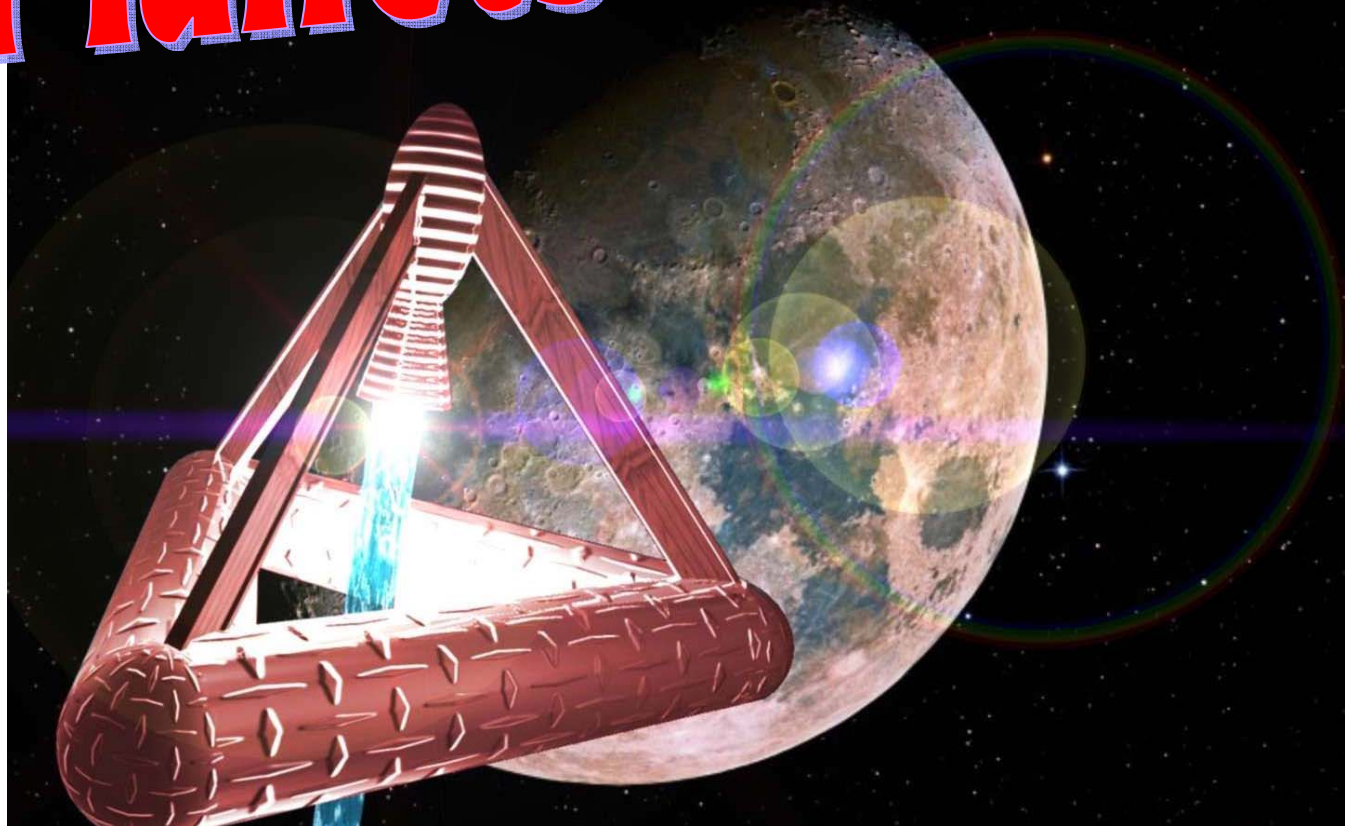
Forgotten Futures XI:

Planets of Peril



Role-Playing in the Worlds of Stanley G. Weinbaum's 1930s Science Fiction

By Marcus L. Rowland

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FORGOTTEN FUTURES XI:

PLANETS OF PERIL

ROLE-PLAYING IN THE WORLDS OF STANLEY G. WEINBAUM'S 1930S SCIENCE FICTION

BY MARCUS L. ROWLAND

This game contains numerous "spoilers" for Weinbaum's stories; you are strongly advised to read the fiction first!

Print formatting: If you print double-sided, for best results print the cover and this page single sided, and all remaining pages (starting with the contents) double sided. The font used for most text is Albertus Medium; some other fonts are used for "handwriting," "newspaper cuttings," etc.

This game uses a mixture of Imperial and US measurements, the metric system, and astronomical measures such as AU and light-minutes, as seems appropriate. While it would be nice to imagine a world that uses a standard measuring system, we all know that things really aren't like that. This game is science fiction, not fantasy…

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A Martian Odyssey
by
Stanley G. Weinbaum

JARVIS stretched himself as luxuriously as he could in the cramped general quarters of the *Ares*.

"Air you can breathe!" he exulted. "It feels as thick as soup after the thin stuff out there!"

He nodded at the Martian landscape stretching flat and desolate in the light of the nearer moon, beyond the glass of the port.

The other three stared at him sympathetically—Putz, the engineer, Leroy, the biologist, and Harrison, the astronomer and captain of the expedition. Dick Jarvis was chemist of the famous crew, the *Ares* expedition, first human beings to set foot on the mysterious □ravelled of the earth, the planet Mars. This, of course, was in the old days, less than twenty years after the mad American Doheny perfected the atomic blast at the cost of his life, and only a decade after the equally mad Cardoza rode on it to the moon. They were true pioneers, these four of the *Ares*. Except for a half-dozen moon expeditions and the ill-fated de Lancey flight aimed at the seductive orb of Venus, they were the first men to feel other gravity than earth's, and certainly the first successful crew to leave the earth-moon system. And they deserved that success when one considers the difficulties and discomforts—the months spent in acclimatization chambers back on earth, learning to breathe the air as tenuous as that of Mars, the challenging of the void in the tiny rocket driven by the cranky reaction motors of the twenty-first century, and mostly the facing of an absolutely unknown world.

Jarvis stretched and fingered the raw and peeling tip of his frostbitten nose. He sighed again contentedly.

"Well," exploded Harrison abruptly, "are we going to hear what happened? You set out all shipshape in an auxiliary rocket, we don't get a peep for ten days, and finally Putz here picks you out of a lunatic ant-heap with a freak ostrich as your pal! Spill it, man!"

"Speel?" queried Leroy perplexedly. "Speel what?"

"He means 'spiel'," explained Putz soberly. "It iss to tell."

Jarvis met Harrison's amused glance without the shadow of a smile. "That's right, Karl," he said in grave agreement with Putz. "Ich spiel es!" He grunted comfortably and began.

"According to orders," he said, "I watched Karl here take off toward the North, and then I got into my flying sweat-box and headed south. You'll remember, Cap—we had orders not to land, but just scout about for points of interest. I set the two cameras clicking and buzzed along, riding pretty high—about two thousand feet—for a couple of reasons. First, it gave the cameras a greater field, and second, the under-jets travel so far in this half-vacuum they call air here that they stir up dust if you move low."

"We know all that from Putz," grunted Harrison. "I wish you'd saved the films, though. They'd have paid the cost of this junket; remember how the public mobbed the first moon pictures?"

"The films are safe," retorted Jarvis. "Well," he resumed, "as I said, I buzzed along at a pretty good clip; just as we figured, the wings haven't much lift in this air at less than a hundred miles per hour, and even then I had to use the under-jets.

"So, with the speed and the altitude and the blurring caused by the under-jets, the seeing wasn't any too good. I could see enough, though, to distinguish that what I sailed over was just more of this gray plain that we'd been examining the whole week since our landing—same blobby growths and the same

Stanley G. Weinbaum

Despite a tragically short life and writing career, Stanley G. Weinbaum (1902-1935) is generally considered to be one of the "greats" of 1930s science fiction, and one of SF's classic authors regardless of period.

He was born in Louisville, Kentucky and studied chemical engineering, later switching to English, at the University of Wisconsin, but failed to graduate, allegedly due to participation in a cheating scandal, which led to him leaving the university in 1923.

For the next ten years he managed a movie theatre, writing in his spare time. His first known work was a romantic novel, *The Lady Dances*, sold in 1933 and serialised in 1934; his first SF was the short story *A Martian Odyssey*, also published in 1934. But at this point Weinbaum was already seriously ill, suffering from the lung cancer which eventually killed him. It's notable that cancer is a recurring theme in his stories; the narrator / hero of *A Martian Odyssey* finds a stone which might be a cure for cancer, the adventurers of *Parasite Planet* are pursued by "dough-pots," explicitly described as giant mobile cancers that eat anything organic in their path.

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eternal carpet of crawling little plant-animals, or biopods, as Leroy calls them. So I sailed along, calling back my position every hour as instructed, and not knowing whether you heard me."

"I did!" snapped Harrison.

"A hundred and fifty miles south," continued Jarvis imperturbably, "the surface changed to a sort of low plateau, nothing but desert and orange-tinted sand. I figured that we were right in our guess, then, and this gray plain we dropped on was really the Mare Cimmerium which would make my orange desert the region called Xanthus. If I were right, I ought to hit another gray plain, the Mare Chronium in another couple of hundred miles, and then another orange desert, Thyle I or II. And so I did."

"Putz verified our position a week and a half ago!" grumbled the captain. "Let's get to the point."

"Coming!" remarked Jarvis. "Twenty miles into Thyle—believe it or not—I crossed a canal!"

"Putz photographed a hundred! Let's hear something new!"

"And did he also see a city?"

"Twenty of 'em, if you call those heaps of mud cities!"

"Well," observed Jarvis, "from here on I'll be telling a few things Putz didn't see!" He rubbed his tingling nose, and continued. "I knew that I had sixteen hours of daylight at this season, so eight hours—eight hundred miles—from here, I decided to turn back. I was still over Thyle, whether I or II I'm not sure, not more than twenty-five miles into it. And right there, Putz's pet motor quit!"

"Quit? How?" Putz was solicitous.

"The atomic blast got weak. I started losing altitude right away, and suddenly there I was with a thump right in the middle of Thyle! Smashed my nose on the window, too!" He rubbed the injured member ruefully.

"Did you maybe try vashing der combustion chamber mit acid sulphuric?" inquired Putz. "Sometimes der lead giffs a secondary radiation—"

"Naw!" said Jarvis disgustedly. "I wouldn't try that, of course—not more than ten times! Besides, the bump flattened the landing gear and busted off the under-jets. Suppose I got the thing working—what then? Ten miles with the blast coming right out of the bottom and I'd have melted the floor from under me!" He rubbed his nose again. "Lucky for me a pound only weighs seven ounces here, or I'd have been mashed flat!"

"I could have fixed!" ejaculated the engineer. "I bet it vas not serious."

"Probably not," agreed Jarvis sarcastically. "Only it wouldn't fly. Nothing serious, but I had the choice of waiting to be picked

up or trying to walk back—eight hundred miles, and perhaps twenty days before we had to leave! Forty miles a day! Well," he concluded, "I chose to walk. Just as much chance of being picked up, and it kept me busy."

"We'd have found you," said Harrison.

"No doubt. Anyway, I rigged up a harness from some seat straps, and put the water tank on my back, took a cartridge belt and revolver, and some iron rations, and started out."

"Water tank!" exclaimed the little biologist, Leroy. "She weigh one-quarter ton!"

"Wasn't full. Weighed about two hundred and fifty pounds earth-weight, which is eighty-five here. Then, besides, my own personal two hundred and ten pounds is only seventy on Mars, so, tank and all, I grossed a hundred and fifty-five, or fifty-five pounds less than my everyday earth-weight. I figured on that when I undertook the forty-mile daily stroll. Oh—of course I took a thermo-skin sleeping bag for these wintry Martian nights.

"Off I went, bouncing along pretty quickly. Eight hours of daylight meant twenty miles or more. It got tiresome, of course—plugging along over a soft sand desert with nothing to see, not even Leroy's crawling biopods. But an hour or so brought me to the canal—just a dry ditch about four hundred feet wide, and straight as a railroad on its own company map.

"There'd been water in it sometime, though. The ditch was covered with what looked like a nice green lawn. Only, as I approached, the lawn moved out of my way!"

"Eh?" said Leroy.

"Yeah, it was a relative of your biopods. I caught one, a little grass-like blade about as long as my finger, with two thin, stemmy legs."

"He is where?" Leroy was eager.

"He is let go! I had to move, so I plowed along with the walking grass opening in front and closing behind. And then I was out on the orange desert of Thyle again.

"I plugged steadily along, cussing the sand that made going so tiresome, and, incidentally, cussing that cranky motor of yours, Karl. It was just before twilight that I reached the edge of Thyle, and looked down over the gray Mare Chronium. And I knew there was seventy-five miles of that to be walked over, and then a couple of hundred miles of that Xanthus desert, and about as much more Mare Cimmerium. Was I pleased? I started cussing you fellows for not picking me up!"

"We were trying, you sap!" said Harrison.

"That didn't help. Well, I figured I might as well use what was left of daylight in getting down the cliff that bounded Thyle. I found an easy place, and down I went. Mare Chronium was just the same sort of place as this—crazy leafless plants and a

Although he was increasingly ill, Weinbaum wrote prolifically through 1934-5, and was working on another romantic novel, *Three Who Danced*, when he died in December 1935, barely eighteen months after *A Martian Odyssey's* first publication. Much of his work was published posthumously, and one story, *Tidal Moon*, was little more than notes at the time of his death, completed by his sister.

Weinbaum wrote in a variety of genres including crime and romance, but is now chiefly remembered for his science fiction, and in particular the "Planetary" sequence, beginning with his first SF story A *Martian Odyssey* (1934), ten stories with a common background describing the exploration and exploitation of a consistently detailed Solar System, and the first to describe genuinely *alien* aliens, whose lives, minds and societies were unlike those of humans or any known human culture. While this collection includes several of Weinbaum's other stories, the Planetary stories are the primary source for this game.

The Planetary stories are not entirely consistent, but Weinbaum probably never envisaged them as a "future history" of the type many subsequent authors have created. Despite this they hang together remarkably well, and it seems likely that many discrepancies would have been eliminated if they had been edited as a single volume in Weinbaum's lifetime.

Weinbaum's other genre work included numerous short stories and three novels; *The Black Flame* (originally two novelettes, *Dawn of Flame* and *The Black Flame*), *The New Adam* (1939), and *The Dark Other* (1950, horror). One SF story, *The Adaptive Ultimate*, was adapted into radio and TV plays, and was filmed as *She Devil* in 1957.

Sources: *The Encyclopaedia of Science Fiction* (Clute & Nicholls); Introduction to *A Martian Odyssey* and other stories (Moskowitz); Wikipedia.

The 'Planetary' Sequence

Ten stories of exploration, trade and adventure around the Solar System, the main body of Weinbaum's SF and the primary source for this game:

A Martian Odyssey	July 1934
Valley of Dreams	Nov 1934
Flight on Titan	Jan 1935
Parasite Planet	Feb 1935
The Lotus Eaters	April 1935
The Planet of Doubt	Oct 1935
The Red Peri	Nov 1935
The Mad Moon	Dec 1935
Redemption Cairn	March 1936
Tidal Moon	Dec 1938

All except the last of these stories accompany this collection; most of *Tidal Moon* was written by Weinbaum's sister Helen (later Helen Kasson) and the story is still in European copyright.

