Gregory Benford - Antarctica And Mars

Recently I was mulling over my favorite authors, and it struck me that often a writer's essential flavor can be summed up by one of his book titles. Charles Dickens, Great Expectations. William Faulkner, The Sound and the Fury. Hemingway, In Our Time.

At least it's an amusing game. I picked The Stars My Destination for Alfred Bester, Star Maker for Olaf Stapledon, Childhood's End for Arthur C. Clarke. Ursula K. LeGuin, The Word for World is Forest. Poul Anderson, Time and Stars.

Then I thought of that ceaseless advocate of the space program, Robert Heinlein. Surely his mood and attitude is captured by The Moon is a Harsh Mistress. Space as gritty, huge, hard, real.

Which depressed me a bit, for today the space program's spirit is anything but that. A diffuse unreality pervades NASA. Similarly, James Gunn's definitive treatment of the radio search for intelligent life, The Listeners-- not a bad title choice for his essential theme, since Gunn is one of our best social critics -- now seems quite optimistic, since Congress recently killed the program (though the Planetary Society plans to carry on, using public donations). Were all these hopeful outlooks in sf simply naive?

I reflected back on my own involvement with space, from the freckled kid reading Willy Ley and Arthur Clarke describing how rockets worked, to a consultant for NASA and the Planetary Society. Somehow a lot of the zip has gone out of space for a lot of us, and for the public, too. Why?

We went wrong just after Apollo, I think. James Fletcher was NASA Administrator from 1971 to 1977, when the Shuttle was being proposed, designed and checked out -- or rather, not checked out. He convinced Congress that this nifty little reusable rocket-cum-space-plane gadget would get magically cheaper and cheaper to fly, eventually delivering payloads to orbit for a few hundred dollars a pound.

The cost now is over $5000 a pound, and still climbing as missions get delayed and services shrink. A twenty-fold increase, allowing for inflation. The Nixon administration bequeathed to us an econo-ride Shuttle (and Jimmy Carter signed the appropriations bill for it). They also axed the remaining Apollo missions and the 1970s version of the space station, though they weren't vital. Their killing the long-range research for a Mars mission had great effects, however, because we now have no infrastructure developed for large deep space missions.

Then came the Challenger disaster, with Fletcher in charge again. In the Challenger commission report he allowed as how "Congress has provided excellent oversight and generous funding and in no way that I know of contributed to the accident." Except, of course, for consistent under-funding and pressure to attain goals set by people with little or no technical competence.

The shuttle is a spaceship designed by a committee of lawyers. "The fault was not with any single person or group but was NASA's fault," Fletcher went on, "and I include myself as a member of the NASA team." As Joe Haldeman sardonically remarked, "Most people would say he was more than just a member."

And we can't even buy shuttles in quantity. The Fletcher-Nixon vision saw a flight a week. That got scaled down to twenty-four a year, then twelve. In 1989 there were nine, in 1990 six, with that abysmal prospect, a flight every few months, apparently settling in as the normal routine.

Unmanned exploration was once the virtually unblemished, high-minded face of space. Now our failures accumulate. The wrong lens curvature of the Hubble telescope. The big antenna which won't deploy

aboard Galileo as it limps toward Jupiter, years late; we could have sent it directly, on a Proton booster the Soviets offered us at bargain rates, but politics of the late 1980s ruled that out. The Titans that explode with billion-dollar packages aboard, the satellites which go awry.

And the Mars Observer, lost to unknown error or just bad luck. My personal guess at the time was that while a small chip manufacturer is now getting blamed, there is an interesting coincidence that we lost contact after the thruster tanks were being pressurized. Tanks have exploded on missions before-- remember Apollo 13 -- and in both cases they had been engineered to three times the expected design limits. The review panel fingered the same plausible culprit, but basically we will never know.

The repair of the Hubble Telescope lifted spirits a bit, but face facts: it was a repair job we should not have had to do at all. The Hubble mission was overloaded with tasks, and NASA ejected to do them all with One Big Shot -- a poor strategy when you're pushing the envelope in several different directions.

