

Motley

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This piece by Greg has attracted a lot of attention on the website Centauri-Dreams. It's a critique of Stan Robinson's latest novel, Aurora, which demonstrates his belief that interstellar travel is impossible in practical terms. Have a read of it; I'll make some comments at the end.

ENVISIONING STARFLIGHT FAILING

GREGORY BENFORD

Human starflight yawns as a vast prospect, one many think impossible. To arrive in a single lifetime demands high speeds approaching lightspeed, especially for target stars such as Tau Ceti, about twelve light years away.

Generation ships form the only technically plausible alternative method, implying large biospheres stable over centuries. Or else a species with lifetimes of centuries, which for fundamental biological reasons seems doubtful. (Antagonistic pleiotropy occurs in evolution, ie, gene selection resulting in competing effects, some beneficial in the short run for reproduction, but others detrimental in the long.) So for at least for a century or two ahead of us, generation ships ("space arks") may be essential.

Aurora [Kim Stanley Robinson, Orbit books, 466 pages, 2015] depicts a starship on a long voyage to Tau Ceti four centuries from now. It is shaped like a car axle, with two large wheels turning for centrifugal gravity. The biomes along their rims support many Earthly lifezones which need constant tending to be stable. They're voyaging to Tau Ceti, so the ship's name is a reference to Isaac Asimov's *The Naked Sun*, which takes place on a world orbiting Tau Ceti named Aurora. Arrival at the Earthlike moon of a superEarth primary brings celebration, exploration, and we see just how complex an interstellar expedition four centuries from now can be, in both technology and society.

In 2012, Robinson declared in a *Scientific American* interview that "It's a joke and a waste of time to think about starships or inhabiting the galaxy. It's a systemic lie that science fiction tells the world that the galaxy is within our reach." *Aurora* spells this out through unlikely plot devices. Robinson loads the dice quite obviously against interstellar exploration. A brooding pessimism dominates the novel.

There are scientific issues that look quite unlikely, but not central to the novel's theme. A "magnetic scissors" method of launching a starship seems plagued with problems, for example. But the intent is clear through its staging and plot.

I'll discuss the quality of the argument *Aurora* attempts, with spoilers.

Plot Fixes

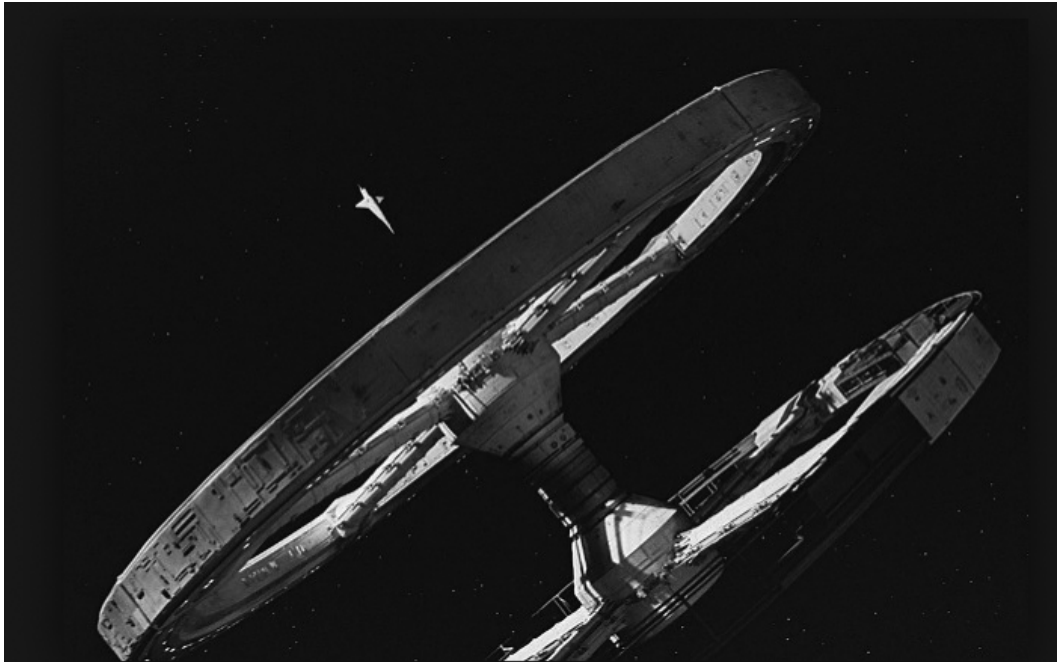
The nonfiction misgivings of physicist Paul Davies (in *Starship Century*) and biologist E.O. Wilson (in *The Meaning of Human Existence*) about living on exoplanets echo profoundly here. As a narrator remarks, "Suspended in their voyage as they had been, there had never been anything to choose, except methods of homeostasis." Though the voyagers in *Aurora* include sophisticated biologists, adjusting Earth life to even apparently simple worlds proves hard, maybe impossible.