The rest of Weinbaum's SF doesn't use the same background as the Planetary series, although there are occasional similarities; for example, rockets in *The Black Flame* resemble the eponymous spaceship of *The Red Peri*. While most of his stories accompany this collection, the remainder were not used as direct source material, but some of the ideas have been used to add extra flavour in what follows.

Pygmalion's Spectacles	June 1935
The Worlds of If	Aug 1935
The Ideal	Sept 1935
The Adaptive Ultimate	Nov 1935
The Point of View	Jan 1936
Proteus Island	Aug 1936
Graph	Sept 1936
The Circle of Zero	Oct 1936
The Brink of Infinity	Dec 1936
Shifting Seas	July 1937
Dawn of Flame	Jan 1939
The Black Flame	June 1939
The New Adam	1939

Several stories and his novel *The Dark Other* are not included because they were co-written with other authors, or were first published less than 70 years ago and remain in European copyright. Most can be found on line via Project Gutenberg or Gutenberg Australia.

bunch of crawlers; I gave it a glance and hauled out my sleeping bag. Up to that time, you know, I hadn't seen anything worth worrying about on this half-dead world—nothing dangerous, that is."

"Did you?" queried Harrison.

"Did I! You'll hear about it when I come to it. Well, I was just about to turn in when suddenly I heard the wildest sort of shenanigans!"

"Vot iss shenanigans?" inquired Putz.

"He says, 'Je ne sais quoi,'" explained Leroy. "It is to say, 'I don't know what.'"

"That's right," agreed Jarvis. "I didn't know what, so I sneaked over to find out. There was a racket like a flock of crows eating a bunch of canaries—whistles, cackles, caws, trills, and what have you. I rounded a clump of stumps, and there was Tweel!"

"Tweel?" said Harrison, and "Tveel?" said Leroy and Putz.

"That freak ostrich," explained the narrator. "At least, Tweel is as near as I can pronounce it without sputtering. He called it something like 'Trrrweerrll!'."

"What was he doing?" asked the Captain.

"He was being eaten! And squealing, of course, as any one would."

"Eaten! By what?"

"I found out later. All I could see then was a bunch of black ropy arms tangled around what looked like, as Putz described it to you, an ostrich. I wasn't going to interfere, naturally; if both creatures were dangerous, I'd have one less to worry about.

"But the bird-like thing was putting up a good battle, dealing vicious blows with an eighteen-inch beak, between screeches. And besides, I caught a glimpse or two of what was on the end of those arms!" Jarvis shuddered. "But the clincher was when I noticed a little black bag or case hung about the neck of the bird-thing! It was intelligent. That or tame, I assumed. Anyway, it clinched my decision. I pulled out my automatic and fired into what I could see of its antagonist.

"There was a flurry of tentacles and a spurt of black corruption, and then the thing, with a disgusting sucking noise, pulled itself and its arms into a hole in the ground. The other let out a series of clacks, staggered around on legs about as thick as golf sticks, and turned suddenly to face me. I held my weapon ready, and the two of us stared at each other.

"The Martian wasn't a bird, really. It wasn't even bird-like, except just at first glance. It had a beak all right, and a few feathery appendages, but the beak wasn't really a beak. It was somewhat flexible; I could see the tip bend slowly from side to side; it was almost like a cross between a beak and a trunk. It

had four-toed feet, and four-fingered things—hands, you'd have to call them, and a little roundish body, and a long neck ending in a tiny head—and that beak. It stood an inch or so taller than I, and—well, Putz saw it!"

The engineer nodded. "Ja! I saw!"

Jarvis continued. "So—we stared at each other. Finally the creature went into a series of clackings and twitterings and held out its hands toward me, empty. I took that as a gesture of friendship."

"Perhaps," suggested Harrison, "it looked at that nose of yours and thought you were its brother!"

"Huh! You can be funny without talking! Anyway, I put up my gun and said 'Aw, don't mention it,' or something of the sort, and the thing came over and we were pals.

"By that time, the sun was pretty low and I knew that I'd better build a fire or get into my thermo-skin. I decided on the fire. I picked a spot at the base of the Thyle cliff where the rock could reflect a little heat on my back. I started breaking off chunks of this desiccated Martian vegetation, and my companion caught the idea and brought in an armful. I reached for a match, but the Martian fished into his pouch and brought out something that looked like a glowing coal; one touch of it, and the fire was blazing—and you all know what a job we have starting a fire in this atmosphere!

"And that bag of his!" continued the narrator. "That was a manufactured article, my friends; press an end and she popped open—press the middle and she sealed so perfectly you couldn't see the line. Better than zippers.

"Well, we stared at the fire for a while and I decided to attempt some sort of communication with the Martian. I pointed at myself and said 'Dick'; he caught the drift immediately, stretched a bony claw at me and repeated 'Tick.' Then I pointed at him, and he gave that whistle I called Tweel; I can't imitate his accent. Things were going smoothly; to emphasize the names, I repeated 'Dick,' and then, pointing at him, 'Tweel.'

"There we stuck! He gave some clacks that sounded negative, and said something like 'P-p-p-root.' And that was just the beginning; I was always 'Tick,' but as for him—part of the time he was 'Tweel,' and part of the time he was 'P-p-p-proot,' and part of the time he was sixteen other noises!

"We just couldn't connect. I tried 'rock,' and I tried 'star,' and 'tree,' and 'fire.' And Lord knows what else, and try as I would, I couldn't get a single word! Nothing was the same for two successive minutes, and if that's a language, I'm an alchemist. Finally I gave it up and called him Tweel, and that seemed to do.

This collection includes all but one of the "Planetary" stories in PDF and HTML format, but brief summaries may be useful. ***These summaries include numerous spoilers for the stories.***

A Martian Odyssey
Valley of Dreams

Two stories chronicling the first flight to Mars by the spaceship *Ares*.

In the first the narrator Jarvis crashes during a reconnaissance flight and rescues the Martian Tweel from a Dream Beast (a hypnotic predator). They explore together, encountering various Martian species including another Dream Beast, a silicon pyramid-builder, and the enigmatic mound-builders, who live in underground hives. They explore one of the mounds and have to fight their way out; during the escape they separate, and Jarvis is rescued by a rescue flight from the Ares.

In the second story, Jarvis and another explorer return to the crash site to recover films from the wreck, and renew their contact with the Martians. They spend several days exploring a Martian city, meet Tweel and more of the enigmatic Martians, and narrowly escape a catastrophic encounter with Dream Beasts.

Flight on Titan

Following a financial crash Tim Vick and his wife Diana travel to Titan to seek flame gems, the most valuable jewels in the solar system, and make their fortunes. A natural catastrophe forces them to flee their trading post and travel across country to the colonial capital. Along the way they lose all but one of the gems, encounter several Martian animals, and eventually discover that flame gems can be grown in Titan's soil.

Some discrepancies in the timing and background of this story are discussed in more detail in the Timeline.

Continued next page

Parasite Planet
The Lotus Eaters

Linked stories set on Venus.

In the first story trader "Ham" Hammond loses his swamp home in a sink-hole, and has to make a cross-country trek to Erotia, the American colony. Along the way he encounters botanist Patricia Burlingame, the first woman born on Venus, who accuses him of poaching in the British territories. Her home is also destroyed, this time by a wandering "dough pot" predator, and she is forced to join him. Their journey takes them across the swampy Hotlands, into the more hospitable Cool Country, then into mountains along the edge of the Night Side. They encounter more predators, and eventually fall in love.

Following their marriage Ham and Patricia explore the Night Side and make first contact with hyper-intelligent telepathic plants, which have no survival instinct and say that they will be extinct within a hundred years. Prolonged exposure to their scent drains the human's will-power; they eventually escape by accident. The subsequent fate of the plants isn't revealed.

The Planet of Doubt

Another Ham and Patricia story, this time set on Uranus, where the second expedition finds a mysterious habitable world shrouded in fog which obstructs sight and limits the usefulness of radio and sound. They discover several plant species and one type of animal, a ferocious creature resembling a "train" of linked giant caterpillars.

Patricia is separated from the other explorers, but is eventually found, trapped in a closed loop of caterpillars, and rescued in time for the explorers to take off before their launch window is lost. Discussing their adventures, they conclude that the caterpillars are the young of a flying species, never seen properly, which are probably the most important inhabitants of Uranus.

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"But Tweel hung on to some of my words. He remembered a couple of them, which I suppose is a great achievement if you're used to a language you have to make up as you go along. But I couldn't get the hang of his talk; either I missed some subtle point or we just didn't think alike—and I rather believe the latter view.

"I've other reasons for believing that. After a while I gave up the language business, and tried mathematics. I scratched two plus two equals four on the ground, and demonstrated it with pebbles. Again Tweel caught the idea, and informed me that three plus three equals six. Once more we seemed to be getting somewhere.

"So, knowing that Tweel had at least a grammar school education, I drew a circle for the sun, pointing first at it, and then at the last glow of the sun. Then I sketched in Mercury, and Venus, and Mother Earth, and Mars, and finally, pointing to Mars, I swept my hand around in a sort of inclusive gesture to indicate that Mars was our current environment. I was working up to putting over the idea that my home was on the earth.

"Tweel understood my diagram all right. He poked his beak at it, and with a great deal of trilling and clucking, he added Deimos and Phobos to Mars, and then sketched in the earth's moon!

"Do you see what that proves? It proves that Tweel's race uses telescopes—that they're civilized!"

"Does not!" snapped Harrison. "The moon is visible from here as a fifth magnitude star. They could see its revolution with the naked eye."

"The moon, yes!" said Jarvis. "You've missed my point. Mercury isn't visible! And Tweel knew of Mercury because he placed the Moon at the third planet, not the second. If he didn't know Mercury, he'd put the earth second, and Mars third, instead of fourth! See?"

"Humph!" said Harrison.

"Anyway," proceeded Jarvis, "I went on with my lesson. Things were going smoothly, and it looked as if I could put the idea over. I pointed at the earth on my diagram, and then at myself, and then, to clinch it, I pointed to myself and then to the earth itself shining bright green almost at the zenith.

"Tweel set up such an excited clacking that I was certain he understood. He jumped up and down, and suddenly he pointed at himself and then at the sky, and then at himself and at the sky again. He pointed at his middle and then at Arcturus, at his head and then at Spica, at his feet and then at half a dozen stars, while I just gaped at him. Then, all of a sudden, he gave a tremendous leap. Man, what a hop! He shot straight up into the starlight, seventy-five feet if an inch! I saw him silhouetted against the sky,

saw him turn and come down at me head first, and land smack on his beak like a javelin! There he stuck square in the center of my sun-circle in the sand—a bull's eye!"

"Nuts!" observed the captain. "Plain nuts!"

"That's what I thought, too! I just stared at him openmouthed while he pulled his head out of the sand and stood up. Then I figured he'd missed my point, and I went through the whole blamed rigmarole again, and it ended the same way, with Tweel on his nose in the middle of my picture!"

"Maybe it's a religious rite," suggested Harrison.

"Maybe," said Jarvis dubiously. "Well, there we were. We could exchange ideas up to a certain point, and then—blooey! Something in us was different, unrelated; I don't doubt that Tweel thought me just as screwy as I thought him. Our minds simply looked at the world from different viewpoints, and perhaps his viewpoint is as true as ours. But—we couldn't get together, that's all. Yet, in spite of all difficulties, I liked Tweel, and I have a queer certainty that he liked me."

"Nuts!" repeated the captain. "Just daffy!"

"Yeah? Wait and see. A couple of times I've thought that perhaps we—" He paused, and then resumed his narrative. "Anyway, I finally gave it up, and got into my thermo-skin to sleep. The fire hadn't kept me any too warm, but that damned sleeping bag did. Got stuffy five minutes after I closed myself in. I opened it a little and bingo! Some eighty-below-zero air hit my nose, and that's when I got this pleasant little frostbite to add to the bump I acquired during the crash of my rocket.

"I don't know what Tweel made of my sleeping. He sat around, but when I woke up, he was gone. I'd just crawled out of my bag, though, when I heard some twittering, and there he came, sailing down from that three-story Thyle cliff to alight on his beak beside me. I pointed to myself and toward the north, and he pointed at himself and toward the south, and when I loaded up and started away, he came along.

"Man, how he travelled! A hundred and fifty feet at a jump, sailing through the air stretched out like a spear, and landing on his beak. He seemed surprised at my plodding, but after a few moments he fell in beside me, only every few minutes he'd go into one of his leaps, and stick his nose into the sand a block ahead of me. Then he'd come shooting back at me; it made me nervous at first to see that beak of his coming at me like a spear, but he always ended in the sand at my side.

"So the two of us plugged along across the Mare Chronium. Same sort of place as this—same crazy plants and same little green biopods growing in the sand, or crawling out of your way. We talked—not that we understood each other, you know, but just for company. I sang songs, and I suspected Tweel did too;

The Red Peri

The pirate ship *Red Peri* intercepts and robs the Interplanetary freighter *Aardkin* as it is approaching Earth, annoying its pilot, Frank Keene. A year later a two-man scientific ship piloted by Keene is forced to make an emergency landing on Pluto, only to discover that it has accidentally landed near the pirate base. Keene and his companion are taken prisoner, and discover that the pirate captain (also known as Red Peri; it isn't clear if Peri is her real name) is an attractive young woman. Pluto is revealed to have dangerous mineral life forms which digest metals, carbon, etc. After saving the pirate captain from a swarm of Carbon Eaters, Keene begins to fall in love with her, but is determined to capture her. He learns that she is following in her father's footsteps, seeking revenge for the theft of patents stolen by Interplanetary, the company that controls most commercial space travel, ship construction, etc.

Keene discovers a way to escape from the base without a space suit, surviving in vacuum for nearly a minute, and recaptures his own ship. He takes Red Peri with him as his prisoner. The pirate ship catches up with them, but Keene uses her as a hostage. She admits that she is afraid of execution, and Keene realises that he wants to force her to give up her career, rather than handing her over to the authorities. Before he tells her she makes a daring escape, leaving Keene en route for Saturn and empty-handed. The story ends with Keene determined to meet her again, and certain that he will do so if he takes a job with Interplanetary and becomes a target for her pitates.[1]

[1] This open ending and similarities between *The Red Peri* and *The Black Flame* (relationships between the main characters, design of spacecraft, etc.) suggest that the latter may have been begun as a sequel to *The Red Peri*, but the final result is very different and not part of the Planetary sequence.

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The Mad Moon

Grant Calthorpe loses his fortune in the crash of 2110 and becomes a trader on Jupiter's moon Io, where the degenerate "Loonies" trade medicinal Farva leaves for chocolate. There is a second native race, the tiny hostile Slinkers. While suffering from fever he encounters another human, the beautiful Lee Neilan, victim of a plane crash, who he believes is a hallucination; she is also ill and makes the same mistake. Later he finds her and rescues her from a slinker attack, but the slinkers then invade Calthorpe's cabin and they are forced to flee to the mountains. There they discover an abandoned city, the last remains of a once-great Loonie civilisation. Calthorpe uses a flame pistol to kill the slinkers, and its blast attracts the attention of a rescue ship. The story ends with Neilan's father offering Calthorpe a better job, and the engagement of Calthorpe and Neilan.

