



Science in the Golden Age

By
Michael McCollum

In 1999, I was on special assignment in Connecticut for six months and took the opportunity to explore the cities of the Eastern Seaboard before returning to Arizona. I visited New York, Boston, and the cities of the Connecticut coast. Of all the places I visited, I think I like Boston the best. Of course, I would not want to live there, as the place is terribly expensive. For instance, on one trip, I went looking for a public restroom, and it ended up costing me \$95!

My son lived in Hartford, Connecticut at the time, a fact that has made my exile there much more pleasant than it would otherwise have been. We got together several times during the week and on the weekends we explored. On one trip we went to Boston with him. It was not the first time I had visited the city. My first trip came in 1974 when I was supporting Northrop on the YF-17 program. (The YF-17 was the prototype for the F-18 fighter, a program that I also worked on for four years.) That first trip, I visited General Electric in Lynn, Massachusetts. Because the Northrop engineers and I spent a lot of time sitting around while we waited for an important test to be run, we had the opportunity to explore the countryside at night and on weekends. We also sought out several of the great seafood restaurants of Boston. I ate steak in all of them.

Shortly after that trip, I decided to become a writer and incorporated my experiences as the background to a story. So it was that my second or third short story was set in that far off, magical place — Boston, Massachusetts. Of course, what I did not realize at the time was that although I considered it a far off, magical place, as far as the SF editors were concerned, it was just plain old Boston. That story was rejected, not only because of the mundane locale, but also because it wasn't written very well. In fact, it would take me another two-dozen attempts before I became practiced enough to sell my fiction. I did learn, however, to start writing stories about locales the editors considered exotic — for instance, the deserts of Arizona.

I may have visited Boston sometime between 1974 and 1997 (when I went there during a vacation), but if I did, I do not remember it. However, with my six-month-long stay in Connecticut, I was only two hours driving time away, and I went back several times. The city is just as I remember it from 1974, with one large exception: *The Big Dig!*

For those who don't know about it, The Big Dig is a project to put all the major freeways in tunnels beneath the city, substantially reducing traffic congestion on the surface. The project was recently completed. However, in 1999, it was a mess. The city was tied in knots, with temporary elevated highways all over the place. If you happened

to be in the wrong lane, you could easily find yourself trapped thirty feet in the air while your intended destination slipped behind you at 50 miles per hour.

During the particular visit I am discussing, my son, daughter-in-law, and I visited the Museum of Science on the causeway between Boston and Cambridge. I had attended a reception there for an airline conference a few months earlier, and thought it sufficiently interesting to go back. One of the highlights of the museum is their Van de Graf generator, the largest in the world. Harvard University bequeathed it to the museum, and they use it for a very impressive lightning demonstration. (That same generator once graced the cover of my 1964 high school physics textbook.)

The museum also has a very large salt crystal on display, a roughly egg-shaped piece nearly three feet across. The sign above the crystal says that it will ring like a bell if one strikes it a sharp blow. I would not know. I wrapped my knuckles on it several times, but didn't hear anything but a dull "thud." While I was trying to make the crystal ring, my daughter-in-law ran a test of her own. Glancing around to make sure no one was watching, she quickly leaned over and touched her tongue to the surface. She had a grimace on her face when she straightened up, and reported that it tasted like rock salt. Her grimace worsened when I pointed out that, over the years, several million snot-nosed kids had probably performed the same test!

After the museum, we went to dinner at Houlihan's Restaurant in Quincy Market, and then walked back toward the parking garage where we had left our car (at the usual usurious Boston parking rates). It was dark on a frigid Saturday night, and most of the stores were closed. About halfway to the garage, my gastrointestinal system decided that it was time to kick in, and I found myself with an urgent need to find a public restroom in a city renowned for their lack. Luckily, the single lighted façade on the block belonged to the huge Borders Bookstore on School Street. Gambling that I would find a restroom there, I led our small party inside, and after a frantic search, found the facilities, thereby avoiding what could have been an embarrassing end to an enjoyable day.

