysterious alien artifact buried in Clavius Crater. And the recent tragic loss of a space shuttle with all seven of its astronauts underlines that even what we have accomplished can seem tenuous.

A year after his first visit, Michael re-appeared with a beautiful collection of photographs that prove there is no reason to be too disappointed in our

progress. These images serve as a spectacular reaffirmation that we are privileged to live in the greatest age of exploration the world has ever known.

Columbus never had it so good. When he set out from Europe he had only a four-thousand-year-old estimate of the circumference of the Earth—and he had cunningly reduced even that in order to make his trip to the “Indies” plausible. As this fantastic collection of pictures demonstrates, when it comes to space—John F. Kennedy’s “new ocean”—we now have far more to go on. In the four decades since Sputnik changed our perception of human capabilities, and in the three since Apollo gave us a new perspective on our planet as seen from space, our robot space probes have charted much of the solar system. Four have now actually left it and are on trajectories leading to the stars. What these intrepid explorers have revealed is even more astounding than we had imagined, back when the best we could do was peer by telescope through the Earth’s turbulent atmosphere at the vaguely glimpsed deserts of Mars or at the four tiny pin-points of light orbiting immense Jupiter.

I only wish that some of my long-gone colleagues at the British Astronomical Association and the Royal Astronomical Society could have seen these pictures! We have indeed taken giant leaps—well beyond Neil Armstrong’s famous “small” step, huge though that was. Or rather, our robot space explorers have taken them for us. When I wrote *The Exploration of Space* in 1951, I never dreamed that within a decade the first man would have traveled into space; still less did I imagine that within just over two, the first phase of manned lunar exploration would not only have begun—but would also have ended. And yet despite the fact that crewed spacecraft have remained in low Earth orbit ever since Apollo 17 returned from the Moon in 1972, the curtain has indeed been inexorably rising—both on our solar system and on the stars. It has done so through the agency of our sophisticated machines.

Although one day we will no doubt possess technologies allowing us to take a balmy afternoon stroll on the baking plains of Venus if we so choose, for now the only way to examine that planet, or sample the atmosphere of gaseous Jupiter, or descend through the opaque clouds

hiding the face of Saturn's mysterious moon Titan (as will happen when the Cassini mission finally reaches the ringed planet in late 2004, and drops an atmospheric probe on Titan), is with our increasingly autonomous interplanetary robots.

So there's no reason to regret that the explorations revealed by the sorts of images Benson has collected were conducted by space probes. In fact, we have now reached a fascinating stage in our development as a species—one in which our tools are moving well beyond us. This process has its roots deep in the prehistoric past. About a million years ago, a not particularly impressive primate located somewhere in the African continent discovered that his forelimbs could be used for purposes other than locomotion. Objects such as sticks and stones—or the bone wielded by our proto-human “Moon-watcher” in *2001*—could be grasped, and were subsequently useful for killing game, digging up roots, or attacking the neighbors. On the third planet from the Sun, tools had appeared, and the place would never be quite the same again.

As Stanley Kubrick's remarkable jump-cut from Moon-watcher's flung bone to an Earth-orbiting satellite eloquently illustrated (in what must surely be the longest flash-forward in the history of the cinema), we have come a long way in the intervening millennia—if not necessarily in our ability to live together peaceably then at least regarding our other abilities. And one thing still not generally understood, but certainly revealed in our film, is that the first users of tools were not men but prehuman anthropoids—and by their discovery they doomed themselves. For even the most simple of tools provides a tremendous mental and physical stimulus to the user. He has to walk upright; he must develop manual dexterity of an increasingly high order. And these, of course, are the specifications of *Homo sapiens*. As soon as they start to be filled, earlier models are headed for a rapid obsolescence.

The conventional idea that men invented tools is therefore a misleading half-truth; it would be more accurate to say that *tools invented man*. In the beginning, these tools were very primitive, of course: stone axes or wooden clubs wielded by creatures practically indistinguishable from apes.

Yet they led to us—and to the eventual extinction of the ape-men who first used them. And eventually they may lead to the extinction, or the rendering into irrelevance, of our species of primate as well.

Indeed, the tools we have invented—not least these probes, many launched from the same pads that Neil Armstrong and his brother humanoids used to reach the Moon three decades ago—may well turn out to be our successors. Biological evolution has been replaced by a far more rapid technological evolution. So that sentence may one day read: *tools invented man, who invented new tools, which replaced him.*

It's interesting to note how this possible evolutionary process from *Homo sapiens* to *Machina sapiens* is both predicted and mirrored in the brief history of space flight. The first true space probe, Sputnik-2, carried scientific instruments but also a dog, Laika. Although the unfortunate creature was doomed, later Soviet capsules returned their dogs back to Earth, and early American flights sent a succession of chimpanzees into orbit, which were also recovered. It was only after these domesticated descendants of prairie coyotes and wolves, and then our jungle primate relatives, were returned safely to Earth that humans were first launched into space. And ever since the last lunar landings, it has been only our machines that have departed the Earth for other worlds. (Yes, for over a generation, no human has ventured beyond a few hundred kilometers in Earth orbit.) It would be far too remarkable a coincidence if this pattern wasn't telling us something important.