The moon Aurora is seemingly lifeless. Yet it has Earth-levels of atmospheric oxygen, which somehow the advanced science of four centuries hence thinks could have survived from its birth, a very unlikely idea (no rust?—this is, after all, what happened to Mars). Plot fix #1.

This elementary error, made by Earthside biologists, brings about the demise of their colony plans, in a gripping plot turn that leads to gathering desperation.

The lovingly described moon holds some nanometers-sized mystery organism that is "Maybe some interim step toward life, with some of the functions of life, but not all...in a good matrix they appear to reproduce.

Which I guess means they're a life-form. And we appear to be a good matrix." So a pathogen evolved on a world without biology? Plot fix #2.



Plans go awry. Backup plans do, too. "Vector, disease, pathogen, invasive species, bug; these were all Earthly terms...various kinds of category error."

What to do? Factions form amid the formerly placid starship community of about 2000. Until then, the crew had felt themselves to be the managers of biomes, farming and fixing their ship, with a bit of assistance from a web of AIs, humming in the background.

Robinson has always favored collective governance, no markets, not even currencies, none of that ugly capitalism—yet somehow resources get distributed, conflicts get worked out. No more. Not here, under pressure. The storyline primarily shows why ships have captains: stress eventually proves highly lethal. Over half the crew gets murdered by one faction or another. There is no discipline and no authority to stop this.

Most of the novel skimps on characters to focus on illuminating and agonizing detail of ecosystem breakdown, and the human struggle against the iron laws of island biogeography. "The bacteria are evolving faster than the big animals and plants, and it's making the whole ship sick!" These apply to humans, too. "Shorter lifetimes, smaller bodies, longer disease durations. Even lower IQs, for God's sake!"

Robinson has always confronted the nasty habit of factions among varying somewhat-utopian societies. His Mars trilogy dealt with an expansive colony, while cramped *Aurora* slides toward tragedy: "Existential nausea comes from feeling trapped... that the future has only bad options."

Mob Rules

Should the ship return to Earth?

Many riots and murders finally settle on a bargain: some stay to terraform another, Marslike world, the rest set sail for Earth. The ship has no commander or functional officers, so this bloody result seems inevitable in the collective. Thucydides saw this outcome over 2000 years ago. He warned of the wild and often dangerous swings in public opinion innate to democratic culture. The historian described in detail explosions of Athenian popular passions. The Athenian democracy that gave us Sophocles and Pericles also, in a fit of unhinged outrage, executed Socrates by a majority vote of one of its popular courts. (Lest we think ourselves better, American democracy has become increasingly Athenian, as it periodically whips itself up into outbursts of frantic indignation.)

When discord goes deadly in *Aurora*, the AIs running the biospheres have had enough. At a crisis, a new character announces itself: "We are the ship's artificial intelligences, bundled now into a sort of pseudo-

consciousness, or something resembling a decision-making function.” This forced evolution of the ship’s computers leads in turn to odd insights into its passengers: “The animal mind never forgets a hurt; and humans were animals.” Plot Fix #3: sudden evolution of high AI function that understands humans and acts like a wise Moses.

This echoes the turn to a Napoleonic figure that chaos often brings. As in Iain Banks’ vague economics of a future Culture, mere humans are incapable of running their economy and then, inevitably, their lives. The narrative line then turns to the ship AI, seeing humans somewhat comically, “...they hugged, at least to the extent this is possible in their spacesuits. It looked as if two gingerbread cookies were trying to merge.”