After exiting the bathroom, I naturally gravitated toward the science fiction section to see what might be worth picking up. It was there that I made an astounding discovery. Old Earth Books, had reprinted all six of E.E. Smith's *Lensman Series* novels in Trade Paperback, and was selling them for the princely sum of \$15 each. Since my copies are all ancient, tattered, 1967 editions, I decided to purchase an entire new set while I had the chance.

And that is how I happened to spend \$95 on a cold Saturday night in Boston when all I really wanted to do was find a restroom!

Edward Elmer Smith, Ph.D., was one of the writers with whom I grew up. His specialty was space opera on a galactic and intergalactic scale, and few, if any, modern writers come close to his work in terms of expansiveness. Indeed, I have personally only written one story that attempts the scale at which "Doc" Smith routinely worked, and that was of limited success ("The Void," available in *Gridlock and Other Stories*, Sci Fi – Arizona).

I had not read the *Lensmen* books since the late 1960s, and after my impulse purchase in Boston, I opened *Galactic Patrol* with delicious anticipation. What I found was that Doc Smith was not nearly as good a writer as I remember him being. His style is rather formal and overblown, florid in the extreme, with contorted sentences, and constructions that seem very artificial to the modern eye. In other words, he was a typical

pulp fiction writer of the 1930s, whose writing style reflected his education and the writing standards that were in vogue around 1900. I have yet to read far enough to regain the awe I felt upon first encountering the *Lensmen*, but I have no doubt that once I get into the story, I will be able to regain the “sense of wonder” that the earlier Michael McCollum felt when he first encountered the series in his high school library.

The *Lensman Series* was conceived originally in early 1937 and submitted to F. Orlin Tremaine, the editor of *Astounding*, as an 85-page synopsis. Unlike many series, Smith conceived this one as a complete story that would require 400,000 words to tell, and which would be published in four segments. He actually wrote the ending of the fourth book in the series first, then went back, and filled in. Tremaine committed *Astounding Science Fiction* to purchasing the entire series, but then left the editor’s chair before Smith could turn in the first novel in the series. Tremaine was replaced as editor by John W. Campbell. With E. E. Smith’s series as an impetus, and with the short stories of several of his own discoveries (Robert Heinlein, Isaac Asimov, and A.E. Van Vogt, to name a few), John W. Campbell turned *Astounding* into a science fiction empire. For more than thirty years, Campbell and his magazine were the center of the science fiction universe, or at least, its *hi tech* sub-genre. In building his magazine into an SF institution, Campbell launched what has become known as “The Golden Age of Science Fiction.”

Few “golden ages” are recognized as such at the time they actually take place. Most are the result of subsequent generations looking backward with fondness to an earlier time. However, the golden age that began in 1937, and which lasted to the end of World War II, and possibly into the early 1950s, saw the very foundations of modern science fiction constructed. It was during the Golden Age that writers like Heinlein, Clarke, Asimov, Van Vogt, and a few others fixed in the public mind what it means to be a modern science fiction writer.

That the Golden Age began with E. E. Smith’s *Lensman Series* is highly appropriate. Smith’s series began with *Galactic Patrol*, serialized in *Astounding* from September 1937 through February 1938. The second book, *Gray Lensman*, was serialized from October 1939 through January 1940. *Second-Stage Lensmen* was in the midst of being serialized when the United States entered World War II. It ran from November 1941 through February 1942. The final book in the series, *Children of the Lens*, appeared in *Astounding* from November 1947 through February 1948. The delay was due to the fact that Smith was engaged in war work for the duration of the hostilities.

Doc Smith subsequently sold the series to Fantasy Press. The owner, Lloyd Arthur Eshbach, talked Smith into adding two “prequels” to the series. These were *Triplanetary* (originally published as a “non-Lensman” story in *Amazing Science Fiction* from January through April 1934), and *First Lensman*. These books were published by Fantasy Press in 1948 and 1950, respectively. Following the publication of the prequels, Fantasy Press brought out the four novels constructed from the *Astounding* serials. They were published in 1950, 1951, 1953, and 1954. It is a “facsimile” of the Fantasy Press editions, including original art deco illustrations, that Old Earth Books was selling when I purchased the series in Boston.