Redemption Cairn

Pilot Jack Sands is blamed for the crash of a returning expedition to Europa; the co-pilot Kratska is actually responsible, but framed Sands then disappeared. Sands is branded a coward and unable to find work. Months later he is hired to pilot another expedition to Europa – his co-pilot is Claire Avery, winner of a prestigious race but actually a poor pilot who won largely through luck.

It emerges that the second expedition is looking for papers left by the captain of the earlier expedition, who discovered how to use protactinium (a radioactive element that is only found in quantity on Europa) to fuel atomic blast engines that will be much more powerful than those in current use. But the expedition's biologist is actually the disguised Kraska; he kidnaps Avery and attacks the others aboard the ship, planning to force Avery to fly him back to Earth with the formula. Sands finds a way to catch up with them and kills Kratska, but is seriously injured; Avery then successfully flies the ship to Io and lands perfectly.

Continued next page

at least, some of his trillings and twitterings had a subtle sort of rhythm.

"Then, for variety, Tweel would display his smattering of English words. He'd point to an outcropping and say 'rock,' and point to a pebble and say it again; or he'd touch my arm and say 'Tick,' and then repeat it. He seemed terrifically amused that the same word meant the same thing twice in succession, or that the same word could apply to two different objects. It set me wondering if perhaps his language wasn't like the primitive speech of some earth people—you know, Captain, like the Negritoes, for instance, who haven't any generic words. No word for food or water or man—words for good food and bad food, or rainwater and seawater, or strong man and weak man—but no names for general classes. They're too primitive to understand that rain water and sea water are just different aspects of the same thing. But that wasn't the case with Tweel; it was just that we were somehow mysteriously different—our minds were alien to each other. And yet—we liked each other!"

"Looney, that's all," remarked Harrison. "That's why you two were so fond of each other."

"Well, I like you!" countered Jarvis wickedly. "Anyway," he resumed, "don't get the idea that there was anything screwy about Tweel. In fact, I'm not so sure but that he couldn't teach our highly praised human intelligence a trick or two. Oh, he wasn't an intellectual superman, I guess; but don't overlook the point that he managed to understand a little of my mental workings, and I never even got a glimmering of his."

"Because he didn't have any!" suggested the captain, while Putz and Leroy blinked attentively.

"You can judge of that when I'm through," said Jarvis. "Well, we plugged along across the Mare Chronium all that day, and all the next. Mare Chronium—Sea of Time! Say, I was willing to agree with Schiaparelli's name by the end of that march! Just that gray, endless plain of weird plants, and never a sign of any other life. It was so monotonous that I was even glad to see the desert of Xanthus toward the evening of the second day.

"I was fair worn out, but Tweel seemed as fresh as ever, for all I never saw him drink or eat. I think he could have crossed the Mare Chronium in a couple of hours with those block-long nose dives of his, but he stuck along with me. I offered him some water once or twice; he took the cup from me and sucked the liquid into his beak, and then carefully squirted it all back into the cup and gravely returned it.

"Just as we sighted Xanthus, or the cliffs that bounded it, one of those nasty sand clouds blew along, not as bad as the one we had here, but mean to travel against. I pulled the transparent flap of my thermo-skin bag across my face and managed pretty well, and I noticed that Tweel used some feathery appendages growing like a mustache at the base of his beak to cover his nostrils, and some similar fuzz to shield his eyes."

"He is a desert creature!" ejaculated the little biologist, Leroy.

"Huh? Why?"

"He drink no water—he is adapt' for sand storm—"

"Proves nothing! There's not enough water to waste anywhere on this desiccated pill called Mars. We'd call all of it desert on earth, you know." He paused. "Anyway, after the sand storm blew over, a little wind kept blowing in our faces, not strong enough to stir the sand. But suddenly things came drifting along from the Xanthus cliffs—small, transparent spheres, for all the world like glass tennis balls! But light—they were almost light enough to float even in this thin air—empty, too; at least, I cracked open a couple and nothing came out but a bad smell. I asked Tweel about them, but all he said was 'No, no, no,' which I took to mean that he knew nothing about them. So they went bouncing by like tumbleweeds, or like soap bubbles, and we plugged on toward Xanthus. Tweel pointed at one of the crystal balls once and said 'rock,' but I was too tired to argue with him. Later I discovered what he meant.

"We came to the bottom of the Xanthus cliffs finally, when there wasn't much daylight left. I decided to sleep on the plateau if possible; anything dangerous, I reasoned, would be more likely to prowl through the vegetation of the Mare Chronium than the sand of Xanthus. Not that I'd seen a single sign of menace, except the rope-armed black thing that had trapped Tweel, and apparently that didn't prowl at all, but lured its victims within reach. It couldn't lure me while I slept, especially as Tweel didn't seem to sleep at all, but simply sat patiently around all night. I wondered how the creature had managed to trap Tweel, but there wasn't any way of asking him. I found that out too, later; it's devilish!

"However, we were ambling around the base of the Xanthus barrier looking for an easy spot to climb. At least, I was. Tweel could have leaped it easily, for the cliffs were lower than Thyle—perhaps sixty feet. I found a place and started up, swearing at the water tank strapped to my back—it didn't bother me except when climbing—and suddenly I heard a sound that I thought I recognized!

"You know how deceptive sounds are in this thin air. A shot sounds like the pop of a cork. But this sound was the drone of a

Tidal Moon

The final story of the sequence was completed by Helen Weinbaum from two pages of notes after her brother's death. Since this story's copyright has not expired in Europe it could not be included on the Forgotten Futures site or the distribution disk. It can be found on line via Project Gutenberg Australia where its copyright has ended.

Ganymede's main export is Cree moss, which can be processed to make the valuable drug Crephine. Ben Amherst collects it for Cree Inc., following a route around the moon to settlements where the natives grow the moss (which is initially red in Ganymede's ammoniated atmosphere) and age it underground to the blue form the company needs. On one of his trips he is accompanied by Kirt Scaler, allegedly from Earth, who claims to be a tourist and plans to stay at the village of Aquia, where one of the company's traders is working on a process to turn the moss blue artificially. During several encounters with the native wildlife Amherst begins to suspect that Scaler knows much more than about Ganymede than he pretends.

At Aquia Amherst discovers that the trader, Carl Kent, has died in one of the tidal floods that sweep the planet, leaving his daughter Carol to carry on in his place. Scaler begins to woo Carol while the domed colony is underwater, and Amherst becomes increasingly jealous as he realises that he loves her.

Eventually it becomes apparent that Scaler is after the secret of Kent's process; Cree has been found growing on Io, but doesn't turn blue there. Ionian Products will make a fortune and glut the market if they can use Kent's process.

Scaler escapes with the formula, but it turns out to be useless; the process needs Ganymedan Gall-ant eggs, and the ants can't live or breed in Io's atmosphere, which has traces of methane, not ammonia.

Timeline

Note: Dates in bold come from the stories. Dates in italics are estimates. Some inconsistencies are discussed in the notes.

Circa 13000 BC

Martian civilization is at its height. A Martian expedition visits Earth, and the pre-Dynastic Egyptian culture treats the explorers as gods. One is remembered as Thoth.

Early 20th Century

Experiments with chemical rocketry and nuclear power.

1993

Atomic blast perfected by Doheny.

2000

Cardoza expedition to the Moon.

2007

de Lancey expedition to Venus fails catastrophically early in flight.

2010 onwards

Ares expedition reaches Mars; later expeditions to Mars and Venus.

A Martian Odyssey, Valley of Dreams

2020

International Congress at Lisle apportions the surface of Venus to the nations that will eventually colonise it. Despite this, colonisation is very slow until the properties of Xixtchil are discovered.

2040s-50s

Moons of Jupiter and Saturn explored and colonized.

2053

First Pluto expedition

2059

Council of Berne decides that explorers cannot claim entire planets or moons, but only the areas actually explored.

2060

First expedition to Uranus.

2071

First *Red Peri* attacks.

2076

Pacific War. Patricia Burlingame born (first child of Venus colonists).

2083

Tidal Moon

Continued next page

rocket, and sure enough, there went our second auxiliary about ten miles to westward, between me and the sunset!"

"Vas me!" said Putz. "I hunt for you."

"Yeah; I knew that, but what good did it do me? I hung on to the cliff and yelled and waved with one hand. Tweel saw it too, and set up a trilling and twittering, leaping to the top of the barrier and then high into the air. And while I watched, the machine droned on into the shadows to the south.

"I scrambled to the top of the cliff. Tweel was still pointing and trilling excitedly, shooting up toward the sky and coming down head-on to stick upside down on his back in the sand. I pointed toward the south, and at myself, and he said, 'Yes—Yes—Yes'; but somehow I gathered that he thought the flying thing was a relative of mine, probably a parent. Perhaps I did his intellect an injustice; I think now that I did.

"I was bitterly disappointed by the failure to attract attention. I pulled out my thermo-skin and crawled into it, as the night chill was already apparent. Tweel stuck his beak into the sand and drew up his legs and arms and looked for all the world like one of those leafless shrubs out there. I think he stayed that way all night."

"Protective mimicry!" ejaculated Leroy. "See? He is desert creature!"

"In the morning," resumed Jarvis, "we started off again. We hadn't gone a hundred yards into Xanthus when I saw something queer! This is one thing Putz didn't photograph, I'll wager!

"There was a line of little pyramids—tiny ones, not more than six inches high, stretching across Xanthus as far as I could see! Little buildings made of pygmy bricks, they were, hollow inside and truncated, or at least broken at the top and empty. I pointed at them and said 'What?' to Tweel, but he gave some negative twitters to indicate, I suppose, that he didn't know. So off we went, following the row of pyramids because they ran north, and I was going north.

"Man, we trailed that line for hours! After a while, I noticed another queer thing: they were getting larger. Same number of bricks in each one, but the bricks were larger.

"By noon they were shoulder high. I looked into a couple—all just the same, broken at the top and empty. I examined a brick or two as well; they were silica, and old as creation itself!"

"How do you know?" asked Leroy.

"They were weathered—edges rounded. Silica doesn't weather easily even on earth, and in this climate—!"

"How old you think?"

"Fifty thousand—a hundred thousand years. How can I tell? The little ones we saw in the morning were older—perhaps ten times as old. Crumbling. How old would that make them? Half a

million years? Who knows?" Jarvis paused a moment. "Well," he resumed, "we followed the line. Tweel pointed at them and said 'rock' once or twice, but he'd done that many times before. Besides, he was more or less right about these.

"I tried questioning him. I pointed at a pyramid and asked 'People?' and indicated the two of us. He set up a negative sort of clucking and said, 'No, no, no. No one—one—two. No two—two—four,' meanwhile rubbing his stomach. I just stared at him and he went through the business again. 'No one—one—two. No two—two—four.' I just gaped at him."

"That proves it!" exclaimed Harrison. "Nuts!"

"You think so?" queried Jarvis sardonically. "Well, I figured it out different! 'No one—one—two!' You don't get it, of course, do you?"

"Nope—nor do you!"

"I think I do! Tweel was using the few English words he knew to put over a very complex idea. What, let me ask, does mathematics make you think of?"

"Why—of astronomy. Or—or logic!"

"That's it! 'No one—one—two!' Tweel was telling me that the builders of the pyramids weren't people—or that they weren't intelligent, that they weren't reasoning creatures! Get it?"

"Huh! I'll be damned!"

"You probably will."

"Why," put in Leroy, "he rub his belly?"

"Why? Because, my dear biologist, that's where his brains are! Not in his tiny head—in his middle!"

"C'est impossible!"

"Not on Mars, it isn't! This flora and fauna aren't earthly; your biopods prove that!" Jarvis grinned and took up his narrative. "Anyway, we plugged along across Xanthus and in about the middle of the afternoon, something else queer happened. The pyramids ended."

"Ended!"

"Yeah; the queer part was that the last one—and now they were ten-footers—was capped! See? Whatever built it was still inside; we'd trailed 'em from their half-million-year-old origin to the present.

"Tweel and I noticed it about the same time. I yanked out my automatic (I had a clip of Boland explosive bullets in it) and Tweel, quick as a sleight-of-hand trick, snapped a queer little glass revolver out of his bag. It was much like our weapons, except that the grip was larger to accommodate his four-taloned hand. And we held our weapons ready while we sneaked up along the lines of empty pyramids.

Timeline *(continued)*

2086
The Red Peri

2098-9
Parasite Planet, The Lotus Eaters

2100
Second expedition to Uranus.
Planet of Doubt

2110
False expectations of a gold strike on Venus cause the failure of the Planetary Trading Corporation and a stock market crash. The Gunderson expedition to Europa crash-lands on its return to Earth.

2111-12
Redemption Cairn

2112
Flight on Titan (or 2145, see below)
The Mad Moon

Notes

The dates for the atomic blast and Moon landing are based on the chronology mentioned in *A Martian Odyssey*.

A Martian Odyssey states that Venus has not yet been colonized, but *Parasite Planet* dates the partition of Venus at 2020, and *The Red Peri* states that Venus has been colonised for more than 50 years. This suggests that Venus was colonised between the date of the first Mars landing and 2020. Assuming roughly a decade of colonization puts the *Ares* expedition at circa 2010.

Despite this early start colonisation of Venus seems to have been slow, since the first child of colonists wasn't born until the 2070s. A likely explanation is repeated setbacks from disease and the appalling climate, and no obvious exports or benefits from a permanent settlement at first. Things only took off when the medical properties of Xixtchil were discovered in the 2060s. Exploitation of the outer planets was evidently much faster, since there is a thriving colony on Ganymede in 2083 (*Tidal Moon*).

Continued next page

The medical properties of Kree moss must have been discovered early, giving a powerful incentive for exploitation. However, it should be remembered that *Tidal Moon* is the least canonical of these stories, since it was largely written after Stanley Weinbaum's death.

Flight on Titan gives later dates for the lunar landing and gold crisis, states that Martian civilization is dead, names a different pilot for the moon landing, and describes the discovery of an archaeological site mentioned in *The Lotus Eaters*, which is set earlier. For simplicity these variations have been ignored.

Wikipedia dates *The Red Peri* at 2083, 150 years after the first flight over Mount Everest (the anniversary is mentioned), but this may be an approximation, not an exact figure; the story is set *after* a conjunction of Saturn and Pluto, and there was a prior landing on Pluto which must have occurred at a previous conjunction. Conjunctions occur in 2053, 2085 and 2118; assuming a first landing in 2053, a date circa 2086 seems most likely. However, there are numerous discrepancies in the handling of conjunctions in these stories, and readers should go with whichever date seems most appropriate for their needs.

The "now" of adventures etc. is circa 2115 AD, a few years after the events of the stories (if the discrepancies in *Flight on Titan* are ignored); this allows many canon characters to appear in adventures. For example, in 2115:

"Red Peri" Maclane is about 48[1]
"Ham" Hammond is about 44[2]
Patricia Hammond is about 39[2]
Grant Calthorpe is about 27[3]
Lee Neilan is about 22[3]
Jack Sands is about 30[4]
Claire Avery is about 27[4]

[1] *The Red Peri*
[2] *Parasite Planet, The Lotus Eaters*
[3] *The Mad Moon*
[4] *Redemption Cairn*

"Tweel saw the movement first. The top tiers of bricks were heaving, shaking, and suddenly slid down the sides with a thin crash. And then—something—something was coming out!

"A long, silvery-gray arm appeared, dragging after it an armoured body. Armored, I mean, with scales, silver-gray and dull-shining. The arm heaved the body out of the hole; the beast crashed to the sand.