It wasn't always so. Both Voyager spacecraft -- remember them? --returned a very interesting bonus in mid-1993 -- a burst of low frequency electromagnetic radiation. We believe these emissions came from beyond the spacecraft, about a hundred astronomical units from the sun lan A.U. is the distance from the sun to your house). A big flare eruption on the sun had propagated past the spacecraft and the emissions came at a time when the fast-streaming particles, going about 100 km/sec, struck something about twenty or thirty A.U. further out. What?

Plasma physicists identified the emissions as probably waves radiated by those particles as they ploughed into the shock wave which separates our solar neighborhood from the true deep-space plasma that ranges between the stars. Thus the Voyagers may have sensed the boundary of our little solar comfort zone. Within a decade or so they will cross that standing transition, where the plasma density drops and true inter-stellar space begins, a "wall" more meaningful than the orbital radius of Pluto.

Voyager was a miracle. We caught the big brass ring on that one, beginning when an orbital specialist noted in 1963 that a Grand Tour could be won by looping a probe past several of the outer planets. The window for this orbital high wire act opens every 175 years, but the last time, when Thomas Jefferson was President, we missed the chance. In 1972, when astronauts still trod the moon, we decided to go for the launch window in 1977.

I don't think NASA could do that today. Hell, it couldn't even decide to not do it that quickly. In just five years during the 1970s NASA invented and developed nuclear-power batteries which are still running, sixteen years after launch. It assembled fail-safe computers, and electronics that withstood the proton sleet of Jupiter, where a human would die of an hour's exposure. Built to give us Jupiter and Saturn, they still forge outward after gliding past Uranus and Neptune as well.

Voyager is a legacy of the 1960s, a child of the hustling Space Age that wanted to do everything it could (and a few things it couldn't, like building a true space plane). The Voyagers keep sailing on just as they were, dutifully sending back reports to a society that has changed profoundly.

Nothing follows them. Sure, Galileo is bound for Jupiter, due to arrive in 1995, but there it stops. NASA passed up the Halley's comet mission, while other nations went. Nothing will go to Saturn for many years. The proposed Cassini probe which does finally reach Saturn, probably sometime in the next millennium, will drop a vessel named Huygens onto Titan, the second largest moon in the solar system and to me the most interesting place of all.

Titan has a surface pressure not much different from that in your living room. It is far colder, but its thick atmosphere holds the organic chemicals we know existed on the early Earth. Has some slow, cold

chemistry been at work there, conjuring up life forms utterly different from our own? Impossible to say, for our only closeup look showed only the featureless upper cloud deck of a methane atmosphere.

The stretching out of missions is getting worse. Galileo was planned to get to Jupiter in 1985. Though cooperation between the US and the Russians keeps getting talked about, it still has not materialized in solid ways. The recent agreements to combine our operations with the Mir station are a good sign, and probably will work out. But it's still only a beginning.

Gorbachev in 1987-88 sounded much like Khrushchev, talking up space. George Bush in 1989 resembled Kennedy, setting a goal: a manned Mars landing by the 50th anniversary of the Apollo landing, 2019. Both leaders sounded the charge. Both countries yawned and changed the subject. Shortly afterward, they changed the leaders, too.

What's different? The game has changed. It isn't national rivalry any more, and probably won't be for quite a while.

Brace Murray, former director of the Jet Propulsion Lab and professor at CalTech, pointed out to me many of these curious analogies and features of the Space Age, but his most striking analogy reached even further back.

Once we had a distant, hostile goal, and men threw themselves at it, too: Antarctica. Early in this century, Scott and Amundsen raced for the south pole with whole nations cheering them on. The Edwardian Englishman who tried to impose his own methods died. The savvy Norwegian who adapted to the hostile continent came through smoothly.

Others tried to follow. Shackleton made some progress, and then national rivalry became far more serious: World War I swallowed up the exploratory energies. Admiral Byrd and others made headway between the wars, but true, methodical Antarctic exploration did not resume in earnest until the International Geophysical Year, 1957.

