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THE EINSTEIN BARRIER, PART II

by
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In the first part of this article for science fiction writers (The Einstein Barrier, Part I) we learned two important facts. The first was the speed of light in a vacuum is the universal speed limit. Nothing can ever go faster than the 300,000 kilometers per second (186,000 miles per second) velocity of a photon. Indeed, strange things begin to happen as one approaches the speed of light. Time slows down, mass increases, and everything begins to flatten like a pancake (people, starships, cats, dogs, and geraniums). Were it possible to actually reach the speed of light, time would slow to a halt, mass would increase to infinity, and any object that achieved this state would be infinitely wide, but possess zero depth. It would be nothing more than an expanding wavefront sweeping through the stars and galaxies of the universe.

Which, of course, is precisely the point.

Since infinite energy is required to accelerate an infinite mass even one millimeter per second faster, no increase in velocity beyond light speed is possible. There is also the minor theoretical problem that since velocity is distance traveled per unit time, when time stops, velocity becomes indeterminate. In other words, the formula we use to compute velocity (Distance/Time) suddenly has a zero in the denominator. And as every math teacher in the world tells their students, *you can't divide by zero!* (I personally came to understand this concept when I got a job in 1967 calculating propeller performance curves. This was in the days before electronic calculators and I worked on an old Frieden mechanical calculator – younger readers will have to see one in a museum. If you tried to divide by zero on the Frieden, the gears would grind away continuously until you pulled the plug and called the repairman.)

The second thing we learned last month was that the universe is a very large place indeed. And though 300,000 kps seems fast for those of us who live our lives at speeds less than 1000 kilometers per hour (the speed of a jet airliner), on the scale of the universe light speed isn't even the equivalent of a snail's pace. In fact, a snail has a far better chance of circumnavigating the globe under its own power than any human being has of reaching another solar system in the foreseeable future.

Obviously, these two incompatible physical realities present more than a minor inconvenience to the poor science fiction writer. How can you write a rollicking interstellar adventure when it takes several lifetimes to travel from one star to another? What do you do about that long dead period in the middle of your plot while everyone is in transit?

Luckily, all is not hopeless. Unlike engineers, we writers aren't required to actually build starships. We merely have to describe them convincingly. And over the decades, quite a number of ingenious schemes for getting around the speed of light have been devised. Some of them might actually be scientifically possible. Then again, they might not.

Luckily for us, we can take refuge in our current imperfect understanding of the way the universe works. I, for one, take comfort from that fact. I would hate to live in a world where we knew for certain that all we would ever possess are one small yellow star, nine average planets, fifty-some moons, a few hundred thousand asteroids, and 100 billion or so meteors and comets. After all, we human beings are far more acquisitive than that!

Which brings us to the subject of this month's article: "How the hell do we ignore one of the more basic physical laws of the universe (possibly *the most basic!*) in order to sell books?" The answer to that question depends primarily on the plot of your story. Let's review the options we have for breaking through the Einstein Barrier, and the advantages and disadvantages of each.

SECTION 1: SLOWER THAN LIGHT (STL) TECHNOLOGIES

Option 1a: Learn to Live With It

A great many science fiction stories avoid the problem of the Einstein Barrier by avoiding the idea of star travel altogether. Authors confine themselves to recognizable extensions of 20th century rocket technology and have their characters travel around the nine worlds of the Solar system. You can also write a story concerning a future Earth in which star travel is possible, but which avoids any mention of how the trick is done. Time travel stories are also ways of keeping on Einstein's good side. (Note: We believe time travel to be just as impossible as traveling faster than light. In fact, both problems are probably related. The ability to travel in time means that you can travel from place to place in zero, or negative, time. Plug that into the velocity equation and see what kind of speed you calculate!)