"It was a nondescript creature—body like a big gray cask, arm and a sort of mouth-hole at one end; stiff, pointed tail at the other—and that's all. No other limbs, no eyes, ears, nose—nothing! The thing dragged itself a few yards, inserted its pointed tail in the sand, pushed itself upright, and just sat.

"Tweel and I watched it for ten minutes before it moved. Then, with a creaking and rustling like—oh, like crumpling stiff paper—its arm moved to the mouth-hole and out came a brick! The arm placed the brick carefully on the ground, and the thing was still again.

"Another ten minutes—another brick. Just one of Nature's bricklayers. I was about to slip away and move on when Tweel pointed at the thing and said 'rock'! I went 'huh?' and he said it again. Then, to the accompaniment of some of his trilling, he said, 'No—no—' and gave two or three whistling breaths.

"Well, I got his meaning, for a wonder! I said, 'No breathe!' and demonstrated the word. Tweel was ecstatic; he said, 'Yes, yes, yes! No, no, no breet!' Then he gave a leap and sailed out to land on his nose about one pace from the monster!

"I was startled, you can imagine! The arm was going up for a brick, and I expected to see Tweel caught and mangled, but—nothing happened! Tweel pounded on the creature, and the arm took the brick and placed it neatly beside the first. Tweel rapped on its body again, and said 'rock,' and I got up nerve enough to take a look myself.

"Tweel was right again. The creature was rock, and it didn't breathe!"

"How you know?" snapped Leroy, his black eyes blazing interest.

"Because I'm a chemist. The beast was made of silica! There must have been pure silicon in the sand, and it lived on that. Get it? We, and Tweel, and those plants out there, and even the biopods are carbon life; this thing lived by a different set of chemical reactions. It was silicon life!"

"La vie silicieuse!" shouted Leroy. "I have suspect, and now it is proof! I must go see! Il faut que je—"

"All right! All right!" said Jarvis. "You can go see. Anyhow, there the thing was, alive and yet not alive, moving every ten minutes, and then only to remove a brick. Those bricks were its waste matter. See, Frenchy? We're carbon, and our waste is

carbon dioxide, and this thing is silicon and its waste is silicon dioxide—silica. But silica is a solid, hence the bricks. And it builds itself in, and when it is covered, it moves over to a fresh place to start over. No wonder it creaked! A living creature a half a million years old!"

"How you know how old?" Leroy was frantic.

"We trailed its pyramids from the beginning, didn't we? If this weren't the original pyramid builder, the series would have ended somewhere before we found him, wouldn't it?—ended and started over with the small ones. That's simple enough, isn't it?

"But he reproduces, or tries to. Before the third brick came out, there was a little rustle and out popped a whole stream of those little crystal balls. They're his spores, or seeds—call 'em what you want. They went bouncing by across Xanthus just as they'd bounced by us back in the Mare Chronium. I've a hunch how they work, too—this is for your information, Leroy. I think the crystal shell of silica is no more than protective covering, like an eggshell, and that the active principle is the smell inside. It's some sort of gas that attacks silicon, and if the shell is broken near a supply of that element, some reaction starts that ultimately develops into a beast like that one."

"You should try!" exclaimed the little Frenchman. "We must break one to see!"

"Yeah? Well, I did. I smashed a couple against the sand. Would you like to come back in about ten thousand years to see if I planted some pyramid monsters? You'd most likely be able to tell by that time!" Jarvis paused and drew a deep breath. "Lord! That queer creature Do you picture it? Blind, deaf, nerveless, brainless—just a mechanism, and yet—immortal! Bound to go on making bricks, building pyramids, as long as silicon and oxygen exist, and even afterwards it'll just stop. It won't be dead. If the accidents of a million years bring it its food again, there it'll be, ready to run again, while brains and civilizations are part of the past. A queer beast—yet I met a stranger one!"

"If you did, it must have been in your dreams!" growled Harrison.

"You're right!" said Jarvis soberly. "In a way, you're right. The dream-beast! That's the best name for it—and it's the most fiendish, terrifying creation one could imagine! More dangerous than a lion, more insidious than a snake!"

"Tell me!" begged Leroy. "I must go see!"

"Not this devil!" He paused again. "Well," he resumed, "Tweel and I left the pyramid creature and plowed along through Xanthus. I was tired and a little disheartened by Putz's failure to pick me up, and Tweel's trilling got on my nerves, as did his flying nosedives. So I just strode along without a word, hour after hour across that monotonous desert.

(Slightly) Weird Science

These stories were written in the 1930s, when the nebular hypothesis, the idea that the sun and planets formed by gradual accretion of gas and dust particles, had temporarily fallen out of favour. The universe was believed to be too young for planets to have formed that way. Solar systems were considered rare, unlikely to form without outside influences.

The theory then in vogue, used by many SF authors of the period, was the near collision hypothesis. It assumed a catastrophic origin for planets, in which another star passed close to the Sun, tidal forces deforming the Sun's atmosphere so much that streams of gas escaped its gravity, condensed as dense clouds of matter and eventually formed the planets. This took a few thousand years rather than the billion or so predicted by early versions of the nebular hypothesis.

While the main consequence of this process is rapid planet formation, a side effect is a more even distribution of elements through the Solar System than predicted by the nebular hypothesis; each of the separate clouds contained a mix of elements, so the outer worlds contain more metal and heavy elements than in the nebular hypothesis.

As a result of the speed of this process, gas giants still radiate internal heat, warming their moons sufficiently for them to be more or less habitable, and there are radioactive materials and other metals on their moons. Gravity of most moons is comparatively high due to the presence of heavy metals.

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Conditions on the worlds and moons described conform to the leading astronomical theories of the time; in particular:

- Mercury was believed to be tidally locked to the Sun; although no stories are set there this is assumed to be the case for game purposes.
- Weinbaum states that Venus is also locked to the Sun, with mountains high enough to be visible above its eternal cloud cover; this theory, based on faulty observations, received publicity at the time.
- Mars was, of course, famous for the "canals" that Lowell and others believed that they'd seen there.
- As already noted, the gas giants were believed to retain a good deal of internal heat, enough to warm their moons to habitable temperatures. Their nature wasn't entirely clear, and it was thought there might be an accessible solid surfaces.
- Finally, Pluto was initially thought to be a comparatively large dense world, whose gravity was strong enough to have perturbed the orbit of Neptune.

Nuclear processes work differently in this setting. Radioactive rays cause the atomic nucleus to break down, releasing huge amounts of energy. The more powerful the radioactive source, the heavier the elements it can break down[1]. This is a controllable process, making atomic rocket engines possible. Their exhaust is hot and immensely destructive, but doesn't appear to be dangerously radioactive.

Atomic bombs use a more destructive reaction which breaks down the radioactive material itself.

Nuclear materials are surprisingly stable. For example, commercially viable deposits of protactinium exist naturally on Europa; in our universe most of its isotopes are extremely unstable and it is only found in traces, a decay product of uranium.

[1] *Redemption Cairn*

"Toward mid-afternoon we came in sight of a low dark line on the horizon. I knew what it was. It was a canal; I'd crossed it in the rocket and it meant that we were just one-third of the way across Xanthus. Pleasant thought, wasn't it? And still, I was keeping up to schedule.

"We approached the canal slowly; I remembered that this one was bordered by a wide fringe of vegetation and that Mudheap City was on it.

"I was tired, as I said. I kept thinking of a good hot meal, and then from that I jumped to reflections of how nice and home-like even Borneo would seem after this crazy planet, and from that, to thoughts of little old New York, and then to thinking about a girl I know there, Fancy Long. Know her?"

"Vision entertainer," said Harrison. "I've tuned her in. Nice blonde—dances and sings on the Yerba Mate hour."

"That's her," said Jarvis ungrammatically. "I know her pretty well—just friends, get me?—though she came down to see us off in the *Ares*. Well, I was thinking about her, feeling pretty lonesome, and all the time we were approaching that line of rubbery plants.

"And then—I said, 'What 'n Hell!' and stared. And there she was—Fancy Long, standing plain as day under one of those crack-brained trees, and smiling and waving just the way I remembered her when we left!"

"Now you're nuts, too!" observed the captain.

"Boy, I almost agreed with you! I stared and pinched myself and closed my eyes and then stared again—and every time, there was Fancy Long smiling and waving! Tweel saw something, too; he was trilling and clucking away, but I scarcely heard him. I was bounding toward her over the sand, too amazed even to ask myself questions.

"I wasn't twenty feet from her when Tweel caught me with one of his flying leaps. He grabbed my arm, yelling, 'No—no—no!' in his squeaky voice. I tried to shake him off—he was as light as if he were built of bamboo—but he dug his claws in and yelled. And finally some sort of sanity returned to me and I stopped less than ten feet from her. There she stood, looking as solid as Putz's head!"

"Vot?" said the engineer.

"She smiled and waved, and waved and smiled, and I stood there dumb as Leroy, while Tweel squeaked and chattered. I knew it couldn't be real, yet—there she was!

"Finally I said, 'Fancy! Fancy Long!' She just kept on smiling and waving, but looking as real as if I hadn't left her thirty-seven million miles away.

"Tweel had his glass pistol out, pointing it at her. I grabbed his arm, but he tried to push me away. He pointed at her and

said, 'No breet! No breet!' and I understood that he meant that the Fancy Long thing wasn't alive.

"Man, my head was whirling!

"Still, it gave me the jitters to see him pointing his weapon at her. I don't know why I stood there watching him take careful aim, but I did. Then he squeezed the handle of his weapon; there was a little puff of steam, and Fancy Long was gone! And in her place was one of those writhing, black rope-armed horrors like the one I'd saved Tweel from!

"The dream-beast! I stood there dizzy, watching it die while Tweel trilled and whistled. Finally he touched my arm, pointed at the twisting thing, and said, 'You one—one—two, he one—one—two.' After he'd repeated it eight or ten times, I got it. Do any of you?"

"Oui," shrilled Leroy. "Moi—je le comprends! He mean you think of something, the beast he know, and you see it! Un chien—a hungry dog, he would see the big bone with meat! Or smell it—not?"

"Right!" said Jarvis. "The dream-beast uses its victim's longings and desires to trap its prey. The bird at nesting season would see its mate, the fox, prowling for its own prey, would see a helpless rabbit!"

"How he do?" queried Leroy.

"How do I know? How does a snake back on earth charm a bird into its very jaws? And aren't there deep-sea fish that lure their victims into their mouths? Lord!" Jarvis shuddered. "Do you see how insidious the monster is? We're warned now—but henceforth we can't trust even our eyes. You might see me—I might see one of you—and back of it may be nothing but another of those black horrors!"

"How'd your friend know?" asked the captain abruptly.

"Tweel? I wonder! Perhaps he was thinking of something that couldn't possibly have interested me, and when I started to run, he realized that I saw something different and was warned. Or perhaps the dream-beast can only project a single vision, and Tweel saw what I saw—or nothing. I couldn't ask him. But it's just another proof that his intelligence is equal to ours or greater."

"He's daffy, I tell you!" said Harrison. "What makes you think his intellect ranks with the human?"

"Plenty of things! First the pyramid-beast. He hadn't seen one before; he said as much. Yet he recognized it as a dead-alive automaton of silicon."

"He could have heard of it," objected Harrison. "He lives around here, you know."

"Well how about the language? I couldn't pick up a single idea of his and he learned six or seven words of mine. And do you realize what complex ideas he put over with no more than those six

Interplanetary Trade

Space travel is extremely expensive, and every pound carried must earn the maximum possible profit. Gold is barely worth carrying – it's expensive to ship because of its weight, and so tempting a target for piracy and theft that insurance accounts for up to fifty percent of profits[1]. One of the many mysteries of the 2110 market crash is why there was expected to be a useful profit in gold from such an uncertain source as Venus[2]. More money can be made from gems, pharmaceuticals and other biochemical material, and useful radioactive ores. There is also a market in Martian antiques and examples of native craftsmanship such as Venusian silver[1].

Value isn't guaranteed to remain stable; for example, the first Titan Flame-Orchid gem sold for half a million dollars[2]. The next six made their finder rich, but already prices were starting to fall, and the trend is likely to continue as more gems are imported. Sooner or later it will be learned that the colonists have found out how to split the gems and culture them; within weeks of the news getting out prices are likely to plummet to a point where they are barely worth shipping. If anyone ever finds a way to duplicate the process on Earth it's likely that they will lose their remaining value, and will be treated as little more than costume jewellery.

Similar trends must affect the prices of imported biochemicals. Venusian Xixtchil is a scarce product in high demand[3], and the traders who gather it risk their lives. Its price is a reflection of these factors. But dozens of pharmaceutical companies must be working on ways to grow the plant on Earth or duplicate the active ingredients synthetically. Eventually someone will succeed, and the price of Xitchil will inevitably fall considerably.

[1] *The Red Peri* [2] *Flight on Titan*
[3] *Parasite Planet*

Technology

While space travel is the definitive technology for this setting, it doesn't exist in isolation. Nuclear power is often mentioned, and many other devices are described in the stories. Some things that we might expect in such a setting are conspicuously absent; they may or may not exist on Earth, they certainly don't seem to have found their way into space.

Definitely Exist: Atomic blasts, atomic bombs, atomic power plants, space travel, vacuum suits, radio (equipment heavy, sometimes omitted from ships to save weight), colour television[1], explosive bullets, heat rays, biotechnology (drugs derived from alien plants and animals), infra-red photography, robots[2], radar[3]

Possibly Exist: Virtual reality[4], flying cars, a perfected radiation treatment for cancer, valve and relay computers.

Unlikely to Exist: Transistors & integrated circuits, spaceship autpilots, digital cameras and small portable video cameras[5], communications satellites (and other unmanned satellites), space stations and other permanent space settlements other than colonies on planets and moons, orbital towers, genetic engineering, lasers.

[1] Possibly only available on Earth.

[2] An 'autobus' with 'robot driver' appears in *Tidal Moon*, but no other robots are described. This is probably an automatic control system, not an android.

[3] The 'Electric Plumb' in *Planet of Doubt* appears to be a radar altimeter, and ships have meteor warning devices, but there is no early warning of an approaching ship in *The Red Peri*, and radar landing aids are not used. Accuracy and range may be limited.

[4] Weinbaum describes VR systems based on film, drugs, and other technologies in two stories outside this sequence, *Pygmalion's Spectacles* and *The Ideal*. It seems plausible that they also exist in the universe of the 'Planetary' sequence.

[5] Photographic plates and film are still used aboard expeditionary ships despite the weight and inconvenience of carrying processing equipment and chemicals.

or seven words? The pyramid monster—the dream-beast! In a single phrase he told me that one was a harmless automaton and the other a deadly hypnotist. What about that?"

"Huh!" said the captain.

"Huh if you wish! Could you have done it knowing only six words of English? Could you go even further, as Tweel did, and tell me that another creature was of a sort of intelligence so different from ours that understanding was impossible—even more impossible than that between Tweel and me?"

"Eh? What was that?"

"Later. The point I'm making is that Tweel and his race are worthy of our friendship. Somewhere on Mars—and you'll find I'm right—is a civilization and culture equal to ours, and maybe more than equal. And communication is possible between them and us; Tweel proves that. It may take years of patient trial, for their minds are alien, but less alien than the next minds we encountered—if they are minds."

"The next ones? What next ones?"