Governance of future societies is a continuing anxiety in science fiction, especially if demand has to be regulated without markets, as a starship must. (Indeed, as sustainable, static economies must.) As far back as in Asimov’s Foundation, Psychohistory guides, because this theory of future society is superior to mere present human will. (I dealt with this, refining the theory, in Foundation’s Fear. Asimov’s Psychohistory resembled the perfect gas law, which makes no sense, since it’s based on dynamics with no memory; I simply updated it to a modern theory of information.) The fantasy writer China Mieville has similar problems, with his distrust of mere people governing themselves, and their appetites, through markets; he seems to favor some form of Politburo. (So did Lenin, famously saying “A clerk can run the State.”)

Aurora begins with a society without class divisions and exploitation in the Marxist sense, and though some people seem destined to be respected and followed, nothing works well in a crisis but the AIs—i.e., Napoleon. The irony of this doesn’t seem apparent to the author. Similar paths in Asimov, Banks and Mieville make one wonder if similar anxieties lurk. Indeed, Marxism and collectivist ideas resemble the similar mechanistic theory of Freudian psychology (both invented by 19th C. Germans steeped in the Hegelian tradition)—insightful definitions, but no mechanisms that actually work. Hence the angst when things go wrong with a supposedly fundamental theory.

The AIs, as revealed through an evolving and even amusing narrative voice, follow human society with gimlet eyes and melancholy insights. The plot armature turns on a slow revelation of devolution in the ship biosphere, counterpointed with the AI’s upward evolution—ironic rise and fall. “It was an interrelated process of disaggregation...named *codevolution*.” The AIs get more human, the humans more sick.

Even coming home to an Earth still devastated by climate change inflicts “earthshock” and agoraphobia. Robinson’s steady fiction-as-footnote thoroughness brings us to an ending that questions generational, interstellar human exploration, on biological and humanitarian grounds. “Their kids didn’t volunteer!” Of course, immigrants to far lands seldom solicit the views of their descendants. Should interstellar colonies be different?

Do descendants as yet unborn have rights? Ben Finney made this point long ago in *Interstellar Migration*, without reaching a clear conclusion. Throughout human history we’ve made choices that commit our unborn children to fates unknown. Many European expeditions set sail for lands unseen, unknown, and quite hostile. Many colonies failed. Interstellar travel seems no different in principle. Indeed, Robinson makes life on the starship seem quite agreeable, though maybe tedious, until their colony goal fails.

The unremitting hardship of the aborted colony and a long voyage home give the novel a dark, grinding tone. We suffer along with the passengers, who manage to survive only because Earthside then develops a cryopreservation method midway through the return voyage. So the deck is stacked against them—a bad colony target, accidents, accelerating gear failures, dismay... until the cryopreservation that would lessen the burden arrives, very late, so our point of view characters do get back to Earth and the novel retains some narrative coherence, with character continuity. Plot Fix #4.

This turn is an authorial choice, not an inevitability. Earthsiders welcome the new cryopreservation technologies as the open door to the stars; expeditions launch as objections to generation ships go away. But the returning crew opposes Earth’s fast-growing expeditions to the stars, because they are just too hard on the generations condemned to live in tight environments—though the biospheres of the Aurora spacecraft seem idyllic, in Robinson’s lengthy descriptions. Plainly, in an idyllic day at the beach, Robinson sides with staying on Earth, despite the freshly opened prospects of humanity.

So in the end, we learn little about how our interstellar future will play out.

Rejecting Tsiolkovsky’s Vision

The entire drift of the story rejects Konstantin Tsiolkovsky’s “The Earth is the cradle of mankind, but humanity cannot live in the cradle forever.”—though there is an interplanetary civilization. It implicitly undermines the “don’t-put-all-your-eggs-in-one-basket” philosophy for spreading humanity beyond our solar

system. Robinson says in interviews this idea leads belief that if we destroy Earth's environment, we can just move. (I don't know anyone who believes this, much less those interested in interstellar exploration.) I think both ideas are too narrow; expansion into new realms is built into our evolution. We're the apes who left Africa.