If you choose to abide by Einstein's stricture against superluminal velocities, then you need to be aware of the limitations you are imposing on yourself. Since light takes a finite time to travel a given distance (and radio waves are a form of light), then communications cannot take place instantaneously over great distances. For short distances such as those found on the Earth, this communications delay can be ignored. After all, we don't worry about the speed of sound in air when we are conversing with someone standing directly in front of us. Yet, when everyone in a football stadium tries to sing their national anthem in synchronization, the delay from one side of the stadium to the other (caused by the relatively slow speed with which sound is transmitted through air) results in the entire performance sounding ragged.

Over interplanetary distances, speed-of-light delay quickly becomes long enough that two way conversations become impossible. The moon is 1.25 light-seconds from the Earth, necessitating a 2.5 second delay between the time you speak and the time the person on the other end of the circuit appears to respond to your comment. You can use this fact in your writing as one means of convincing the reader that he or she has really been transported into the future.

Beyond the Moon, communications delay becomes unmanageable. Delays between Earth and Mars vary from 4 to 21 minutes, depending on where each planet is in its orbit. Jupiter is 35-52 minutes away, and to talk to Pluto requires a 5.5 hour delay in each direction.

Consider then the following plot situation: Your hero is on Pluto. He's lonely, so he calls his girlfriend on Earth. He says "Hello, I miss you!" Eleven hours later, she says, "I miss you, too." They continue the conversation this way for the next six weeks. Obviously, when we begin to colonize the worlds of the Solar system, there is likely to be a resurgence in letter writing!

I faced this same problem when I set out to write my novel, *Life Probe.* For those who haven't read it, I will briefly summarize the plot:

The Makers are a race of technologically advanced aliens who are running out of resources in the home star system, and who are attempting to transplant their civilization to another star. To do this they require a working faster-than-light drive, a goal they have sought without success for hundreds of thousands of years. Long before our ancestors took up farming, the Makers hit upon the idea of sending instrumented probes to all the neighboring stars to see if any other race might have solved the problem. The Makers' life probes cruise from star to star, looking for intelligent life. One of them encounters 21st century Earth and isn't sure that it has found any.

In the novel, the probe has been "asleep" for most of its journey. It awakens when it is one light-month out from the sun. (Like the light-year, the light-month is a measure of distance, not of time. It is the distance light travels in one month, approximately 777 billion kilometers [466 billion miles].) I remember distinctly the moment I woke up to the fact that the light-month is a measure of *both* distance and time. I was sitting in the lobby of the Hilton Hotel in Denver, thinking about my new book and waiting for a friend to meet me for dinner. As I mulled over the plot in my mind, I suddenly realized that there could be no dialogue between the life probe and humanity for the first half of the book. Why not? Because the communications delay between the probe (one light-month from the sun) and humankind (9 light-minutes from the sun) is 30 days each direction!

Actually, the situation was more complicated than that. For I had also postulated that the probe was inbound toward Sol at one-tenth the speed of light. Knowing the distance and speed did two things for me. The first was that it caused my plot to extend over a ten month period between the time the probe wakes and the time it reaches Earth. Why? Because at one-tenth of light speed, it takes the probe ten months to cross one light-month of space. This means that I had to think up sufficient plot details to keep the readers interested for the ten months that would pass between the time the probe wakes and the time it first meets people.

If the probe sends a message to the people the moment it wakes (which it does, sort of), it will take 30 days for that message to reach Earth. However, it will not take 30 days for the human response to return to the probe. That is because the life probe is falling in toward the sun at one-tenth the speed of light. While messages are passing between probe and Earth, the probe's distance from the sun is constantly decreasing. So that first message takes 30 days to reach Earth, but the reply only requires 27 days to make the return journey, for 57 days total communication time. Subsequent messages will take less and less time, until the probe reaches Earth and real time communications can begin.

Sound complicated? It is, and all because I have postulated that nothing can exceed the speed of light. I worked up a small computer spreadsheet with all the details in it to keep everything straight,. For each day of the ten months it takes the probe to reach Earth, I know the probe's distance and the round trip communications delay for messages. To a large extent, it was this spreadsheet that controlled the pace of the novel.