"The people of the mud cities along the canals." Jarvis frowned, then resumed his narrative. "I thought the dream-beast and the silicon-monster were the strangest beings conceivable, but I was wrong. These creatures are still more alien, less understandable than either and far less comprehensible than Tweel, with whom friendship is possible, and even, by patience and concentration, the exchange of ideas.

"Well," he continued, "we left the dream-beast dying, dragging itself back into its hole, and we moved toward the canal. There was a carpet of that queer walking-grass scampering out of our way, and when we reached the bank, there was a yellow trickle of water flowing. The mound city I'd noticed from the rocket was a mile or so to the right and I was curious enough to want to take a look at it.

"It had seemed deserted from my previous glimpse of its and if any creatures were lurking in it—well, Tweel and I were both armed. And by the way, that crystal weapon of Tweel's was an interesting device; I took a look at it after the dream-beast episode. It fired a little glass splinter, poisoned, I suppose, and I guess it held at least a hundred of 'em to a load. The propellant was steam—just plain steam!"

"Shteam!" echoed Putz. "From vot come, shteam?"

"From water, of course! You could see the water through the transparent handle and about a gill of another liquid, thick and yellowish. When Tweel squeezed the handle—there was no trigger—a drop of water and a drop of the yellow stuff squirted into the firing chamber, and the water vaporized—pop!—like that. It's not so difficult; I think we could develop the same principle. Concentrated □ravelled acid will heat water almost to

boiling, and so will quicklime, and there's potassium and sodium—

"Of course, his weapon hadn't the range of mine, but it wasn't so bad in this thin air, and it did hold as many shots as a cowboy's gun in a Western movie. It was effective, too, at least against Martian life; I tried it out, aiming at one of the crazy plants, and darned if the plant didn't wither up and fall apart! That's why I think the glass splinters were poisoned.

"Anyway, we trudged along toward the mud-heap city and I began to wonder whether the city builders dug the canals. I pointed to the city and then at the canal, and Tweel said 'No—no—no!' and gestured toward the south. I took it to mean that some other race had created the canal system, perhaps Tweel's people. I don't know; maybe there's still another intelligent race on the planet, or a dozen others. Mars is a queer little world.

"A hundred yards from the city we crossed a sort of road—just a hard-packed mud trail, and then, all of a sudden, along came one of the mound builders!

"Man, talk about fantastic beings! It looked rather like a barrel trotting along on four legs with four other arms or tentacles. It had no head, just body and members and a row of eyes completely around it. The top end of the barrel-body was a diaphragm stretched as tight as a drumhead, and that was all. It was pushing a little coppery cart and tore right past us like the proverbial bat out of Hell. It didn't even notice us, although I thought the eyes on my side shifted a little as it passed.

"A moment later another came along, pushing another empty cart. Same thing—it just scooted past us. Well, I wasn't going to be ignored by a bunch of barrels playing train, so when the third one approached, I planted myself in the way—ready to jump, of course, if the thing didn't stop.

"But it did. It stopped and set up a sort of drumming from the diaphragm on top. And I held out both hands and said, 'We are friends!' And what do you suppose the thing did?"

"Said, 'Pleased to meet you,' I'll bet!" suggested Harrison.

"I couldn't have been more surprised if it had! It drummed on its diaphragm, and then suddenly boomed out, 'We are v-r-r-riends' and gave its pushcart a vicious poke at me! I jumped aside, and away it went while I stared dumbly after it.

"A minute later another one came hurrying along. This one didn't pause, but simply drummed out, 'We are v-r-r-riends!' and scurried by. How did it learn the phrase? Were all of the creatures in some sort of communication with each other? Were they all parts of some central organism? I don't know, though I think Tweel does.

"Anyway, the creatures went sailing past us, every one greeting us with the same statement. It got to be funny; I never thought to find so many friends on this God-forsaken ball! Finally I made a

Glossary

Apogee Race: *See Curry Cup*

Atomic Blast: Atomic rocket engine; the main engine(s) of a spaceship, also called **Afterjets**.

AU: Astronomical Unit, the average distance from the Earth to the Sun.

Auxilliary Rocket: Small craft carried by exploratory ships such as the *Ares*, to avoid the dangers of moving the ship repeatedly. As atomic blasts improve they have become uncommon.

Barrier: Range of high glaciers around the rim of the night side of Venus.

Biopod: Martian organisms which combine some of the characteristics of Terran plants and animals.

Bladder Bird: Balloon-like animal found on Europa.

Blancha: AKA "White Fever," a disease that affects visitors to Io.

Blanket Bat: Four-winged Ganymedan flying predator which envelops its prey then drains electrical energy from the victim's nervous system.

Blaster: Small atomic bomb.

Boland Bullet: Explosive bullet.

Conjunction: This term has several meanings in astronomy; for the purposes of this book it is when two planets are on the same side of the sun and closest to each other. See later sections.

Crawler Crystals: Pluto's living minerals, named for the minerals they eat, e.g. carbon feeders, sulphur feeders.

Cree: Medicinal moss of Ganymede.

Cree Inc.: Ganymedan company which exports and processes Cree.

Crephine: Drug derived from Cree.

Curry Cup: An annual rocket race from Earth, around the Moon, and back to Earth. Won in 2111 by Claire Avery, AKA "The Golden Flash."

Dough-Pot: Venusian mobile fungus; a deadly amorphous predator which eats anything organic it encounters.

Electric Plumb: Radio echo finder; used to measure a ship's altitude.

Erotia: American settlement on Venus.

Continued next page

Ferva Leaf: Plant found on Io which produces a range of medically useful alkaloid drugs.

Ferverin: Drug from Ferva leaves used to combat the effects of Blancha.

Flame-Orchid: Thermoluminescent egg-shaped gems found on Titan; they glow in colours that vary with temperature and are worth hundreds of thousands of dollars.

Flame-Pistol: Guns which convert the bond energy of industrial diamonds into blasts of lightning-like energy and flame a hundred yards long. They are clumsy and slow to load, and the barrels frequently burn out.

Fluorolux bulb: Low energy fluorescent light bulb.

Floor Magnets: Magnetized floors in spaceships, used to create the illusion of gravity. The occupants wear shoes containing steel plates.

Gamma Rorqual: Spear-tipped aquatic predator of Ganymede.

Greater Eternities: 50-mile high mountain range separating the British and American territories on Venus.

Herapolis: City on Io.

Hex, Hexylamine: A synthetic narcotic. The name is misleading; pure hexylamine is actually highly toxic, the drug is a hexylamine derivative.

Hipp: *Hippocampus Catamiti*. The "Sea-horse" of Ganymede, tamed and used as a riding animal by the natives and by human colonists.

Hydropole: South polar city of Ganymede; the only part of the planet that isn't affected by tidal floods raised by Jupiter's gravity.

Ice-Ant: Small three-legged animals of Titan which melt and live in bubbles in the ice. They are semi-intelligent and make use of primitive tools.

Interplanetary: The main space travel consortium, accused of patent theft by the so-called Red Peri.

Ionian Products: Io's main export company.

Junopolis: Colonial capital of Io.

Continued next page

puzzled gesture to Tweel; I guess he understood, for he said, 'One-one-two—yes!—Two-two-four—no!' Get it?"

"Sure," said Harrison. "It's a Martian nursery rhyme."

"Yeah! Well, I was getting used to Tweel's symbolism, and I figured it out this way. 'One-one-two—yes!' The creatures were intelligent. 'Two-two-four—no!' Their intelligence was not of our order, but something different and beyond the logic of two and two is four. Maybe I missed his meaning. Perhaps he meant that their minds were of low degree, able to figure out the simple things—'One-one-two—yes!—but not more difficult things—Two-two-four—no!' But I think from what we saw later that he meant the other.

"After a few moments, the creatures came rushing back—first one, then another. Their pushcarts were full of stones, sand, chunks of rubbery plants, and such rubbish as that. They droned out their friendly greeting, which didn't really sound so friendly, and dashed on. The third one I assumed to be my first acquaintance and I decided to have another chat with him. I stepped into his path again and waited.

"Up he came, booming out his 'We are v-r-r-riends' and stopped. I looked at him; four or five of his eyes looked at me. He tried his password again and gave a shove on his cart, but I stood firm. And then the—the dashed creature reached out one of his arms, and two finger-like nippers tweaked my nose!"

"Haw!" roared Harrison. "Maybe the things have a sense of beauty!"

"Laugh!" grumbled Jarvis. "I'd already had a nasty bump and a mean frostbite on that nose. Anyway, I yelled 'Ouch!' and jumped aside and the creature dashed away; but from then on, their greeting was 'We are v-r-r-riends! Ouch!' Queer beasts!

"Tweel and I followed the road squarely up to the nearest mound. The creatures were coming and going, paying us not the slightest attention, fetching their loads of rubbish. The road simply dived into an opening, and slanted down like an old mine, and in and out darted the barrel-people, greeting us with their eternal phrase.

"I looked in; there was a light somewhere below, and I was curious to see it. It didn't look like a flame or torch, you understand, but more like a civilized light, and I thought that I might get some clue as to the creatures' development. So in I went and Tweel tagged along, not without a few trills and twitters, however.

"The light was curious; it sputtered and flared like an old arc light, but came from a single black rod set in the wall of the corridor. It was electric, beyond doubt. The creatures were fairly civilized, apparently.

"Then I saw another light shining on something that glittered and I went on to look at that, but it was only a heap of shiny sand. I turned toward the entrance to leave, and the Devil take me if it wasn't gone!

"I supposed the corridor had curved, or I'd stepped into a side passage. Anyway, I walked back in that direction I thought we'd come, and all I saw was more dimlit corridor. The place was a labyrinth! There was nothing but twisting passages running every way, lit by occasional lights, and now and then a creature running by, sometimes with a pushcart, sometimes without.

"Well, I wasn't much worried at first. Tweel and I had only come a few steps from the entrance. But every move we made after that seemed to get us in deeper. Finally I tried following one of the creatures with an empty cart, thinking that he'd be going out for his rubbish, but he ran around aimlessly, into one passage and out another. When he started dashing around a pillar like one of these Japanese waltzing mice, I gave up, dumped my water tank on the floor, and sat down.

"Tweel was as lost as I. I pointed up and he said 'No—no—no!' in a sort of helpless trill. And we couldn't get any help from the natives. They paid no attention at all, except to assure us they were friends—ouch!

"Lord! I don't know how many hours or days we wandered around there! I slept twice from sheer exhaustion; Tweel never seemed to need sleep. We tried following only the upward corridors, but they'd run uphill a ways and then curve downwards. The temperature in that damned ant hill was constant; you couldn't tell night from day and after my first sleep I didn't know whether I'd slept one hour or thirteen, so I couldn't tell from my watch whether it was midnight or noon.

"We saw plenty of strange things. There were machines running in some of the corridors, but they didn't seem to be doing anything—just wheels turning. And several times I saw two barrel-beasts with a little one growing between them, joined to both."

"Parthenogenesis!" exulted Leroy. "Parthenogenesis by budding like *les tulipes*!"

"If you say so, Frenchy," agreed Jarvis. "The things never noticed us at all, except, as I say, to greet us with 'We are v-r-r-riends! Ouch!' They seemed to have no home-life of any sort, but just scurried around with their pushcarts, bringing in rubbish. And finally I discovered what they did with it.

"We'd had a little luck with a corridor, one that slanted upwards for a great distance. I was feeling that we ought to be close to the surface when suddenly the passage debouched into a domed chamber, the only one we'd seen. And man!—I felt like dancing when I saw what looked like daylight through a crevice in the roof.

Knife-Kite: Predatory bird of Titan which flies at 100 MPH and impales prey on its rapier-sharp beak.

Land Leet: Land-dwelling octopus-like animal of Ganymede. Edible by humans, considered "good eating."

Leveling Poles: Graduated poles erected around a rocket landing field to give pilots an indication of height and attitude.

Libration: The "wobble" of tidally locked worlds and moons which makes the primary move in the sky.

Loonie: Native of Io.

Mound Builder: Underground-dwelling hive race of Mars.

Nivia: Colonial capital of Titan. Often described as the "City of Snow."

Nympus: Native of Ganymede.

Opposition: The time at which two worlds are at their furthest distance apart, on opposite sides of the Sun.

Parcat: Talking animal found on Io; a common pet of the colonists.

P.T.C.: Planetary Trading Corporation, whose failure caused the financial crash of 2110.

Rectifier: Air purifier.

Red Peri, The: *(1)* The pirate ship of that name; *(2)* its first captain, 'Red' Perry Maclane; *(3)* its second captain, his daughter. She is repeatedly called 'Peri' but it is never confirmed as her real name.

Sillicellu: Plastic used for vacuum suit visors.

Slinker: Semi-intelligent species of Io; viciously aggressive ratlike creatures. They may also live on Mars.

Terminator: On tidally locked worlds such as Mercury and Venus, the twilight region between the day side and night side. On Venus this is the only region inhabitable by humans, who still need protective clothing in many areas.

Thermide: Water purification pill which uses a chemical process to boil water and kill fungal spores and bacteria. The pills are essential for survival in the Venus Hotlands.

Continued next page

Thermoid Expansion Chamber: An essential safety component of the Atomic Blast engine; the patent was stolen by Interplanetary Corporation lawyers, a direct cause of the original Red Peri's piratical career.

Thermo-Skin: Insulated sleeping bag.

Thoth: The ostrich-like intelligent race of Mars.

"Top": Fly a spaceship so that another ship is "below" its engines and in danger of being hit by the exhaust; a common tactic of pirates such as Red Peri.

Transkin: Protective rubbery over-suit worn in the Hotlands of Venus. Porous to allow the wearer to perspire without letting spores in. Worn with a filter mask and goggles to keep spores out of the eyes and lungs.

Triops, Trioptes: Vicious semi-intelligent predators found on the edges and interior of the Dark Side of Venus; they resemble Hotland Venusians but have claws instead of pincers. *Triops noctivivans.*

U-Bar: Spaceship attitude control yoke, usually designed for dual pilots.

Uniped: A Venusian predator shaped like a single-legged kangaroo with a long spearlike beak.

Underjet: Secondary atomic blasts used for takeoffs and landings. Depending on the configuration of the ship they may point aft with other engines, or at ninety degrees to the main engines so that the ship can land on its side (as in the *Gaea,* the second ship to visit Uranus).

Venoble: British colonial capital on Venus.

'Vision Set: TV.

Xixtchil: Venusian plant that can be processed to make a rejuvenation drug which prolongs virility but has no effect on overall lifespan.

Yarkand: Chinese town, ruled by an Ameer circa 2112.

Young's Field: Rocket-port on Long Island.

"There was a—a sort of machine in the chamber, just an enormous wheel that turned slowly, and one of the creatures was in the act of dumping his rubbish below it. The wheel ground it with a crunch—sand, stones, plants, all into powder that sifted away somewhere. While we watched, others filed in, repeating the process, and that seemed to be all. No rhyme nor reason to the whole thing—but that's characteristic of this crazy planet. And there was another fact that's almost too bizarre to believe.

"One of the creatures, having dumped his load, pushed his cart aside with a crash and calmly shoved himself under the wheel! I watched him being crushed, too stupefied to make a sound, and a moment later, another followed him! They were perfectly methodical about it, too; one of the cartless creatures took the abandoned pushcart.