Robinson takes on the detail and science of long-lived, closed habitats as the principal concern of the novel. Many starship novels dealt with propulsion; Robinson's methods—a "magnetic scissors" launch and a mistaken Oberth method of deceleration—are technically wrong, but beside the point. His agenda is biological and social, so his target moon is conveniently hostile. Then the poor crew must decide whether to seek another world nearby (as some do) or undertake the nearly impossible feat of returning to Earth. This deliberately overstresses the ship and people. Such decisions give the novel the feel of a fixed game. Having survived all this torment, the returning crew can't escape the bias of their agonized experience.

Paul Davies pointed out in *Starship Century* that integrating humans into an existing alien biosphere (not a semi-magical disaster like his desolate moon with convenient oxygen) is a very hard task indeed, because of the probable many incompatibilities. That's a good subject for another novel, one I think no one in science fiction has taken up. This novel avoids that challenge with implausible Plot fix #2.

Realistically considered, the huge problems of extending a species to other worlds can teach us about aliens. If interstellar expansion is just too hard biologically (as Paul Davies describes) then the Fermi paradox vanishes (except for von Neumann machines, as Frank Tipler saw in the 1970s). If aliens like us can't travel, maybe they will expend more in SETI signaling? Or prefer to send machines alone? An even-handed treatment of human interstellar travel could shore up such ideas.

Still, a compelling subject, well done in Robinson's deft style. My unease with the novel comes from the stacked deck its author deals.

My Thoughts on Aurora Stan Robinson replied to Greg, saying of the critiques "It's characteristic of attacks (as opposed to analyses) to mix arguments literary, political, and technical, in a slurry." An odd thing to say, as his book does exactly that! My thought is that the book itself is very much a combination of literary, political, and technical notions, but in many cases, especially the technical, without supporting credible detail.

In particular, at the end of the novel, as Greg says, the ship returns to Earth, decelerating using what is called the 'Oberth maneuver', invented by Hermann Oberth in 1928. It's a two-burn orbital maneuver that would, on the first burn, drop an orbiting spacecraft further down into the central body's gravity well, followed by a second burn deep in the well, to accelerate the spacecraft to escape the gravity well. A ship can gain energy by firing its engines to accelerate at the perigee of its elliptical path.

The *Aurora* novel wants to use this to decelerate from 3% of light speed down to earth orbital velocity. 3% of lightspeed is 9,000 km/s. Earth's orbital velocity is 30 km/s. [The ratio of these two speeds is 300. In the novel the dozen or so Oberth maneuvers are required to make this velocity difference. Therefore each velocity change would have to be of about 800 km/s.] But the key problem with using the Oberth Maneuver for deceleration of an interstellar craft is that this craft is on *unbound* trajectory meaning that, on entering the solar system its trajectory can be bent by the Sun's gravity, but will then exit the System because it has not lost enough velocity to be bound to the Solar System. To be bound to the System would require velocity decreased down to perhaps 100 km/sec, which is 1% of the incoming velocity. Therefore 99% of the deceleration has take place in the first pass. Consequently the Oberth maneuver is of no use, because you have to get down to interplanetary orbital velocity to stay in the system. If the ship can do that it may as well just fully decelerate to Earth's orbital velocity and come home. Therefore this scheme in the book makes no sense scientifically.

The launch acceleration out of the Solar System is described very vaguely in the book. There's a "magnetic scissor" that accelerates the ship over 200 million miles. If this is using magnetic pressure with a rapid time varying magnetic field, known as a 'mass driver' (as in *The Moon is a Harsh Mistress*) or 'coil gun', the amount of energy involved is absolutely enormous and far greater than the kinetic energy that is gained by the ship. (Stephen Baxter estimates the ship mass as 74 million tons!) There then follows a laser driven acceleration. While lasers can certainly accelerate light craft, as has been shown experimentally, they certainly can't accelerate the enormous and massive vehicle that the novel describes. The amount of power required would be on a truly astronomical scale. So scientifically the propulsion aspects of this novel don't make any sense.

If Stan Robinson is going to make a case that interstellar travel is, as he says, "a joke,... a systemic lie", he's going to have to do far more credible job of it.