Option 1b: Generation Ship

It isn't absolutely necessary to assume that a starship can exceed the speed of light in order to reach the stars. After all, taking my *Life Probe* example above, if you can reach one-tenth of light speed, then Alpha Centauri is a mere 43 years away. Longer journeys will require several lifetimes

to complete. This isn't a problem if you don't want it to be one. You just build a starship the size of a small city, people it with both sexes, and have them raise children who will take over running the ship when the original crew grows old and dies. This multi-generation approach to star travel is eminently feasible. After all, aren't we all crewmembers aboard a generation starship called Earth?

Extending the idea that our beloved planet is actually a multi-generation starship highlights the restrictions inherent in using this approach. When you live your life aboard such a ship, of necessity, all of your stories must be about the ship. For fifty thousand years we inhabitants of Starship Earth have been telling each other stories about adventures onboard our ship. Only recently have we begun speculating about the inhabitants of other ships. The same stricture holds for any multi-generation ship story. All such stories tend to have a claustrophobic feel to them because they are confined to the ship, or at most, a single planet the ship is visiting.

Option 1c: Cold Sleep

Do you tire of having your characters grow old and die every few chapters? Then put them on a "slowboat" (a slower than light starship), but put them into hibernation. This is a scientifically accurate idea that is only slightly beyond our current level of technology. If you can halt the biological process of a human being without actually killing them (such as by freezing), then you ought to be able to store these people indefinitely. So what if your ship takes centuries to cross the gulf between the stars so long as your characters can sleep through the ordeal, awakening as young and invigorated as when they went to sleep?

Of course, it's pretty boring aboard a cold sleep ship for most of the journey. Either the automatic machinery is flying the ship, or at most, a few crew members are awake. In either event, it's difficult to write a crowd scene. Also, as in all forms of slower-than-light star travel, commuting is out of the question. By the time you get home from a business trip to a nearby star, your wife and kiddies are dead, buried, and have long ago turned to dust. This doesn't make for happy marriages.

Option 1d: Time Dilation Effect

So, do you want to get your people to the nearer stars in a relatively short time, have everyone awake and in the plot, yet not violate Einstein's Theory of Relativity? No problem. As we discussed in Part I of this article, time slows down as you go faster. This effect isn't very noticeable until you approach quite closely to the speed of light. Still, as one approaches light speed asymptotically, the time dilation multiplier gets to be impressively large.

The usual example given to explain time dilation effect is the "twin paradox." In fact, Robert Heinlein wrote a pretty good juvenile novel, *Time for the Stars*, on the subject. Let us say that we have two twin brothers, age 20, and one of them signs on to crew aboard a starship that approaches the speed of light during its journey. The ship leaves and returns to Earth 80 years later. The brother who stayed behind is now an old man of 100, while the twin who left is only 25 years old.

For people who think that time dilation effect is a good way to achieve immortality, remember that the brother who went to the stars is only five years older because he's only lived *five* years aboard ship. His stay-at-home brother has lived a full and productive life of 80 years. The starfarer will one day be 100 also, having lived precisely the same amount of time as his twin. It's

just that he will have lived those 80 years later than his brother because of the five years he spent at nearly the speed of light.

My wife recently took a course in astronomy as part of her curriculum to gain a degree in English Literature. All through the explanation of time dilation effect she kept expecting the professor to say, "Just kidding!" He never did.

If this all sounds unbelievable to you, please be assured that so far we have been discussing orthodox physics. The time dilation effect is very well documented by numerous experiments with particle accelerators.

Having exhausted all of the ways to reach the stars known to modern science, let's investigate the various methods science fiction writers use to get their ships across the vast black gulf that separates us from the stars.

SECTION 2: FASTER THAN LIGHT (FTL) TECHNOLOGIES

Option 2a: Warping Space

One of the standard lectures which I give is "Spacecraft Propulsion and Science Fiction Writing: The Art of Matching Propulsion With Plot." During that lecture I always poll the audience with the following question: "How many people know that gravity is not a force?" Usually, about one person out of ten will raise their hand. Those who don't are usually thinking, as are many of you readers, "What the hell is he talking about?"