Those of us who are part of the baby-boom generation of science fiction writers look back with fondness at the stories and novels that came out of the pulp fiction era. Though they predate us (I was born in 1946), we were greatly affected by them. Just as Edward Elmer Smith’s writing style drew from the literary conventions of his youth; the

writers of the Golden Age heavily influence my writing style and that of my contemporaries.

There is nothing unique about this affection for a time long gone, of course. It is a common human trait to gaze back with fondness at one's youth. In my case, that means the late 1950s and 1960s, when I first read the stories from the Golden Age. Since *The Art of Science Fiction* is intended to be an exhaustive study of all things "science fictional," I thought it would be interesting to review the science of that long ago time.

In many ways, the universe of the Golden Age was considerably more attractive than the universe we know today. For although we now have all of those lovely pictures of the various planets in the Solar System, they do not help us in our writing as much as we had hoped. The reason for this is that reality is a great deal harsher than the masters of science fiction imagined it would be. Except for Earth, the Solar System is an inhospitable place. Frankly, I prefer the fictional planets on which Heinlein, Asimov, and Clarke placed their stories of wonder.

So, to quote another icon of my youth, "Let us now return to those thrilling days of yesteryear..." and the science of the Golden Age of Science Fiction.

The Science of the Golden Age

Most people view science as a great marble monolith, an Acropolis of the Mind, a structure that is perfect and whole in every respect. Nothing could be farther from the truth. Science is a ramshackle structure built in a plethora of architectural styles. At its lowest levels are the subbasements lit by smoky tallow candles where alchemists' mortars and pestles are scattered around the workbenches. On the first floor of the edifice, the rooms are decorated in Victorian wood paneling and furnished with red-leather settees, while the air carries the stink of ozone and the distant buzzing of naked electrical sparks. Only toward the top of the structure do we see the steel-and-glass construction so beloved by modern architects. Science, far from being complete, is a work in progress, a never-ending construction project that requires as much tearing down as building.

Just as Newtonian physics gave way to Einsteinian physics, so too will our modern beliefs evolve into something we barely recognize. We know this, because even today we can dimly see the outlines of that future science emerging from the fog of ignorance. A universe that allows Chaos Theory, String Theory, and Quantum Mechanics all to coexist with Einsteinian curved space is a universe we do not yet fully understand.

Because science continuously evolves, the concepts used by science fiction writers evolve as well. The science of the Golden Age was not as refined as the science we moderns have at our disposal. In one way, this was a blessing in disguise. For not knowing what the universe was like allowed the writers of sixty years ago to be much freer with their speculations than are we.

Nor was the Golden Age of Science Fiction driven solely by the unfettered imagination of the field's practitioners. Like the Renaissance in Europe, it occurred because of the confluence of several outside events – all of them bad. In 1937, the Great War had given way to The Great Depression, and totalitarian governments were on the rise all over the globe. Mussolini, Hitler, and Stalin all strode onto the World Stage in the 1930s, and it did not require the predictive powers of Nostradamus to know that nothing

good would come of them. It was a time of turmoil in which society was undergoing major upheavals. It was a time ripe for escapist entertainment of all kinds. In the decade between 1929 and the day Hitler invaded Poland, all forms of entertainment flourished. Few people were so poor that they could not spend a nickel on a movie or to purchase a pulp magazine.

Nor was the turmoil limited to the socio-economic sphere. Science, too, was in turmoil at the time, and had been so for more than 30 years. The late 19th and early 20th Centuries were decades when conventional science was torn asunder by strange new theories. The Michelson-Morely experiment and Einstein's Theory of Relativity forced scientists to face the fact that the mechanistic picture of a clockwork universe was no longer valid. Space was curved, time elastic, and the indivisible atom split.

One would think that the Golden Age would have occurred at the turn of the century (that would be the turn of the *last* century), when Herbert George Wells was at the height of his powers. However, there is always a lag of a few decades between a major scientific discovery and the time when awareness of it finally percolates out into the public. In the case of Einstein's revolution in physics, that percolation had begun in the first decade of the century, and was well along at the end of the third decade.