The wars gave the International Geophysical Year teams cheap, reliable air and sea transport technology. (Scientists don't like to talk about it much, but modem war bequeaths science a feast of intriguing gadgets.) Military services were happy to assist, exercising their capabilities. International though the spirit was, national and territorial claims did not vanish; Argentina and Chile still mutter over their rights to turf. Indeed, perhaps the major reason nobody disturbs the present high-minded international air is that no serious resources seem to be at stake. Discover a rich field for mining or pumping and all bets are off.

Scott-Amundsen: Apollo. Shackleton and Byrd: Voyager and Galileo. The World Wars, in this analogy, are like our rising concern with domestic problems -- not soaring nationalism, luckily, but at least a deflection of those energies to local concerns.

Bruce Murray pointed out, in a speech published in Space Policy, Feb. 1991, that a science fictional alternate world scenario can perhaps illuminate our predicament. Think what our world would be like, he said, if the two-term limit on the presidency had not been enacted in the late 1940s. Franklin Roosevelt's four terms had provoked that change in the Constitution. The first president it applied to was Dwight Eisenhower. I remember how popular he was even in 1960. I'm pretty sure he could have beaten Kennedy; good grief, Nixon almost did.

Eisenhower would have presided over the whole early Space Age, 195764. He called space programs "pie in the sky," refused to fund research at a fast clip, and warned us against the "military-industrial complex".

In a parallel world with Eisenhower in office until 1964, we would have had no brave setting of the Apollo goal, no race to the moon. "It was that close," Bruce said.

He thinks that by 1990 we would probably have seen some US-USSR muscle-flexing in near Earth orbit and probably a few unmanned probes would have studied the moon. No Grand Tour trajectory for Voyager, probably no Mariner to Mars or any of the rest of it. George Bush's 1989 speech might have been a stalwart call for a manned moon landing before the turn of the millennium.

Not impossible. I can scarcely argue that such a plausible, sensible space program was unlikely. After all, I had once written a story in which Robert Taft got the nomination in 1952, not Eisenhower. (And Taft's private choice for the vice presidency was one Senator McCarthy of Wisconsin...)

The plausibility of this imaginary history tells us that we have been very lucky. We lived through dramatic times, Sputnik-Apollo-Voyager, which quite probably will be seen as like Columbus-Magellan-Drake. Maybe we are now getting back to normal. And normal means, alas, dull.

The trick in using analogies and scenarios is knowing when to stop. How does our predicament differ from the past? We must play to those differences if we are to steer a better course than Destiny would give us.

Large space projects have fed off nationalism. Kennedy sold fears of Soviet technology, with an attractive patina of worry over our science education. This worked well -- and I directly benefited, being a senior in high school in 1959, from the special science courses rushed into the schools; in fact, I might well not be a scientist today, were it not for the sudden spotlight cast on lowly high school physics courses.

Gerard K. O'Neill tried to hook up his giant solar power collecting satellites to the energy "crisis" of the 1970s, but of course the price of oil fell well before any such gargantuan project could get under way.)I never really believed in the O'Neill designs or strategy, and spent an entire dinner in a pricey restaurant trying to argue him out of the approach. He was sure that eventually energy prices would prove him right. When he died in 1992 he was still rather wistfully pushing the project.}

The paranoia road is necessarily short. Fears abate. Enemies topple. So it's time to face "Space as a Place" -- a terrain to be studied and used in its own right, not as a sideshow battleground for earthly concerns.

We must also face the fact that we've done the easy things. Putting a pressurized Huygens probe on Titan, amid chilly winds and with many more light-minutes of delay in getting radio orders through, will be a much tougher job than was landing Viking on Mars.