The idea that gravity is a force is an intuitive one that everyone learns the first time they jump out of a tree as a child. The shooting pains that ascend through your feet and legs as you hit the ground teach you the lesson much better than any teacher can. Sir Isaac Newton codified this innate human understanding when he postulated his Law of Universal Gravitation in 1687.

The idea that gravity is a force held sway until Albert Einstein published his Theory of Relativity at the beginning of the twentieth century. Like so many other of the precepts of Newton, Einstein demonstrated that the Law of Gravitation is not what it appeared to be. Einstein's theory postulated that gravity is actually a curvature of the local space-time continuum caused by the presence of mass. His theory was proved correct when, during a solar eclipse, astronomers discovered that Mercury was several arc-seconds from where it should have been in the sky. Or rather, Mercury was where it should have been, but the point of light seen in Earth based telescopes appeared to have moved. In other words, gravity had bent the light rays radiating from Mercury as they passed close to the massive sun en route to Earth. Since photons have no mass, their flight path cannot be affected by an external force (that would violate Newton's Second Law, $F=MA$). That the light waves were bent anyway means that the universe must also be "bent."

What does this have to do with traveling faster than light? Possibly nothing at all. However, the concept that the presence of mass causes space to curve gives us the ability to visualize a machine that might be able to do the same trick. The ability to control the local curvature of the space-time continuum would be a useful one to have. For one thing, it would mean practical anti-gravity. Want to float through the sky like a cloud? Simple. Just reduce your local space-time curvature and you'll find yourself rising into the sky like the morning mist.

What if our machine didn't reduce the local curvature of the universe, but rather increased it. And not a little. What if we warped the universe so much that it collapsed back onto itself, forming a closed sphere? Would we then find ourselves in our own, self contained universe? And might it not be possible to propel this tiny bubble of closed space at any velocity we wish while the mass inside remains at rest with respect to its own little artificial universe? In other words, the starship turns on its warp drive, wraps a little ball of space around it, and then zips off at several times the speed of light, never violating Einstein's rule about things going faster than light. Why not? Because in the starship's universe, the ship isn't moving at all – the universe is! This, in essence, is the "theory" behind the warp drive.

If this explanation sounds like gibberish to you, then don't worry. It *is* gibberish, at least until we prove that we can do it. But it has sufficient science behind it to satisfy the readers and that is all that is necessary in writing science fiction.

What would a warp drive generator look like? That's easy. Anyone who has ever watched *Star Trek, The Next Generation* will tell you that it is a big cylinder with blue and white lights moving along its length. And, of course, warp drive generators require di-lithium crystals to do their magic. Precisely what a di-lithium crystal is, where they are found, and what you have to do to make them go faster than light is beyond the scope of this article. Answering these questions is therefore left as an exercise for the student.

"Warp Factor Nine, Scotty!"

I am not aware that any *Star Trek* episode or movie has ever explained the "warp factor" system that they use. Basically, "warp factor" is the cube of the speed of light. That is, Warp Factor One is 1*c*, Two is 8*c*, and Three is 27*c*. As the table below shows, the speeds build up very quickly. No wonder the new *USS Enterprise* is so much faster than the old one!

Warp Factor	Multiples of Light Speed
1	1
2	8
3	27
4	64
5	125
6	216
7	353
8	512
9	729
10	1000

Option 2b: Worm Holes, Tramlines, Foldlines

A warp drive is a general purpose science fiction machine for propelling starships. You get in the ship and point it in the direction you want to go, turn on the warp drive, and you're off. Like a ship on an endless sea, the shortest distance between two points is a straight line. A warp driven starship is also analogous to a water-borne ship in another way. As the vessel travels from one point to another, it traverses all the points in between.