So, the masters of science fiction, with a ready-made Depression-weary audience, took the scientific ideas that were just beginning to achieve widespread acceptance, and they imbedded them into a variety of enjoyable action-adventure stories. It was an imperfect view of the universe, to be sure; but then, what view is not? Where they were required to look beyond the boundaries of known science, they extrapolated, and in so doing, they built a universe that was infinitely more interesting than the real thing. Or, if not more interesting, certainly easier for readers of the time to understand.

Space Travel in the Golden Age

The pulp magazines of the Golden Age had two stereotypical covers. One featured a winged rocket flying through a universe filled with suns, planets, and meteors; while the other showed a scantily clad woman in the clutches of a bug-eyed monster. The first cover portrayed the view that any ship that ventures outside the atmosphere will run into a swarm of meteors as thick as a stream of machine gun bullets. This proved not to be the case. In fact, I am unaware of any spacecraft or satellite ever having been seriously damaged by a meteor. True, the space shuttle occasionally gets a pit in its windshield, but nothing more serious. Even our probes transiting the asteroid belt have done so unscathed. The numerous scenes Golden Age authors wrote concerning the race to patch the hull after a meteor hit have turned out to be mere fantasy.

As for the second stylized cover, bug-eyed monsters were so prevalent in science fiction that a shorthand term was coined for them: BEM. Why this particular form of alien life should be more prevalent than any other, I have no idea. Moreover, as we have noted before in this series, their attraction for half-naked human females is equally perplexing. Other than the obvious reason, namely assassination with intent to ingest, just what would a bug-eyed monster do with a half-naked woman anyway?

The Golden Age was wedded to a concept of space travel that we no longer use. In numerous books written in that age, one encounters sentences like, "The ship rocketed through the ether, its tubes spewing white-hot flames behind."

I remember being very confused when I first encountered the concept of “ether” in a science fiction novel at around age 12. “Ether,” I knew, is the common name for the anesthetic gas whose long name is diethyl ether [(C₂H₅)₂O]. What an anesthetic has to do with space travel, I had no idea.

It turned out that I was confused. “Ether” or “aether” is a concept that goes back to Pythagoras, but which in the modern usage means “the stuff that lies beneath the vacuum of space.” Like the medieval “phlogiston,” it is a concept that comes from a logical, but incorrect, interpretation of physical phenomena. By the early 19th Century, scientists knew enough about light that they realized color was due to a variation in frequency. Thus, light and all other electromagnetic radiation was determined to be a wave phenomenon, and since waves require a medium through which to transit, it was logically argued that a “medium” exists between the planets. This medium was known as “ether.” The only problem was that no one was able to find this elusive substance.

Because they could not find the medium through which light waves traveled, scientists decided that light was actually caused by a particle — the photon. The fact that particles can exhibit the properties of waves was something of a mystery until explained by Louis de Broglie in 1923. Thus, while the idea was available in the literature and causing considerable consternation in scientific circles, it had not yet had time to seep into the public consciousness. Because of this, the writers of the Golden Age were largely wedded to the older ether theory and said so in their books

One problem that they knew about and worked hard to overcome was Einstein’s theory that nothing can ever go faster than the speed of light. Indeed, although they were the first generation of science fiction writers to face this conundrum, they were not the last. We, too, struggle with Einstein’s Universal Speed Limit, which, if followed religiously, would eviscerate most science fiction stories. It is difficult, after all, to keep the readers’ juices flowing when it takes a thousand years to go from one star to another. Think of the Starship *Enterprise* if it was limited to velocities less than that of light. They would need a new cast for the program each week!

One of the first people to pay homage to Einstein’s Barrier was E. E. Smith. In the *Lensmen* series, his ships have top speeds that are virtually infinite. He attains these fantastic velocities by building a stardrive generator that effectively neutralizes the effects of inertia. Now inertia is an inherent property of matter, and it shows up in Newton’s First Law of Motion: An object at rest will tend to remain at rest, and one in motion will tend to continue in a straight line unless acted upon by an external force. In fact, Einstein’s Theory of General Relativity states that gravity and inertia are sort of the same thing.