There are some signs of intelligent management. In January 1994 NASA launched Clementine, a bargain basement mission. It rose on a Titan IIG rocket, recycled after spending 25 years in an Arkansas ICBM silo. It is a light, low-cost probe, using land testing) sensors developed by the Ballistic Missile Defense Organization, the heir to the Strategic Defense Initiative, a.k.a. "Star Wars." Clementine is state of the art with powerful laser-ranging device which can map our moon completely for the first time, then leave the moon and fly by an asteroid to within 100 kilometers, 1620 Geographos, about the time you read this.

Contrasting with the billion dollar Mars Observer, Clementine cost a mere 75 million. Plans for a second mission which will rendezvous with an asteroid and study it come in at about 30 million dollars. A small team put Clementinc together in two years. Such savings point to the hard-nosed, realistic program we

need.

Space must be made cheaper. Even Space Station Freedom, an orbiting pork barrel, is proving to be more than the congress can swallow. The present NASA Administrator, Daniel Goldin, has negotiated with Russia to combine Freedom and Mir, their already orbiting station.

The reality of the mid-1990s seems to be that a go-it-alone station is not going to get funded by congress. A three-step plan appeals: first, send shuttle flights to the existing Mir for early experiments. Second, fly up US add-ons, so we get our own gear running. Third, collaborate on Mir II, a much fancier station, somewhere a decade or so hence. The trouble here is that shuttles can carry only light payloads into the high-latitude Mir orbit. We can't get by with this "workhorse" any longer. This opens the door to a new, better workhorse vehicle to come.

I suspect this is how matters will work out. US-Russian joint ventures contain the ominously large station costs, letting the rest of the space program go on with long-range plans that have some fiscal plausibility. Symbolizing the end of the Cold War, collaboration will also provide jobs for Russian engineers who might otherwise be working on North Korean or Libyan missile projects.

It would also lessen the load on the Shuttle. This is a time bomb in the belly of NASA, for its own internal studies show that the odds are about one in seventy-eight of a major accident, every time it flies. I served on a study group assessing the Shuttle in the 1970s, and we calculated the odds rather higher -- about four percent, or one flight in twenty-five. Regrettably, Challenger was right on the money. Then NASA became obsessed with hand-tuning every bolt on the craft, and now the odds are better.

But they will never be good. Rockets are not safe, period. The Titan failure rate is about three percent, and the Russian Protons do about the same. No rocket has ever done better over the long haul.

The schoolteachers-in-shuttles agenda, sold to the public for so long, came out of wanting to project the Eisenhower perspective-- a go-slow Space Age, elbows tucked in, chin down, making no mistakes. How can we counter that?

First, appeal to the frontier. Young people, not just Americans, want to believe in an expansive sense of the future. More than consumerism and the Beavis & Butthead worldview. Our time needs heroes rather desperately. Notice how the media seize on the merest sign of character, such as Attorney General Janet Reno's accepting some blame for the errors of her underlings.

Political leaders are tuned to sense this better than scientists. That's why the emphasis on manned space, which scientists like James Van Allen deplore because, after all, it is pricey and returns little for research folk to study. Man-in-space is a political event.

Actually, the general risk of rocketry plays to this. Danger equals drama. It would be a breath of fresh air if the President would simply tell the public that every launch is much more like a test pilot run, with casualties expected. No schoolteachers riding a bus into orbit. Instead, gutsy men and women on a wing and a prayer. As in The Right Stuff, "No Buck Rogers, no bucks."

We'll probably have a shuttle blowup before this decade is out, a fiery finish with grieving widows, and we might as well be prepared. Indeed, the deeper lesson we should drive home is that space will never be safe. Adventures aren't.

Second, we should have a clear set of cost-conscious reasons for every single project. Here the Antarctica analogy helps.

There are still solid national reasons for space. Nobody thought that there were good scientific uses to Antarctica when Scott and Amundsen raced across it. We didn't see that chilly clime as a laboratory peculiarly sensitive to the whole planetary system.

Now the "ozone hole" is a major diagnostic of our planetary health, an early indicator of the depletion which is hard to measure globally, but gives itself away among the frozen crystals floating high above the poles.