Another concept on *Star Trek* is the worm hole. This is a point in space that ties directly to another point in space far away. You get from one to another without passing through any of the intervening points. You can jump millions of light-years in no time at all while flying in a spaceship moving no faster than a jet aircraft.

The theory of worm holes is best illustrated by taking a piece of paper and marking two points (*A* and *B*) on it. Normally, the way to get from *A* to *B* is to follow the straight line between them along the surface of the paper. If the paper is rolled into a cylinder, then the way to get from *A*

to *B* is along the curved surface of the paper. But wouldn't it be easier if you just picked up the sheet of paper, folded it in half until Point A was touching Point B, and then had your ship move directly from the surface of the paper at Point A to the surface at Point B? That is the theory behind the wormhole.

Typically worm holes are used in plots where travel to the stars is necessary, but must be restricted somehow. Jerry Pournelle and Larry Niven invented the tramline, a "path along the equipotential lines of nuclear flux" between stars for *The Mote In God's Eye*. In order to jump between stars, their ships had to reach the Alderson point where the Alderson drive would send a ship to another point in space, perhaps hundreds of light-years away Try to use the Alderson drive anywhere but at a bona fide Alderson point and nothing happens. You certainly don't jump halfway across the universe. In *The Mote In God's Eye*, the limited ability of ships to jump from star to star has a vital fictional reason behind it. At the end of the book, humanity solves the problem of the Moties by blockading their Alderson point. Obviously, that wouldn't be practical of the inhabitants of Mote Prime could just come boiling out into human space any time they feel like it.

I also used a similar concept in my novels *Antares Dawn, Antares Passage,* and *Antares Victory*. My ships, too, were limited to jumping between stars at specific points (called *foldpoints*, with the lines between the points called *foldlines*.) Like Niven and Pournelle, I needed to restrict access to the universe for reasons of plot. I could have used their tramlines, of course, but one of the things about being a science fiction writer is that you get to make up your own fake science. In fact, there is an unofficial competition between the various scifi writers as to who can be the most creative in getting around Einstein's Barrier.

Option 2c: Tachyon Drives

The theorem which defines the Einstein Barrier is usually stated: "Nothing can ever go faster than light." This is somewhat imprecise. What Einstein actually said was that "Nothing can ever *accelerate* to a speed faster than light. This is due to the increase in mass to infinity and the slowing of time to zero when you reach the speed of light.

Einstein didn't say that you couldn't create a particle that was traveling faster than light at the moment of its creation. And, in fact, astrophysicists have some theoretical basis for postulating the existence of a particle that spends its life at speeds greater than light. They have dubbed this particle, the *tachyon.*

Do tachyons exist? No one knows. Nor do we know how we might detect one if they do. However, if tachyons exist, they are proof that the Einstein Barrier isn't the impenetrable wall that we think it is. And in any event, throwing a reference to the "tachyon drive" into your story is an easy way to avoid longer explanations about how you have conquered the stars.

Option 2d: Hyperspace

There is no single theory about how "hyperspace drives" work. It's kind of a catchall term for moving faster than light without violating Einstein's theories. The most common idea, however, is that there are other universes in parallel with ours and that in some "hyper-universe" the speed of light is much faster than it is here at home. So to travel from star to star, a ship turns on its generator and jumps from our universe to this different hyper-universe where the Einstein Barrier doesn't

exist. A ship can go just as fast as it wants. When it reaches the point in the hyper-universe that corresponds to its destination, the ship turns off its generators and "falls" back into the normal universe.

Option 2e: Jump Drives

A variation on the wormhole drive discussed earlier is the "jump drive." Poul Anderson is one of the leading practitioners of this technology. His ships don't travel faster than light. They create a short wormhole and disappear at one point and reappear at another one fairly close by (a few light-minutes distant). Once they've reached the new point, they "jump" again, and then again, and again, and again. In this way they "microjump" their way across the universe.

The jump drive has the advantage that you can get around the Einstein Barrier while also watching the scenery along the way. And it allows one to write exciting battle scenes where two warships are engaged in a duel trying to synchronize their jumps so that one can get a shot off at the other.