Since the reason it is impossible to exceed the speed of light is that mass increases as one approaches light speed, and becomes infinite when one reaches it, Doc Smith postulated that neutralizing inertia would neutralize the Theory of Relativity. This appears to be a semi-reasonable assumption, or at least, a very clever plot device. Whichever it was, his solution was much better than in his earlier *Skylark of Space* (1928), where he had one character note (in wonder) that Einstein appeared to have been wrong!

Having invented the inertialess drive, Smith explored the implications in a way that serves as a model for all of us who have come after. For the property of inertia is one that is built into our bones and the consequences of its lack are counter-intuitive. In

the first scene in *Galactic Patrol*, Doc Smith has the 100 upper classmen of Earth's Galactic Patrol Academy march to their graduation ceremony. As part of the ceremony, accompanied by the thundering strains of the *Patrol March*, the students step off the edge of an open drop shaft in perfect synchronization, only to hit the ground ninety stories below a second later, and then march out again in perfect time to the music as the second rank lands right behind them. Obviously, if a person lacks inertia, then stepping into an open shaft will allow gravity to instantaneously accelerate his body to terminal velocity, only to come to a dead stop the instant his heel touches the ground. Remember, it is not the speed that kills you in a high-speed crash; it is the inertia.

Smith's ships show a similar lack of concern for the consequences of high velocity. They race toward one another, only to stop at the instant of collision, their shields pressed against one another and their "ravaging beams of destruction driving the shields to radiate upwards through the full polychromatic spectrum!" With his inertialess drive, Smith sent his spaceships racing across the galaxy, giving his *Lensmen* an infinite number of locales in which to battle the evil Eddorians, and at no time did anyone yell, "Warp Factor Six, Scottie!"

Most of the other writers of the Golden Age were less enthusiastic than Doc Smith when it came to space travel. Their ships were plain old rockets, or starships that operated on principles not explicitly explained, or with more mundane explanations for how they, too, managed to violate Einstein's Barrier. Poul Anderson, who started his career in the Golden Age, but who really belongs to a later time, used the "microjump" to drive his ships. Robert Heinlein was the first person that I read who actually explained how one would go about "warping space." He did this in *Starman Jones* (1953), about which I will speak at greater length in a bit.

The Golden Age Solar System

The astronomy of the Golden Age was limited to observation through giant Earth-based telescopes. The largest telescope in the world for a very long time was the Hale Telescope at Palomar Observatory, put online in 1948. The astronomers of the day were limited to what they could see with photographic emulsion on glass plates. There were no charge-coupled-devices, no flexible mirrors, no Hubble Orbiting Telescope to help them penetrate Earth's wavering atmosphere. Consequently, their view of the surrounding universe was decidedly fuzzy.

This left the science fiction writers of the day with clues as to conditions on the other planets in the Solar System, but few hard facts. That was okay with them. What they lacked in facts, they more than made up for with imagination. What they came up with was a Solar System infinitely more hospitable to human beings than the real thing. Let us take a quick tour of the Golden Age Solar System and compare it with our own.

Mercury

For a long time, astronomers thought that Mercury, the closest planet to the sun, was tidal locked to Sol. In other words, like Luna, Mercury only showed one face to the sun. This meant that one side was perpetually baked in sunlight, with temperatures hot enough to melt lead at the sub-solar point. The other side of the planet was cold enough

to freeze nitrogen, with only the twilight zone between the two hemispheres marginally habitable. There were numerous stories where the intrepid hero's Mercury buggy breaks down in the middle of Sunside Mercury, and he and the heroine are forced to walk across the burning plain to safety.

In reality, of course, Mercury has a slow rotation with respect to the sun, which means that all sides are baked equally. There is no perpetual sub-solar point, no frozen nitrogen snow, and no twilight zone where the sun hangs forever just below the horizon. There is only a heavily cratered planet where the sun rises and crosses the sky in 88 days, followed by another 88 days of night.

In my opinion, the older view was much more interesting!