Mailing Comments

Lofgeornost – Fred Lerner I always enjoy your writings. You have an interesting point of view and interesting experiences. A few comments from recent mailings: "I wonder what a size fiction convention in India would be like." I'm sure it would be fascinating! We've been to India for a month and enjoyed every minute of it. I would recommend that they have it Jaipur at one of the better hotels. Relatively uncrowded, great things to see! / I recently reread *The Rolling Stones* by Heinlein. I remembered it as a book I really loved when I was 10 years old. Rereading it I was quite disappointed. Of course the juvenile characters are extremely juvenile but so was I the time. The technical aspects, which everyone lauded Heinlein for, are amazingly out-of-date. Ships get to planets much faster than they really would, even with a nuclear rocket engine. The rockets are much too small to carry such payloads. Perhaps the most unrealistic technology is that people quickly put on spacesuits and pop outside as if they were just putting on a windbreaker. People would go in and out in the course of a single scene! We now know that it takes hours of preparation and careful management of the oxygen and nitrogen in one's bloodstream. / I love your comments on your trip to London and to Costa Rica & Puerto Rico. Next time you go to London I suggest you of course skip the Tate Modern and concentrate on the Turner collection at the Tate Britain. I've long appreciated the National Portrait Gallery and go there on every visit. All the places you mention going to we have seen. I've been to Britain about 40 times now and there's very little I've not seen before. (My wife is English and we for many years would simply stay with her parents for weeks at a time.). This year it was twice to London! I notice on your online website that you do not mention fandom or FAPA! On my website, jamesbenford.com, I don't either! / Your vacations as described seem to be rather brief I would gather you are in London something like a week to 10 days and then about the same for Costa Rica & Puerto Rico. Since you're retired, why don't you stay longer to keep out of the Vermont winters? I assume that your appreciation of Kipling does not connect to his later reactionary phase, although as you say on your website his writing did not deteriorate, and that is what matters.

The Devil's Work Norm Metcalf I like your review of the Heinlein biography. There was altogether too much of it wasn't there? You really should read *The Moon Is A Harsh Mistress* because IMHO it may be his very best novel. Of course I haven't reread all of those marvelous books he produced in the 50s and 60s but *The Moon Is A Harsh Mistress* is the only one of his adult novels that I have reread. / *The Martian* is a very readable book and very credible for the most part. But there are some real technical errors in it, which I will not bore you with. The amazing thing is that he came out of nowhere with a technical background, created this novel and self published it. It sold so well that he got a publishing contract and the rest is history. I look forward to seeing the movie with Matt Damon.

Nice distinctions Arthur Halvaty Yours is another of my fave zines; I read with great interest. /I never liked the idea of flying cars because I realized that with people having enough trouble in two dimensions, the three dimensions would simply give them far larger problems and higher speeds to have accidents at. /I like your piece about Philip Larkin. You surely know that he was a close friend of Kingsley Amis, who I like, esp. *Lucky Jim*. /Westlake is the funniest of crime novelists, but I don't actually read crime for comedy.

Voice of the Habu Roger Wells I've been following your unemployment crisis over the last couple of years and I'm glad you settled at Boeing. Indeed, it is a lot cheaper to live there. In past days I spent some time at that Boeing plant working with the people in Phantom Works. It was all classified, having to do with UAV HPM systems. (If you don't know these acronyms you don't have a need-to-know.) / In my visits to Missouri I have found it to be quite pleasant. I even went to a Cardinals game there once and while I was at a conference. Are the social and criminal problems happening in Missouri this year causing any issues for you? /I use checks frequently for both security and documentation reasons. I never did use a typewriter; I went straight to word processor.

Colder than... Curt Phillips I definitely was not at the Loncon. Although we go to London at least once a year, with Hillary I visited that year at a later time so that I can go on to Venice and take a cruise to Istanbul. Indeed, Worldcons have been much too big for too long. /I'm glad you liked the picture in *Motley* of Bob and Brian and Greg. If you'd like, I could send you the color version.

King Biscuit Time –Robert Lichtman I liked Dylan in the 60's. Saw him in a concert in SF in 70's and didn't like his religious songs and ruined voice. Only thing I liked after that was *Blood on the Tracks*.