Conclusion: Is Any Of This Real?

Many people will dogmatically maintain that reaching the stars in anything less than years is physically impossible and that only a bunch of hopeless dreamers would suggest such a thing. As for the charge of being a hopeless dreamer, I plead guilty. However, I would also like to point out that people had the same attitude toward Newtonian physics until Albert Einstein came along to kick over the apple cart. Who knows what the future will bring in the way of insights?

Virtually every science fictional device ever invented to drive a starship had some basis in science. We know that our four dimensional universe (length, width, depth, time) must have at least one other dimension into which it can be "bent" by a gravity field. Actually, current cutting edge theories in physics suggest that the universe has ten dimensions. If true, there would appear to be plenty of extra dimensions in which we might avoid Einstein's Barrier.

Let's do a thought experiment to demonstrate just how little we truly understand about the universe in which we live. Imagine that you are millions of light-years out in space, so far out that there is nothing but vacuum around you. It is completely dark. There isn't a single atom of matter within a thousand light years and space-time is as flat as a pancake. Even your presence doesn't disturb things (because this is, after all, a thought experiment). As you float there in the darkness, you extend your arms to their full length and hold out your right and left index fingers. Each finger touches a point in space. What, exactly, is it that distinguishes one of these points from the other? Other than the fact that one of them has different coordinates than the other, what other characteristic distinguishes them?

Could it be that the quantity we think of as distance isn't really there at all? What if moving from one point to another were as easy as rewriting a set of invisible coordinates on some cosmic blackboard? If we could do that, this preoccupation we have with the Einstein Barrier will look pretty silly in retrospect.

Only time will tell whether Einstein was right. For all of our sakes, let's hope that he, like Newton, perceived only a subset of the truth. Life will be much more interesting if the speed of light isn't truly the universal speed limit.

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The End

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NOVELS

1. Life Probe - ^{US}$4.50

The Makers searched for the secret to faster-than-light travel for 100,000 years. Their chosen instruments were the Life Probes, which they launched in every direction to seek out advanced civilizations among the stars. One such machine searching for intelligent life encounters 21st century Earth. It isn't sure that it has found any...

2. Procyon's Promise - ^{US}$4.50

Three hundred years after humanity made its deal with the Life Probe to search out the secret of faster-than-light travel, the descendants of the original expedition return to Earth in a starship. They find a world that has forgotten the ancient contract. No matter. The colonists have overcome far greater obstacles in their single-minded drive to redeem a promise made before any of them were born...

3. Antares Dawn - US$4.50

When the super giant star Antares exploded in 2512, the human colony on Alta found their pathway to the stars gone, isolating them from the rest of human space for more than a century. Then one day, a powerful warship materialized in the system without warning. Alarmed by the sudden appearance of such a behemoth, the commanders of the Altan Space Navy dispatched one of their most powerful ships to investigate. What ASNS Discovery finds when they finally catch the intruder is a battered hulk manned by a dead crew.

That is disturbing news for the Altans. For the dead battleship could easily have defeated the whole of the Altan navy. If it could find Alta, then so could whomever it was that beat it. Something must be done…

4. Antares Passage - US$4.50

After more than a century of isolation, the paths between stars are again open and the people of Alta in contact with their sister colony on Sandar. The opening of the foldlines has not been the unmixed blessing the Altans had supposed, however.

For the reestablishment of interstellar travel has brought with it news of the Ryall, an alien race whose goal is the extermination of humanity. If they are to avoid defeat at the hands of the aliens, Alta must seek out the military might of Earth. However, to reach Earth requires them to dive into the heart of a supernova.

5. Antares Victory – First Time in Print – US$7.00

After a century of warfare, humanity finally discovered the Achilles heel of the Ryall, their xenophobic reptilian foe. Spica – Alpha Virginis – is the key star system in enemy space. It is the hub through which all Ryall starships must pass, and if humanity can only capture and hold it, they will strangle the Ryall war machine and end their threat to humankind forever.