Venus

The greatest difference between Golden Age astronomy and today's counterpart involves the planet Venus. Because it was covered perpetually with clouds, writers could imagine anything they wanted about its surface. Mostly they imagined it to be a sweltering swamp and jungle, where large carnivorous *things* lay just below the surface to gobble up the unwary. Robert Heinlein was especially fond of the swamplike, cloudy Venus. He returned to it repeatedly, including *Space Cadet* (1948), *Between Planets* (1951) and *Podkayne of Mars* (1963), with mentions in *The Puppet Masters* (1951) and *Double Star* (1956). Other writers also adopted the consensus view that Venus is just like Earth, only hotter and wetter.

The problem, of course, is that those clouds are not water vapor on Venus, they are sulfuric acid. The atmospheric pressure is 90 times that at Earth's sea level, and the temperature is 750 degrees Kelvin. In other words, Venus is hotter than Mercury! What a disappointment. I was so looking forward to meeting Sir Isaac Newton (*Between Planets*) and the rest of the Venerian dragons.

Mars

Of course, the planet of most interest to human beings (other than our own) is Mars. The Red Planet has been studied for more than a century, and in all that time, has been the subject of intense speculation. Golden Age astronomers were aware of the fact that the Martian polar ice caps wax and wane with the seasons, and some of them thought they detected "canali," which means "channel" in Italian, but which everyone instantly translated as "canal."

The thought that Mars might be inhabited has generated more science fiction stories than just about anything. There was H.G. Wells's *War of the Worlds*, and many other books before the onset of the Golden Age in 1937. In fact, Mars became a stock locale for setting a story somewhere other than Earth. A few months before he invented Tarzan, Edgar Rice Burroughs wrote *Dejah Thoris, Princess of Mars*. It was reading these stories that got the young Robert Heinlein interested in science fiction, just as reading Heinlein got many of us interested.

As with Venus, Robert Heinlein was very committed to a Mars that had canals and an intelligent indigenous race. In *The Green Hills of Earth*, one of the stanzas of Rhysling's anthem involves Red Mars, as does several of his (Rhysling's) earlier works

(*The Grand Canal*). *Red Planet* (1949), *Between Planets* (1951), *The Rolling Stones* (1952), *Double Star* (1956), and *Podkayne of Mars* (1963) all use the same canal-strewn Martian model as their backdrops.

As we all know, Mars is the most hospitable place in the Solar System outside of Earth, but the beautiful picture of an ancient Martian civilization (sometimes dead) that built towering castles and globe-girdling canals is no more. The canals turned out to be optical illusions caused by the astronomers' brains stringing together meteor craters, the water that once flowed there is long gone, and the atmosphere is primarily composed of carbon dioxide. There were never any Martians, not those of Herbert George Wells, Robert Anson Heinlein, or Ray Douglas Bradbury. Which is a crying shame if you ask me! There should have been Martians. And no, the Face on Mars does not count. They just re-photographed the area and it turned out to be merely a mountain photographed at a low sun angle.

The Moons of Jupiter

The most popular place in the Outer Solar System during the Golden Age was the Jovian Moons. The astronomers of the day knew of 12 moons, not the 16 of today. Except for *Farmer in the Sky* (1950) where Robert Heinlein terraformed Ganymede, the moons were typically presented in the best scientific detail of the day.

Modern discoveries have not dramatically changed the descriptions of the moons. This is not to say that the individual moons are not dramatically different from those the masters of science fiction wrote about. However, those portrayals were always of moons where human beings needed artificial life support to survive, and that is as true today as it was then. One thing that Golden Age writers missed, however, was the existence of a whopping big Van Allen radiation belt that surrounds Jupiter. Io, Jupiter's innermost moon, for instance, has the most hostile environment in the Solar System because it orbits inside this belt. Other moons penetrate it periodically, making living on them hazardous to one's health unless precautions are taken.

Computers in the Golden Age

One area where the Golden Age writers differed considerably from modern writers was in their depiction of computers and automation. Kimball Kinnison and his merry band of Lensmen, for instance, essentially did not have computers. They flew ships across the galaxies that were navigated by hand, and occasionally via an electro-mechanical autopilot. Any calculations that were needed were done on slide rules (I still own mine). [Author's note: Actually, I bought a "new" slide rule in 2000. It's a Picket Log-Log Vector Speed Rule, came still packed in the original packaging, and has a lifetime guarantee from a company that went bankrupt 30 years ago. The company I bought it from in British Columbia for \$100 has a motto: "When that computer you are working on has been in a landfill for a century, your slide rule will just be getting broken in!"]