"Tweel didn't seem surprised; I pointed out the next suicide to him, and he just gave the most human-like shrug imaginable, as much as to say, 'What can I do about it?' He must have known more or less about these creatures.

"Then I saw something else. There was something beyond the wheel, something shining on a sort of low pedestal. I walked over; there was a little crystal, about the size of an egg, fluorescing to beat Tophet. The light from it stung my hands and face, almost like a static discharge, and then I noticed another funny thing. Remember that wart I had on my left thumb? Look!" Jarvis extended his hand. "It dried up and fell off—just like that! And my abused nose—say, the pain went out of it like magic! The thing had the property of hard x-rays or gamma radiations, only more so; it destroyed diseased tissue and left healthy tissue unharmed!

"I was thinking what a present that'd be to take back to Mother Earth when a lot of racket interrupted. We dashed back to the other side of the wheel in time to see one of the pushcarts ground up. Some suicide had been careless, it seems.

"Then suddenly the creatures were booming and drumming all around us and their noise was decidedly menacing. A crowd of them advanced toward us; we backed out of what I thought was the passage we'd entered by, and they came rumbling after us, some pushing carts and some not. Crazy brutes! There was a whole chorus of 'We are v-r-r-riends! Ouch!' I didn't like the 'ouch'; it was rather suggestive.

"Tweel had his glass gun out and I dumped my water tank for greater freedom and got mine. We backed up the corridor with the barrel-beasts following—about twenty of them. Queer thing—the ones coming in with loaded carts moved past us inches away without a sign.

"Tweel must have noticed that. Suddenly, he snatched out that glowing coal cigar-lighter of his and touched a cartload of plant limbs. Puff! The whole load was burning—and the crazy beast pushing it went right along without a change of pace. It created some disturbance among our 'v-v-r-riends,' however—and then I noticed the smoke eddying and swirling past us, and sure enough, there was the entrance!

"I grabbed Tweel and out we dashed and after us our twenty pursuers. The daylight felt like Heaven, though I saw at first glance that the sun was all but set, and that was bad, since I couldn't live outside my thermo-skin bag in a Martian night—at least, without a fire.

"And things got worse in a hurry. They cornered us in an angle between two mounds, and there we stood. I hadn't fired nor had Tweel; there wasn't any use in irritating the brutes. They stopped a little distance away and began their booming about friendship and ouches.

"Then things got still worse! A barrel-brute came out with a pushcart and they all grabbed into it and came out with handfuls of foot-long copper darts—sharp-looking ones—and all of a sudden one sailed past my ear—zing! And it was shoot or die then.

"We were doing pretty well for a while. We picked off the ones next to the pushcart and managed to keep the darts at a minimum, but suddenly there was a thunderous booming of 'v-v-r-riends' and 'ouches,' and a whole army of 'em came out of their hole.

"Man! We were through and I knew it! Then I realized that Tweel wasn't. He could have leaped the mound behind us as easily as not. He was staying for me!

"Say, I could have cried if there'd been time! I'd liked Tweel from the first, but whether I'd have had gratitude to do what he was doing—suppose I had saved him from the first dream-beast—he'd done as much for me, hadn't he? I grabbed his arm, and said 'Tweel,' and pointed up, and he understood. He said, 'No—no—no, Tick!' and popped away with his glass pistol.

"What could I do? I'd be a goner anyway when the sun set, but I couldn't explain that to him. I said, 'Thanks, Tweel. You're a man!' and felt that I wasn't paying him any compliment at all. A man! There are mighty few men who'd do that.

"So I went 'bang' with my gun and Tweel went 'puff' with his, and the barrels were throwing darts and getting ready to rush us, and booming about being friends. I had given up hope. Then suddenly an angel dropped right down from

About Forgotten Futures

Forgotten Futures is a shareware role-playing game whose core rules material, supplements, and adventures have been published on disk and on line since 1993. Previous supplements were for the most part based on Victorian and Edwardian scientific romances and fantasies, with *FF X* a licensed RPG based on *Tooth and Claw* by Jo Walton, a modern fantasy with a Victorian feel.

Two previous releases for the game have included space travel:

FF II is based on *Stories of Other Worlds* aka *A Honeymoon in Space* by George Griffith, and involves antigravity spaceships and a grand tour of an inhabited Solar System, with humanoid natives on Mars, Venus, Ganymede, Saturn and the Moon. *FF IX* focuses on weird science and gadgeteering, and includes a race to the Moon with some very odd contestants. While neither is entirely compatible with the Solar System described by Weinbaum, some elements might make the transition with a little work. Additionally, *FF X* includes an optional change in setting that would give Venus a race of intelligent dragons.

This supplement is distributed without charge – if you find it useful and wish to encourage the author to write more please consider registering or purchasing the *Forgotten Futures CD-ROM;* visit www.forgottenfutures.co.uk and follow the links to the game. A portion of the earnings from the game is donated to Cancer Research UK.

Some special rules are used for this setting, discussed in later sections:

Linguist skill starts at zero for alien languages regardless of MIND, e.g. a character with MIND 4 might spend a point to buy Linguist (German, French) 5, (Venusian) 1. This also applies to aliens learning human languages.

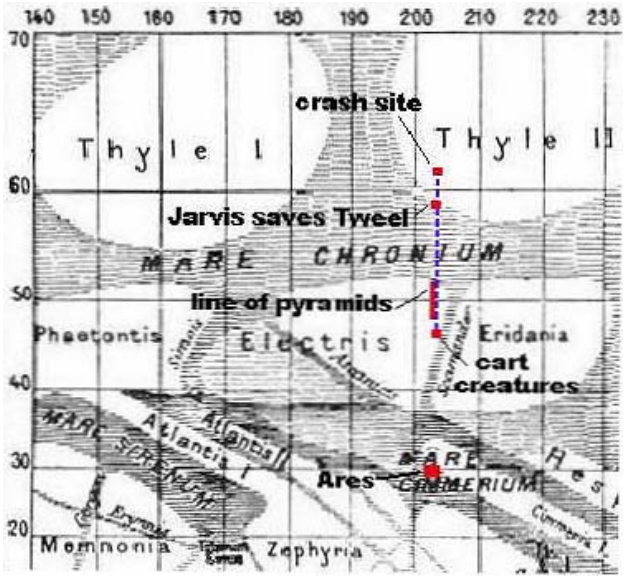
Spaceship pilots need **Pilot 6** or better and must spend 2+ points on the skill

Spaceship navigators need a minimum of **Babbage Engine (Astrogator) 6**

Heaven in the shape of Putz, with his underjets blasting the barrels into very small pieces!

"Wow! I let out a yell and dashed for the rocket; Putz opened the door and in I went, laughing and crying and shouting! It was a moment or so before I remembered Tweel; I looked around in time to see him rising in one of his nosedives over the mound and away.

"I had a devil of a job arguing Putz into following! By the time we got the rocket aloft, darkness was down; you know how it comes here—like turning off a light. We sailed out over the desert and put down once or twice. I yelled 'Tweel!' and yelled it a hundred times, I guess. We couldn't find him; he could travel like the wind and all I got—or else I imagined it—was a faint trilling and twittering drifting out of the south. He'd gone, and damn it! I wish—I wish he hadn't!"



Route taken by Jarvis and Tweel *(J. Pez)*

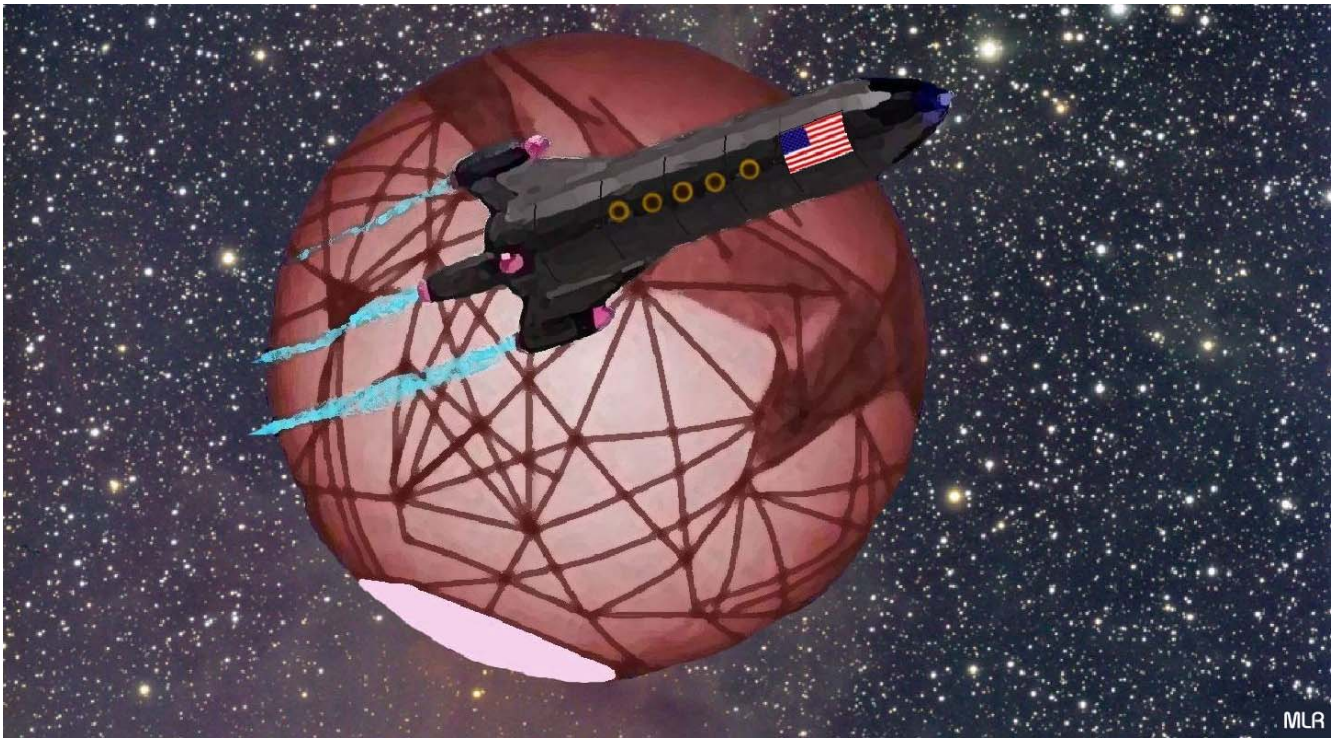
The four men of the *Ares* were silent—even the sardonic Harrison. At last little Leroy broke the stillness.

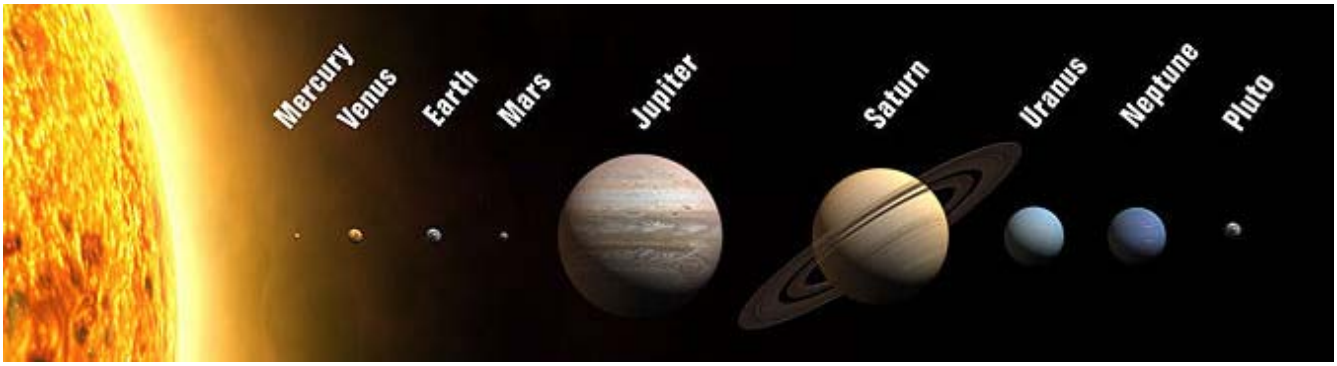
"I should like to see," he murmured.

"Yeah," said Harrison. "And the wart-cure. Too bad you missed that; it might be the cancer cure they've been hunting for a century and a half."

"Oh, that!" muttered Jarvis gloomily. "That's what started the fight!" He drew a glistening object from his pocket.

"Here it is."





We wandered down the valley and I talked, talked about anything. I told her of the various forms life assumed on the planets, how on Mars and Titan and Europa sex was unknown, though Venus and Earth and Io all possessed it; and how on Mars and Europa vegetable and animal life had never differentiated, so that even the vastly intelligent beaked Martians had a tinge of vegetable nature, while conversely the song-bushes on the hills of Europa had a vaguely animal content… ***Redemption Cairn***

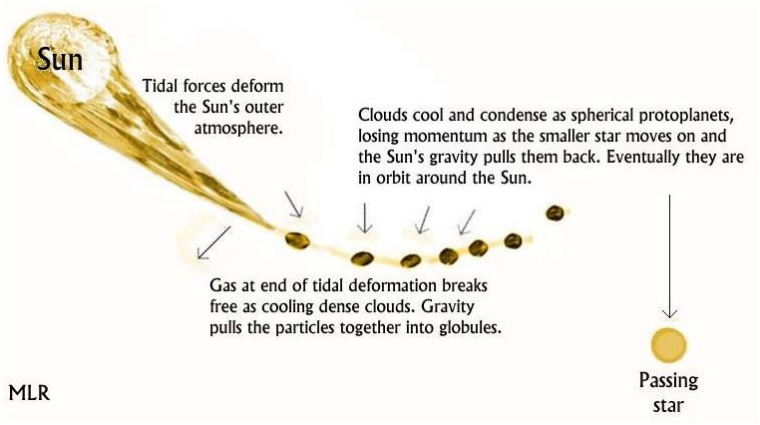
Strange how mistaken one can be, Amherst reflected. He could have sworn this man had been hardened by such adventure as existed, nowadays, only on the planets. ***Tidal Moon***

Islands in the Sky

SEVERAL hundred million years ago a small dense fast-moving star happened to pass relatively close to the newly-formed Sun.

Astronomers disagree on the size of the other star and the distance of their closest approach; all that can be stated with any certainty is that its gravitational influence was sufficient to distort the Sun's atmosphere and start to pull huge clouds of gas into space.

Some of the Sun's atmosphere may have transferred to the passing star, but most of the clouds failed to escape and ended up orbiting at various distances from the Sun. Eventually they began to cool and combine, forming progressively larger "clumps" of matter which were slowly pulled together by gravity. Over a few thousand years the first protoplanets began to condense from the clouds of debris, eventually forming the worlds we know today.



Somewhere along the way something went wrong with the formation of the fifth planet; the gravity of the largest protoplanet, later Jupiter, may have simply ripped it apart through tidal forces. The debris became the Asteroid Belt between Mars and Jupiter, comets, meteors, and other interplanetary rubble.

While the distribution of elements in the clouds started out even, lightweight gas molecules such as hydrogen tended to be lost by the innermost planets as they cooled; driven outwards by light pressure, they ended up in deeper space and were swept up by the gas giants. A small proportion of hydrogen

Let Us Not Go There...