It all seemed so simple in the computer simulations: Advance by stealth, attack without warning, strike swiftly with overwhelming power. Unfortunately, conquering the Ryall proves the easy part. With the key to victory in hand, Richard and Bethany Drake discover that they must also conquer human nature if they are to bring down the alien foe …

6. Thunderstrike! - US$6.00

The new comet found near Jupiter was an incredible treasure trove of water ice and rock. Immediately, the water-starved Luna Republic and the Sierra Corporation, a leader in asteroid mining, were squabbling over rights to the new resource. However, all thoughts of profit and fame were abandoned when a scientific expedition discovered that the comet's trajectory placed it on a collision course with Earth!

As scientists struggled to find a way to alter the comet's course, world leaders tried desperately to restrain mass panic, and two lovers quarreled over the direction the comet was to take, all Earth waited to see if humanity had any future at all…

7. The Clouds of Saturn - US$4.50

When the sun flared out of control and boiled Earth's oceans, humanity took refuge in a place that few would have predicted. In the greatest migration in history, the entire human race took up residence among the towering clouds and deep clear-air canyons of Saturn's upper atmosphere. Having survived the traitor star, they returned to the all-too-human tradition of internecine strife. The new city-states of Saturn began to resemble those of ancient Greece, with one group of cities taking on the role of militaristic Sparta...

8. The Sails of Tau Ceti – US$4.50

Starhopper was humanity's first interstellar probe. It was designed to search for intelligent life beyond the solar system. Before it could be launched, however, intelligent life found Earth. The discovery of an alien light sail inbound at the edge of the solar system generated considerable excitement in scientific circles. With the interstellar probe nearing completion, it gave scientists the opportunity to launch an expedition to meet the aliens while they were still in space. The second surprise came when *Starhopper's* crew boarded the alien craft. They found beings that, despite their alien physiques, were surprisingly compatible with humans. That two species so similar could have evolved a mere twelve light years from one another seemed too coincidental to be true.

One human being soon discovered that coincidence had nothing to do with it...

9. Gibraltar Earth – First Time in Print — $6.00

It is the 24th Century and humanity is just gaining a toehold out among the stars. Stellar Survey Starship *Magellan* is exploring the New Eden system when they encounter two alien spacecraft. When the encounter is over, the score is one human scout ship and one alien aggressor destroyed. In exploring the wreck of the second alien ship, spacers discover a survivor with a fantastic story.

The alien comes from a million-star Galactic Empire ruled over by a mysterious race known as the Broa. These overlords are the masters of this region of the galaxy and they allow no competitors. This news presents Earth's rulers with a problem. As yet, the Broa are ignorant of humanity's existence. Does the human race retreat to its one small world, quaking in fear that the Broa will eventually discover Earth? Or do they take a more aggressive approach?

Whatever they do, they must do it quickly! Time is running out for the human race…

10. Gibraltar Sun – First Time in Print — $7.00

The expedition to the Crab Nebula has returned to Earth and the news is not good. Out among the stars, a million systems have fallen under Broan domination, the fate awaiting Earth should the Broa ever learn of its existence. The problem would seem to allow but three responses: submit meekly to slavery, fight and risk extermination, or hide and pray the Broa remain ignorant of humankind for at least a few more generations. Are the hairless apes of Sol III finally faced with a problem for which there is no acceptable solution?

While politicians argue, Mark Rykand and Lisa Arden risk everything to spy on the all-powerful enemy that is beginning to wonder at the appearance of mysterious bipeds in their midst…

11. Gridlock and Other Stories - US$4.50

Where would you visit if you invented a time machine, but could not steer it? What if you went out for a six-pack of beer and never came back? If you think nuclear power is dangerous, you should try black holes as an energy source — or even scarier, solar energy! Visit the many worlds of Michael McCollum. I guarantee that you will be surprised!

Non-Fiction Books

12. The Art of Writing, Volume I - US$10.00

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