Precise work was done with the use of vernier controls. For those who missed the age of verniers, the term refers to a graduated scale with another such scale linked to it. One reads the rough measurement by looking where the zero line falls on the first scale,

then reads the “tenths” by determining which line on the second scale lines up precisely with the first. Reading vernier scales took a certain amount of skill, and was the height of accuracy in the Golden Age.

In fact, if you look at science fiction stories, except for Arthur Clark’s and Isaac Asimov’s work, which were about computers, there were not very many computers in science fiction for a long time. Moreover, those computers that existed were of the massive mainframe variety, some literally miles long, and attended by hundreds of white-coated acolytes who toiled in the bowels of the great thinking machine. If any science fiction writer foretold the coming of the personal computer, I am unaware of it.

The one book that illustrates best how far we have come since the days of the Golden Age, is Robert Heinlein’s *Starman Jones* (1953). In this story, Max Jones runs away from his home in Appalachia and joins the crew of the Starship *Asgard*. The *Asgard* is a combination freighter and passenger liner. It plies the spacelanes by accelerating to very near the speed of light, and then “jumping” from one star to another through the application of power. Max Jones becomes a trainee astronaut aboard the *Asgard*, a position made possible by his photographic memory. He has, it seems, memorized the entire Handbook of Astrogator’s Tables.

Those who grew up in the age of computers will have difficulty understanding what I just said, so let me elaborate. Back in the days of slide rules, it was possible to multiply numbers using a slip stick, but the degree of accuracy obtained was only three decimal places. For more accurate work, one used a table of logarithms. For those who remember their math, a logarithm is the power of 10 that results in a particular number. That is, $10^2=100$, and therefore, the logarithm of 100 is 2.0000.

To multiply two large numbers precisely, one looked up the two numbers in a table of logarithms, added the two logarithms together, and then used the result to find the number whose logarithm equaled the sum. Slide rules work on the same principle. By adding logarithms (which is what a slide rule does), it is possible to multiply.

Max Jones’s job as an astrogator was somewhat similar to multiplying using logarithms. As the starship approached the speed of light, the bridge crew (the bridge was known as the “worry hole”) took photographic sightings on the positions of various stars. They would then use these observations to determine the ship’s position, but before that information could be put into the computer, it had to be converted into binary. Max Jones’s job was to *convert the decimal data into binary by looking it up in a book!*

I must have read *Starman Jones* a dozen times before I realized that was what they were doing. The chartsman would figure out the position, he would pass the information to the astrogators, they would look up the corresponding binary code in a bound book, and the computerman would use a series of toggle switches to input the code into the computer. In other words, if the velocity change turned out to be 10, the astrogator would look up 1010 (the binary equivalent for 10) in a book, and the computer man would close the first and third switch and open the second and fourth. Of course, in the book, they were working with far more than four digits, but the principle was the same.

That, then, was the state of computing in 1953. Not only couldn’t computers read simple ASCII code (since it had yet to be invented), they had to be programmed in binary!

Isaac Asimov made it a specialty to write stories about the coming age of computers, but he wrote about big mainframes. Except for his positronic robot series, of course.

It is in this one area that the Golden Age still outpaces modern times. Where our computers are vastly smaller and much more powerful than any they imagined, our technology in robotics remains primitive compared to the self-aware marvels envisioned by Isaac Asimov. We would be happy if we could build a robot that could recognize a human being, let alone know that it must not allow a human being to come to harm (the first law of robotics).

Conclusion

That then, was the state of science in the days of the Golden Age of Science Fiction. What the masters lacked in knowledge, they more than made up for in creativity. For perfect knowledge is not of much use to a science fiction writer unless he or she can pass on that knowledge to the readership, and do so in a way that is both entertaining and not disruptive to the plot. We, their descendents, owe everything to those poor underpaid scribes who pounded away on manual typewriters for a few cents per word. Writing in those days was much more physical labor than it is today. If you don't believe me, try typing your next manuscript on a typewriter with three sets of carbon paper rolled into the platen.