The 'Planetary' stories don't detail every world and moon in the Solar System; some obvious omissions leave a lot of scope for exploration. Brief non-canonical descriptions are provided in the main text, referees should feel free to make whatever changes they like:

Mercury isn't mentioned in any story, but it was believed to be tidally locked in the 1930s. Comparison with the descriptions of tidally-locked Venus suggests it is uninhabitable; airless apart from volcanic gases, searing heat right up to the terminator, but only a little above absolute zero on the dark side. There may be mines and other facilities there, but they are never described. That doesn't rule out life, of course, perhaps mineral forms similar to the Martian pyramid-builder or the feeder crystals of Pluto.

We see almost nothing of **Earth**, and **The Moon** is dismissed as "arid and useless" in *Flight on Titan*, which also mentions that there is no gold there, nor any other heavy metals. But it's a really *big* moon; surely there must be something worth such an easy trip. If there aren't heavy metals, what about the light ones, and other light elements?

The Asteroids are mentioned in passing, never described. While they're probably all airless, everything else that goes to make up a world must be drifting out there somewhere, including the metals and minerals that are deep below the ground on a normal world. There ought to be some interesting possibilities out there if adventurers are prepared to risk the dangers of this region of space.

Finally, the major moons of Jupiter and Saturn are colonised, and there are landings on Uranus and Pluto, but **Neptune** is never described. This may simply be because it's too cold and its moons are too small to sustain life or human colonies, but that shouldn't stop someone from taking a closer look sooner or later.

remains, bound into water and other chemical compounds, most has gone. Mercury lost almost all its atmosphere, while Venus, Earth and Mars retained enough water and air to support human life. In the case of Venus many areas are uninhabitable for other reasons, for Mars a period of conditioning (or an oxygen mask) is needed. The larger moons of Jupiter and Saturn also have breathable atmospheres, as does Uranus. Finally, Pluto retained its atmosphere, but cooled to only a few degrees above absolute zero, and the "air" is now a mixture of frozen gases that must be scooped up and melted before they can be breathed.

Adventure Idea: Frozen Fortress

For decades the pirate Red Peri operated from a base on Pluto, but the secret was revealed when a prisoner escaped. It will be years before the authorities can reach her there, but engines are improving and she's looking at alternatives. One she has already rejected is the dark side of Mercury; there are too many problems with life support. But if she can spread the idea that she's based there it will divert attention from her real plans.

In a few months a "sun-grazing" comet will pass within half a million miles of Earth, heading towards Mercury. Attorneys for the mysterious Rip Reed Foundation (an anagram of *Red Peri;* Rip Reed is supposed to be a reclusive millionaire) hire the adventurers to fly to the comet, land, survey it, take specimens from the surface and core samples, and bring them back to Earth. They're told that Reed hopes to find evidence of the composition of the primordial Solar System in the dissolved gasses and other materials of the comet.

The main complication is that getting to the comet will take a lot of power – it's moving fast. Flying there then decelerating, landing, and heading straight back to Earth would take more fuel and supplies than the adventurers' ship can carry; it will be easier to follow the comet around the Sun (and close to Mercury) then decelerate and refuel on Venus before heading back to Earth. The attorneys "reluctantly" agree to the additional expense and time. As instructed, of course.

There should also be a few complications on the comet; perhaps there is some sort of life there, perhaps it's just accompanied by hundreds of icy meteors. But the adventurers should feel pleased with their success as they prepare to land on Venus.

Unfortunately, their ship will then be attacked by the *Red Peri*, and all records and samples will be taken. The pirates will make it obvious that they're especially interested in pictures of Mercury in general and the dark side in particular, radio logs, and any other records that might relate to Mercury. They might even say something about "pictures of the base" if the adventurers seem sufficiently gullible.

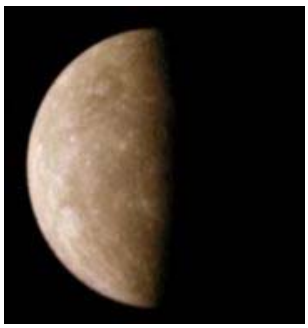
"Luckily" the Foundation insured the mission, and in the end the adventurers won't lose much apart from time and their place in scientific history (assuming that there had ever been a real intention to publish their results). Working out who really hired them and why should lead to some interesting adventures.

Planet	Distance from Sun (astronomical units)	Distance[1] from Earth	Day[2]	Year[2]	Surface Gravity	Atmosphere
Mercury	0.39	57 to 129	87.9 days	87.9 days	0.4g	Volcanic gases
Venus	0.72	26 to 160	224.7 days	224.7 days	0.7g	Nitrogen / Oxygen
Earth	1.00	-	24 hours	365.25 days	1.0g	Nitrogen / Oxygen
Mars	1.52	48 to 234	24hr 37m	687 days	0.4g	Nitrogen / Oxygen [3]
Jupiter	5.20	387 to 573	9hr 54m	11.86 years	2.5g	Hydrogen / Helium
Saturn	9.54	793 to 979	10hr 41m	15 years	1.1g	Hydrogen / Helium
Uranus	19.22	1,690 to 1,876	17 hr 14m	84 years	0.9g	Argon / Oxygen
Neptune	30.06	2,700 to 2,886	14 hours	165 years	1.1g	Helium / Oxygen ??
Pluto	29.7 to 49.3 [5]	2,664 to 4,676	20 hours	248 years	1.2g	Neon / Oxygen[4]

[1]Millions of miles [2]Earth hours, days or years [3]Low pressure, breathable with adaptation [4]Frozen
[5]Closest to the Sun circa 1990 and 2238, most distant circa 2114. 44 AU in 2086, the date of *The Red Peri*

Every world is a different environment – for example, while the table above shows that Venus, Earth and Mars all have Nitrogen / Oxygen atmospheres, conditions are very different. A Martian on Earth would be too hot, and oppressed by what it would regard as hugely excessive pressure and gravity. A human must spend weeks adapting to conditions on Mars, and will die without a filter mask and transkin on most parts of Venus. The atmosphere of Pluto is breathable – if you can melt it! And there are huge extremes of temperature, often on a single world. The brief descriptions that follow can't hope to be more than a glimpse of the other worlds; you are advised to refer to prime sources or visit them for yourself if you want to learn more. The London Geological Museum and Natural History Museum and the Smithsonian Institution all have excellent galleries on the explored worlds, and there are similar if smaller exhibits in most major cities.

Mercury: Too Hot To Handle



The innermost and by far the hottest world of the Solar System, Mercury is tidally locked to the Sun, with a bright face and a dark face. It has no permanent atmosphere; gases are released by volcanic processes on the hot side, and either escape into space or condense as solids or liquids on the dark side of the planet. Mostly these gas traces are at very low pressures; a hundredth of an atmosphere or less. Explorers generally consider them a nuisance, since they tend to condense on cool objects such as space suits, damaging visors and electrical equipment. The gas components can include nitrogen and sulphur dioxides, sulphur vapour, etc.

While Mercury is a comparatively dense world and should in theory have useful deposits of heavy metals, the difficulties of exploration are immense.

Because it is so deep in the Sun's gravity well the amount of fuel needed is double what the distance alone would suggest (about 50% more if an expedition originates on Venus). Huge velocity changes are needed to match speed and to land, and to get back again afterwards. Ships going this close to the Sun encounter many other problems, from overheating to radiation damage. They can be built or modified to compensate, of course, but that adds considerably to the expense of an expedition.

There is no water or air; all supplies must be carried for the round trip. Fuel is also a problem; older atomic blasts run on sodium salts, the later radium drives on iron salts. Both are rare on Mercury, usually found as small deposits of the metal sulphides which are difficult to mine and inconvenient to use. When the new protactinium blasts are available they will use lead, which is comparatively common on Mercury, but until they are available fuel will be a real problem.

A Matter of Gravity

With the exception of air, gravity is the most noticeable factor in planetary exploration.

On the smaller worlds and moons it's possible to carry more equipment with less effort, although there are obvious limits. It might be possible to carry a ton of equipment at 0.1g, but it still has a ton of mass; it's hard work to get it moving, even harder to stop it. Explorers carrying large loads have occasionally been injured when they tried to stop too suddenly, and were hit by the equivalent of a compact car travelling at several miles an hour. On worlds with higher gravity than the Earth it's easy to become tired or suffer serious injuries from "minor" falls.

Game Data: The table below shows gravity, changes to the effective BODY of a human, and modifiers to the Effect of falls and hours of sleep needed:

Gravity	BODY *	Falling / Sleep
0.25g or less	+4	– 4 **
0.25 – 0.5	+2	– 2
0.5 – 0.75	+1	– 1
0.75 – 1.25	~ Unchanged ~	
1.25 – 1.5	-1	+1
1.5 – 1.75	-2	+2
Over 1.75g	-4	+4

* For feats of strength etc., not for damage resistance. BODY is always at least 1 regardless of modifiers.

** An experienced traveller needs far less sleep in low gravity, but newcomers often suffer nausea and lose sleep at first. Usually this ends in a few days. The Effect of a fall is always at least 1.

Example: Jarvis (*A Martian Odyssey*) is fit (e.g. BODY 5 or 6) and weighs about 210lb on Earth. On Mars (0.4 g) he carries a 250lb water tank (BODY 4 or so) with ease. With his weight reduced by the low gravity, the total effective weight is less than his weight on Earth, but if he is moving fast and tries to change speed or direction in a hurry the extra 250lb of inertial mass will make itself very apparent. On Earth he prefers eight hours of sleep; on Mars he will be rested after four.

The bright side is always at temperatures measured in hundreds of degrees. The surface is in a continual state of flux, with volcanoes and quakes continually "churning" the rock. Today's mineral deposit may be tomorrow's volcano! There are pools of boiling sulphur and molten lead, often covered by a crust that looks like firm ground. Explorers must wear reflective suits (linked to a supply of liquefied air or a refrigerator pack) and can only work outside for an hour or two a day at best.

The cold side is equally inhospitable, a few tends of degrees above absolute zero. While the cold side surface is comparatively stable, the difficulties of working in extreme cold are immense; metals snap and become brittle, lubricants freeze, and huge amounts of power must be used to stay warm.

Thermal suit for use on Mercury; the umbilical line is used to supply cool air and remove heat. This particular model passed all tests on Earth, but failed in practical use on the second expedition.

Smithsonian Institution

At any given time a "twilight" zone a few miles wide has a temperate (but airless) climate, but libration[1] ensures that these conditions are never stable for more than a few days. After a week or so it will become uncomfortable warm or cool, and it is time to move on.

Finally, tidal forces ensure that all parts of Mercury experience frequent quakes, strong enough to topple a typical freighter. Smaller exploratory ships are less likely to be damaged, but there is still a substantial risk.

Putting these factors together, for the moment Mercury is generally regarded as more trouble than it's worth; there have been several scientific expeditions, but none have found enough gold, gems, or radioactive minerals to justify the considerable risks and expense of a mining operation. There appears to be no life there, so there are no medically useful biochemical compounds, and the surface is too dangerous for permanent scientific installations. For now, and possibly for many years to come, it's not worth visiting.

[1] Wobbling – Mercury's orbit is very eccentric, and its rotation sometimes lags behind its orbital position, and is sometimes ahead of it. As a result of this eccentricity there is no permanent twilight zone, as on Venus; all parts of the border between the bright and dark sides experience extremes of warmth and cold at some point in the planet's short year.

…It was mid-winter when the mudspout came. Mid-winter, that is, in the Venusian sense, which is nothing at all like the conception of the season generally entertained on Earth, except possibly, by dwellers in the hotter regions of the Amazon basin, or the Congo.

They, perhaps, might form a vague mental picture of winter on Venus by visualizing their hottest summer days, multiplying the heat, discomfort and unpleasant denizens of the jungle by ten or twelve.

Parasite Planet

Venus: The Parasite Planet

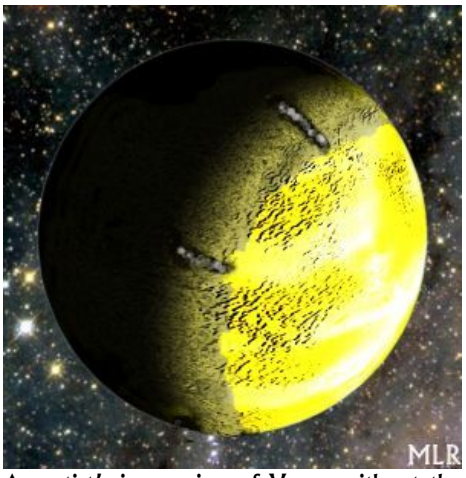
First explored within a year of the first landing on Mars, Venus is in some ways a wetter and more hospitable replica of Mercury. Like Mercury, Venus is tidally locked to the sun, with the best climate (ranging from 60° to 140°F over 15-day seasons) in a relatively narrow Twilight Zone, the terminator between the bright and dark hemispheres. But there the resemblance ends; Venus teems with life, and parts of it are habitable without much protection. Regrettably they aren't the most *profitable* parts, but they serve as an excellent springboard for exploitation of the rest of the planet.

The habitable zone averages about 500 miles wide, and is for the most part swampy. Venus has nearly as much water as Earth, but much of it is frozen in the dark hemisphere. Hot winds carry moisture into the dark side, cooling, sinking, and melting the glaciers at the border as they do so; they feed water back into the habitable zone, huge underground rivers which undermine the surface and flow towards the sunlit hemisphere before evaporating or turning back towards the dark. Sinkholes and hot geysers are common, and the only stable areas are the rare patches of rocky ground around occasional mountains and the foothills bordering the Dark Side, the main colonised areas.

Although Venus has natives, the 2020 Lisle treaty splits the planet into segments running from the hot edge of the terminator to the middle of the Dark Side, their width determined by the colonising nation's share of the terminator zone. The main claimants are Britain, America, the Pacific Alliance, Holland and Russia.

The Hotlands

The Hotland swamps make up approximately eighty percent of the Twilight Zone. They are implacably hostile, virtually impassable without mud shoes, their air filled with deadly fungal spores that would quickly devour anyone foolish enough to breathe the air or drink the water without proper protection. Transkin oversuits and filter masks must be worn at all times, and all food must be canned, opened only when the spores have

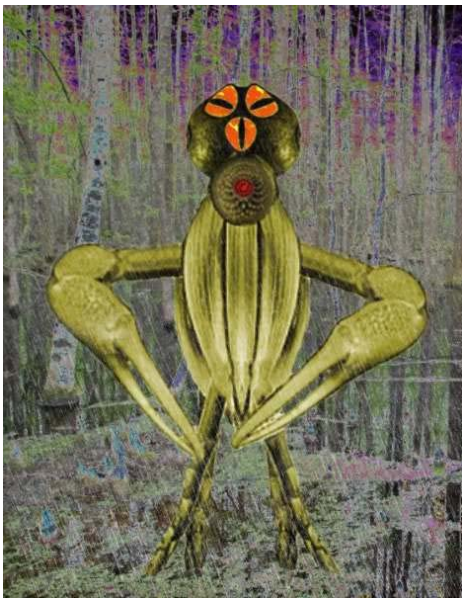


An artist's impression of Venus without the cloud that normally enshrouds the planet. The Twilight Zone is a green ring, 500 miles wide, between the parched Bright Side and the dark hemisphere. The white areas are salt flats, a useful mineral source. The black lines crossing the Twilight Zone to the Bright Side are mountain ranges, their peaks extending above the atmosphere. ***UPI***

Xixtchil

Venus's main export is the spore pods of the *Xixtchil* plant, which are processed to make the rejuvenation drug xixtline, trihydroxyl–tertiary–tolunitrile–beta–anthraquinone (Triple-T-B-A for short). The drug darkens and restores hair, removes wrinkles, and generally restores vitality. However, it treats the symptoms of age rather than the underlying causes, and may actually reduce lifespan slightly, although the statistical evidence is inconclusive. While their effect is masked for some considerable time, the toxins of aging continue to accumulate in the muscles, nerves, and brain, and eventually pass a critical level at which the drug becomes ineffective. After that aging is actually accelerated until the body catches up with its real age, and sometimes continues for several months afterwards, with senility an occasional side effect.