The space analogy to this is "comparative planetology." We can learn basic information about how our system works by seeing the variants played out on Mars, Venus and elsewhere. These places can teach us much about the sensitivity of planets to the sun, to chemical components in their atmospheres, and much else. Clearly there is some connection between solar activity and climate, but we know little of how it works, much less how to make predictions. Mankind arose during the last great inter-glacial time, and another may be coming. What should we do about it.?

The Martian polar caps contain layers going back to the Ice Ages of Earth. Was the main cause external to both planet s-- the sun? Or is there something more complicated going on, involving the atmospheres as primary players?

These questions are best answered by robots. They send back reams of data, grist for the scientists' mill -- for people like me, who explore the solar system in their mind's eye. What about manned flight?

An old siren song might work here: leadership in aerospace. Control of how to get into orbit. Further, dominance of the technologies which might be useful in future conflicts. This certainly means communication and surveillance satellites, but it probably implies some space station capability as well. Certainly, even big robotic expeditions to other worlds will take some assembly in orbit.

I doubt that robots can do that, though the answer is not obvious. Politically, the manned solution to orbital assembly might be preferred simply because the public will find it far more interesting than watching a cousin of R2D2 fitting pipes together in zero g.

Most space advocates have regrouped around a clear, seemingly inevitable goal: Mars. Mostly, I suspect, for its romance, mystery and the classic: because it's there. Of all manned projects-- the space station, a moon base, even power satellites--it promises the least, Alan Steele argues, in economic or technological spinoff benefits. Probably true. But it's also the one goal which can quicken the pulse of the multitude.

I don't think anything on the space menu can satisfy a public longing for action with meaning nearly as well as Mars. It will be expensive and dangerous and we can all go, via TV.

But to even propose such a thing, as George Bush did, pushes quite a few problems to the top of any space agenda. Current blue-sky planning for Mars exploration assumes that we will use liquid rockets and take about a year each way. This means problems of human deterioration in zero g become major. calcium leaches from bones, muscles atrophy. Should we do studies of people inside spinning cans, to see if centrifugal effects will duplicate gravity in the physiological sense?

Maybe. Or perhaps we should look beyond chemical rockets. To fast ships which can get a small payload, of people plus a few weeks' rations, to Mars within a month. Their supplies could be pre-positioned, waiting in orbit at Mars. Nobody needs to leave until all their support gear is in place and working.

Of course, space station research in rotating living quarters has more human involvement, so it might be politically preferred. But the other major problem of a Mars expedition, really high reliability of all that gear, is best served by sending backup systems along long, slow, cheap orbits.

This underscores another need: really big rockets for getting considerable masses into Earth orbit. Or else, much better ways to do it --laser-driven systems, say.

All these are policy decisions, but they must be made in light of what humanity as a whole wants to see in space. Drama. People. Mystery. Wonder.

Perhaps manned presence should be seen now as intrinsically international, because we desperately need goals as big as the human prospect. The world needs lofty aims. Space buffs love their iconography -- the drama of liftoff, of horizons brimming with the unknown, of Voyagers serenely gliding above alien landscapes. As well, they have an answer to those who say that these are simply the distractions of a high culture, perched atop a seething, oppressed mass.

The industrial nations have about twenty percent of the world's population. The bulk of humanity labors long and hard for little. Not because the advanced nations steal their wealth -- that same twenty percent produces two thirds of the world's output, including agriculture -- but because most of the world has never learned the many social and intellectual abilities which produce wealth.

We will probably have no real peace in the world until most of humanity is somewhat prosperous, or at least has solid hope of becoming so. But if they pursue the agenda of the industrial nations, the strain on raw resources will be vast. So, too, will be the pollution from more mining, metal smelting, fossil fuel burning, irrigation and the like. The planet simply can't support it, not with present technology.

The energy and mass needed for uplifting humanity must come from elsewhere -- space. And it is quite foolish, in the long run, for us to do messy, polluting things in this thin shell of vulnerable air and water which gave birth to us all.

We're fouling our nest. But a smart bird learns to fly.

The End

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