Of course the idea that the machine is going to take over, or might try to do so, is one of science fiction's oldest clichés, and dates back through Capek's *RUR*, Samuel Butler's *Erewhon*, Mary Shelley's *Frankenstein*, and the Faust legend, to the mysterious figure of Daedalus, King Minos's one-man Office of Scientific Research, who may not have been a wholly mythical figure. So *2001's* HAL-9000 had ancestors that were both distinguished and disreputable, and although we still have not built a computer like it, we already know it can be done.

The fact that most contemporary computers are still high-speed half-wits, capable of doing little more than what is carefully programmed into them,

has given people a false sense of security. Michael Benson is right to locate the potential beginnings of a next evolutionary step in the successful deployment of robots like the space probes. If you don't believe in the creative capabilities of these machines, look at these photographs—and talk to world chess champion Gary Kasparov, whose defeat by IBM's Deep Blue is already regarded as a turning point in history.

The argument that originality and creativity are solely human attributes reminds me of those whip-cracking buggy drivers who used to make fun of broken-down Model Ts. And yet despite the evidence provided by these pictures, which are surely some of the greatest landscape photographs ever taken, many will refuse to grant any degree of intelligence or creativity to these robots. But the sooner we acknowledge this, the better. Even now, we are developing machines that can learn from experience, profit from their mistakes, and—unlike human beings—*never repeat them*. There are intelligent machines that do not sit passively waiting for instructions, but explore the world—or worlds—around them in a manner which can only be called inquisitive. The Jet Propulsion Laboratory in Pasadena, which designed many of the probes that took these photographs, is working on innovative designs featuring “arms” with metal “bones” sheathed in quasi-organic “muscles”—and in which the extended “fingers” will have something very much like nerve endings. And this is only the beginning. So we need look no further for the famous “missing link”—*it is us*. As Nietzsche said, Man is a rope stretched between the animal and the superhuman—a rope across the abyss. It may be that intelligence and creativity can only arise from organic life, because only living creatures, by their very nature, can evolve from simple to complex organisms. It is a little difficult to see how a lifeless planet could progress directly from metal ores and mineral deposits to electronic computers by its own unaided efforts. But though intelligence and creativity can arise only from life, they may then learn to do without the fragile organic substrate that they now require. And the greatest single stimulus to the evolution of mechanical intelligence is the challenge of space.

Only an exceedingly small percentage of the universe is directly accessible to mankind, in the sense that we can live there without elaborate mechanical protections. If we generously assume that humanity's

potential *Lebensraum* extends over the whole Earth and reaches from sea level to an altitude of three miles, that gives us a total of some half-billion cubic miles. It sounds like a lot, particularly given that the entire human race could be packed into a cube a few miles on each side. But it is a vanishingly tiny amount when set against capital-“s” Space. Our current telescopes, which are certainly not the last word on the subject, sweep a volume at least a million-million-million-million-million-million-million-million-million times greater.

Such a number is utterly beyond the conception of our fragile organic brains, of course—though not necessarily of our microchip-based ones—but it can be given a vivid meaning. If we reduced the known universe to the size of the Earth, then the portion in which *w*e can live without protection is about the size of a single atom.

Even if we organic humans do colonize other “atoms” in that immense volume of known space, it will be at the cost of tremendous technical efforts, because most of our energies will be devoted to protecting our frail and sensitive bodies against the extremes of temperature, pressure, or gravity found in space and on other worlds. Within very wide limits, machines are indifferent to these extremes. And more importantly, they can wait patiently through the years and centuries that will be needed for travel to the far reaches of the universe.

We creatures of flesh and blood can and will explore space—setbacks like the recent Columbia tragedy notwithstanding. And thanks to the probes, we have a much better idea of what we will encounter there than did Columbus or Magellan. But it may be that only creatures of metal and plastic can ever really conquer it, as they have already started doing. The tiny brains of our Voyagers and Pathfinders barely hint at the mechanical intelligence that will one day be launched at the stars. H. G. Wells famously wrote that the choice was the universe—or nothing. But he didn’t specify that it was necessarily *our* choice to make—nor did he exclude the possibility that the choice might be made in exactly the form that our robots are pioneering.

The sheer aesthetic value of such pictures gives me another idea. It may well be that only in space, confronted with environments fiercer and more complex than any to be found upon this planet, will intelligence and creativity be able to reach their fullest potential. Like other qualities, they are developed through struggle and conflict. In ages to come, dullards and the uninspired may remain on placid old Earth, while real genius and the adventurous will flourish in space—the realm of the machine, not of flesh and blood.

Exactly forty years ago, in *Profiles of the Future*, I first published my Third Law, which states that any sufficiently advanced technology is indistinguishable from magic. Finally our mechanical offspring may outgrow our narrow definition of intelligence, and pass onward to goals wholly incomprehensible to us. It will then be they, not us, who will complete the millennia-long trajectory from the sea of salt to the sea of stars. When the time comes, the descendants of the marvelous machines that took these pictures will head out into intergalactic space looking for new frontiers, leaving us once more the masters of the Solar System they first revealed to us.