Sir Isaac Newton, who was not a humble man, nevertheless said it best when he said, "If I have seen further it is by standing on the shoulders of Giants." Those of us who write or read science fiction in this, the first decade of the 21st century, owe a debt of gratitude to those who built the field in the Golden Age. For it is we who truly stand on the shoulders of these giants of the Golden Age!

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The End

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Moreover, if you like space art, you can visit our Art Gallery, where we feature the works of Don Dixon, one of the best astronomical and science fiction artists at work today. Don is the Art Director of the Griffith Observatory. Pick up one or more of his spacescapes for computer wallpaper, or order a high quality print direct from the artist.

We have book length versions of both Writers' Workshop series, "The Art of Writing, Volumes I and II" and "The Art of Science Fiction, Volumes I and II" in both electronic and hard copy formats.

So if you are looking for a fondly remembered novel, or facing six hours strapped into an airplane seat with nothing to read, check out our offerings. We think you will like what you find.

NOVELS

1. Life Probe - ^{US}\$5.00

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}\$5.00

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\$5.00

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\$5.00

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\$5.00

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\$5.00

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. Gibraltar Stars – First Time in Print — ^{US}\$7.50

The great debate is over. The human race has rejected the idea of pulling back from the stars and hiding on Earth in the hope the Broa will overlook us for a few more generations. Instead, the World Parliament, by a vote of 60-40, has decided to throw the dice and go for a win. Parliament Hall resounds with brave words as members declare victory inevitable.

With the balance of forces a million to one against *Homo sapiens Terra*, those who must turn patriotic speeches into hard-won reality have their work cut out for them. They must expand humanity's foothold in Broan space while contending with a supply line that is 7000 light-years long.

If the sheer magnitude of the task isn't enough, Mark and Lisa Rykand discover they are in a race against two very different antagonists. The Broa are beginning to wonder at the strange two-legged interlopers in their domain; while back on Earth, those who lost the great debate are eager to try again.

Whoever wins the race will determine the future of the human species... or, indeed, whether it has one.

12. Gridlock and Other Stories - US\$5.00

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

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

Have you missed any of the articles in the Art of Writing Series? No problem. The first sixteen articles (October, 1996-December, 1997) have been collected into a book-length work of more than 72,000 words. Now you can learn about character, conflict, plot, pacing, dialogue, and the business of writing, all in one document.

14. The Art of Writing, Volume II - US\$10.00

This collection covers the Art of Writing articles published during 1998. The book is 62,000 words in length and builds on the foundation of knowledge provided by Volume I of this popular series.

15. The Art of Science Fiction, Volume I - US\$10.00

Have you missed any of the articles in the Art of Science Fiction Series? No problem. The first sixteen articles (October, 1996-December, 1997) have been collected into a book-length work of more than 70,000 words. Learn about science fiction techniques and technologies, including starships, time machines, and rocket propulsion. Tour the Solar System and learn astronomy from the science fiction writer's viewpoint. We don't care where the stars appear in the terrestrial sky. We want to know their true positions in space. If you are planning to write an interstellar romance, brushing up on your astronomy may be just what you need.

16. The Art of Science Fiction, Volume II - US\$10.00

This collection covers the *Art of Science Fiction* articles published during 1998. The book is 67,000 words in length and builds on the foundation of knowledge provided by Volume I of this popular series.

17. The Astrogator's Handbook – Expanded Edition and Deluxe Editions

The Astrogator's Handbook has been very popular on Sci Fi – Arizona. The handbook has star maps that show science fiction writers where the stars are located in space rather than where they are located in Earth's sky. Because of the popularity, we are expanding the handbook to show nine times as much space and more than ten times as many stars. The expanded handbook includes the positions of 3500 stars as viewed from Polaris on 63 maps. This handbook is a useful resource for every science fiction writer and will appeal to anyone with an interest in astronomy.