Currently the pods are worth their weight in radium, and until someone succeeds in synthesising the drug or cultivating the pods on Earth it's likely that prices will remain very high.



A Hotland native poses for the camera in light rain. Unlike many Terrestrial primitives they have no fear of photography and can recognise themselves if shown a picture.

National Geographic

The Venusians

There are at least two sentient Venusian species, but the Hotland natives are by far the best known. They have a natural immunity to fungal spores and, although they face constant danger from the other hazards of the swamps, seem to have no fear of them. They can predict mud-spouts and sink-holes and avoid them instinctively, possibly by sensing changes in the acidity or temperature of the mud. While humans must always wear cumbersome mud-shoes, they customarily walk through the mud, supported on four large webbed feet (immersed in the picture).

Their language is inflective, like Chinese, with apparently identical words having multiple meanings according to inflection and context. For example, "Murra" can be a greeting, convey a warning, or may be interpreted as an offer of friendship or a challenge to fight! As a noun it can mean peace, war, fear, or courage. Very few explorers have mastered more than basic words such as *Murra, Usk* (What, Where, etc.), and *Curky* (trader, stranger, guest, enemy).

settled after rain. Water must be boiled with Thermide tablets. Unfortunately these are the areas where the natives live, and where they are prepared to trade Xitchil plants and other rarities for knives, beads, and other useful items. Further towards the Dark Side the spore count decreases, and it's possible to breathe unfiltered air near the terminator glaciers.

The Hotland food chain is unusually complicated, gaining most of its energy from thermosynthesis; conversion of infra-red radiation to chemical energy by the mud bacteria. These are in turn eaten by any of a hundred different species of "animal", "plant" or "fungus" (for want of better descriptive terms) which also devour each other and are in turn eaten by the larger species, while trying to devour them or infect them with their spores. A typical example is *Deas Gonzonian*, a "worm" which appears after rain. It has specifically evolved to mimic less harmful species, its sole role in life being to be eaten – because once eaten its spores, which have a waxy coating and strong shell, and are highly resistant to most digestive enzymes, can attack the eater from the inside!

These creatures are in turn preyed on by larger predators, and eventually the most familiar plants and animals:

The **Jack Ketch Tree** is a carnivorous plant which deploys hundreds of nooselike tendrils coated with digestive enzymes to entangle and strangle its prey. Once caught, the prey is rotted down and absorbed. Its branches can snare victims in seconds.

The so-called **Friendly Tree** also attempts to eat any animals that come near it, via hundreds of small tendrils equipped with sucker/mouths, but does so comparatively slowly. It's possible to climb one and sleep for several hours before it becomes really dangerous, although it should be remembered that humans aren't the only creature to have realised this; several predators are equipped to climb such trees without being eaten, and will take a good deal of interest in anything else they encounter in the branches. The Friendly Tree has a much more dangerous relative, the **Pharisee Tree**, which looks virtually identical but conceals hundreds of lethally sharp spikes in its branches.

Finally, **Snake Vines** are exactly what they sound like, tipped with sharp venomous teeth which can easily penetrate transkin.

	BODY	Weapon	Effect	A	B	C
Jack Ketch Tree	15	Noose[1]	6	F	I	C/K
Friendly Tree	12	Suckers[2]	1 + 1 per 2 hrs.	F	F	I
Pharisee Tree	12	Spikes[3]	8 + 1D6 poison	F	I	C/K
Snake Vine	6	Fangs[3]	1D6 poison	F	I	I

[1] Attacks with Brawling 6. Breaking free of a noose is Difficulty 8. I or C result is a broken limb of varying severity, K a broken neck.

[2] Attacks with Brawling 2. Attacks cannot penetrate transkin but victims must break free by overcoming Effect of its attack.

[3] Attacks with Brawling 4. Any I or C/K wound penetrates transkin.

A small doughpot, weighing approximately a ton, moves through shallow water in search of food. Seconds after this photograph was taken it noticed the photographer and chased him for several miles. *Smithsonian institution*

The most dangerous Hotland predator by far is the **Doughpot**, essentially an amorphous "blob" of de Proust cells that eats anything in its path, growing and eventually dividing to produce more doughpots as it does so. Sizes range from microscopic to huge, up to twenty tons. Doughpots have been described as mobile cancers, and even the Venusian natives avoid them. Fortunately they are comparatively uncommon, especially in the largest sizes. The reason is simple; if a doughpot can't get enough food the chemical communication between its cells breaks down and it starts to eat itself, a vicious cycle that can continue indefinitely. Doughpots lured to the Bright Side deserts have taken this process to completion, lacking any sense of self-preservation, leaving nothing but a few dried spores.

Doughpots cannot digest transkin, but anyone caught in one is doomed; they are pulled in and pummelled, suffocated and crushed, carried along with it until the suit rips, then digested.

	BODY	Weapon	Effect	A	B	C
Doughpot	6+2D6	Bludgeon	**BODY +2**	F	I/C	C/K
		Wrestle[1]	**BODY +2**	F	I	C/K
		Suffocation	**1+1/30 sec**	I	I	C/K

[1] The term "wrestle" is used very loosely. Essentially the victim is engulfed. All attacks are accompanied by the use of digestive enzymes and infective spores. Without a Transkin suit they are not survivable.

The Venusians *(continued)*

Although the Venusian language is confusing, the natives seem to have a code of honour; allegedly they will always warn you before they decide to kill you and take your belongings!

While the Venusians are superficially simple hunter-gatherers, their arts and crafts include silverwork, elaborate beadwork, weapon-making and wood-carving; the latter is of course an ephemeral art since the wood must be processed to protect it from fungal spores, and will inevitably succumb to them sooner or later.

Attempts to explain the origin of humans to the Venusians have always failed; they seem to be unable to grasp the concept of other worlds, probably because the sky is never clear. They generally seem to be uneasy about discussing the matter.

Jfff'filtfik - ATypical Hotlander
BODY 3, MIND 2, SOUL 3
Pincers, Effect 5 (x2) A:F, B:I,C:I
Bite, Effect 6 A:F, B:I, C:C/K
Skills: Artist (silversmith) 5, Brawling 4, Melee Weapon 5, Marksmanship 7 (bow, throwing knife), Sneak 6.
Quote: *"Usk? Usk?? Murra!!" [makes a complex but totally untranslatable gesture and runs off.]*
Notes: Despite huge claws Jffffiltfik is surprisingly dextrous, and pities the clumsy humans she occasionally encounters. She *does* understand that humans are saying that they come from another world, most Venusians do, but conventional Venusian wisdom is that humans are relatively friendly demons, and that the world that they come from is actually one of the colder circles of the Hell of their religion, somewhere in the Dark hemisphere. It's considered unsafe to state this explicitly, in case the demons drag you back with them when they go home.
Hotlander player characters should be built on 14 points, and begin with no knowledge of human languages or skills.

Adventure Idea: Medical Run

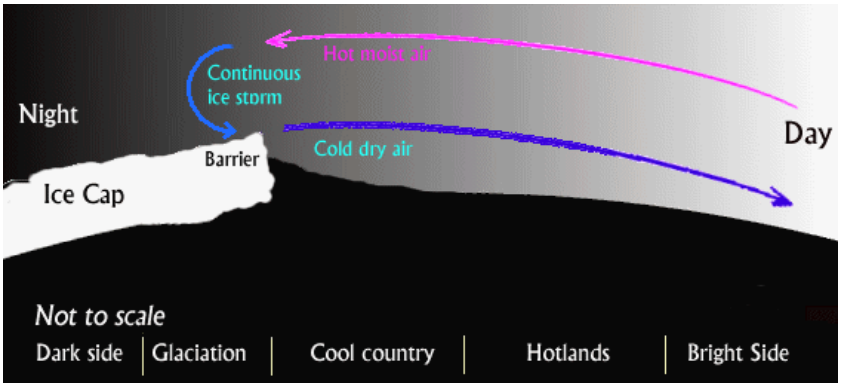
Five years ago Venoble suffered a measles epidemic. On Earth this childhood disease is rarely more than a nuisance; on Venus most of the native-born colonists had no natural immunity and several children died. Since then Venoble's hospital has kept stockpiles of vaccine, ready for another epidemic; unfortunately the new epidemic is in Erotia.

If the adventurers are in Erotia and *don't* have their own ship they should be hired to carry the news of the epidemic to Venoble by land – radio messages aren't getting through and no ship is available or expected for several weeks. If they are in Venoble without a ship they should be hired to carry the drugs to Erotia; again, no ship is expected in time to do any good. The best land route crosses the Mountains of Eternity (see *Parasite Planet*) and several rivers, and is an arduous trek with endless natural hazards.

If they *do* have a ship find a reason why they can't use it; for example, the pilot may be one of the victims of the disease, an engine part is needed before it can fly again, the radio beacon needed for a landing at Venoble may be out of action because the operator is ill, whatever seems most appropriate.

There needn't be any other problem en route, other than natural hazards, but optionally the adventurers run into a native who wants to trade them a small fortune in Xixtchil pods, enough to make one man rich – but are the adventurers prepared to share and share alike? A good source here is *The Treasure of the Sierra Madre*. If you use this option it may be advisable to include NPCs in the expedition to cause trouble, if the adventurers don't seem to be inclined to do so for themselves.

Alternatively, throw in a few bandits (human or native) who think that the supplies or vaccine the adventurers are carrying must be some sort of treasure, and decide to take it for themselves.



The main weather systems affecting the Cool Country; moist air rises from the Hotlands and cools as it reaches the Night Side. A continuous electrical and ice storm moves backwards and forwards with libation. Ice sometimes settles on the Barrier glaciers, sometimes melts, so that there is a continual movement of ice, while the weight of the ice cap as a whole pushes up hills of glacial rock and sediment. Cooler dry air and cold rivers return towards the Hotlands.

The Cool Country

The section of the habitable zone closest to the dark hemisphere is usually referred to as the Cool Country; the average temperature (below 80°F throughout the year) is too low to sustain the ubiquitous spores of the Hotlands, and the prevailing winds blow away the few that make it into the area. It's possible to survive without a transkin and respirator. There are still dangers; doughpots and other predators are capable of surviving in these areas, as well as some predatory plants such as the Jack Ketch tree, but "true" trees and plants predominate. There are still large areas of cool swampland, though rocky ground is more common in the foothills below the eternal glaciers. There are vicious piranha-like predators in the rivers, and the highlands are often subject to devastating lightning storms. Despite these problems it's one of the more habitable regions off Earth, with a temperate climate, ample water and air, and a few edible plant and animal species (thorough cooking and a strong stomach are recommended).

There are several settlements with population averaging a few hundred, the largest being Erotia (the capital of the American zone; the name is Latin for Cupid, son of Venus) and Venoble (The British capital; named for Henry Venoble, British President at the time of colonization). There is even a small but vocal independence movement with supporters in all of the national zones, although realistically it will probably be another twenty to forty years before Venus has built up the industrial base and infrastructure needed for true self-sufficiency.

Communication and travel between the separate colonies is difficult. Formidable mountains and other natural obstacles block land travel, and the omnipresent lightning storms usually drown radio signals. At present the main means of transport is by rocket.

The Planetary Trading Corporation prospectus contained grandiose plans for a monorail to link Erotia and Venoble, including a mountain tunnel at least twenty miles long, but in the wake of the company's collapse it has been estimated that the project would have required most of Venus's metal production over two to three years. Construction of a road is a little more plausible, since most of the route could be cleared and levelled using native rock and a tractor-mounted atomic blast, but the best routes run too close to glaciers for comfort and it would still be necessary to construct an extremely long tunnel – and since the road would have to be at ground level, travellers would have to be ready for encounters with doughpots and other unwelcome flora and fauna. The thought of running into a doughpot or a pack of triops deep inside a mountain is the stuff of nightmares. For now, at least, the colonies remain separate.

The Glacial Zone

The glacial edge of the Cool Country had a reputation for being haunted until it was learned that a Dark Side species, *triops noctivivans*, has adapted to conditions in this zone and attacks travellers when it can. The species resembles an "apelike" version of the Hotland natives, with larger eyes and claws rather than pincers. They are extremely vicious, pelting travellers with stones and seed pods containing a narcotic vapour then consuming their unconscious bodies. *Triops* bodies contain natural alcohols, acting as antifreeze, which are toxic to most other Venusian life, and it may eventually be possible to manufacture these chemicals in quantity and use them to eradicate doughpots and other unwanted species around the colonies.

The Dark Side

Most of what is known of the Dark Side comes from the joint Royal Society / Smithsonian institution expedition of 2099[1], which discovered various plant and animal species including an allegedly intelligent plant species, *Lotophagi Veneris,* the source of the narcotic pods thrown by Triops. This species appears to have no survival instinct whatever, and releases a vapour which slowly saps the willpower of humans who inhale it for prolonged periods. They are apparently able to read human thoughts and assimilate human languages, but appear to be unable to add new concepts. They claim a deep understanding of the universe, but their philosophy appears to be little more than fatalism; they have no willpower, and seem likely to become extinct within the next few decades, as the Triops eat the last of the species.

Triops noctivivans
BODY 4, MIND 1, SOUL 1
Claws, Effect 5 (x2) A:F, B:I, C:C/K
Bite, Effect 7 A:F, B:I, C:C/K
Stones, Effect 5, A:F, B:F, C:I/KO
Seed pods, Area 10ft gas cloud, effect 3+1/round, A: –, B: –, C: KO
Skills: Brawling 6, Marksmanship 4 (throwing seed pods etc.), Sneak 6.
Quote: *"Oook ooop oook Grrrrrr!"*
Notes: The species name means "three-eyed dweller in the dark" and is entirely descriptive. The pods they throw derive from one of the Dark Side plants, and the gas they contain is a strong narcotic which takes effect extremely quickly. They attack in packs of four to six. Their main weakness is an aversion to bright light; they are only encountered in dark or near-dark conditions. While they are generally described as a Dark Side species, their anatomy suggests that they are comparatively recent migrants from the Hotlands or Cool Country, within the last 20,000-50,000 years.

Lotophagi Veneris
BODY 2, MIND 7, SOUL 1
No physical attacks.
Surrounded by clouds of narcotic vapour, Effect 1+1/hour, causes apathy if it overcomes BODY.
Skills: Acquire any purely mental skill (e.g. Science, Linguist, Scholar) that they are exposed to at the same level as the person who possesses the skill. No other skills.
Quote: *"When we are gone it will make no difference to any except the trioptes who eat us."*
Notes: The species name means "Venusian Lotus Eater." The gas is a more dilute version of the pods thrown by Triops. It can be stopped by a filter mask, as used in the Hotlands, or a spacesuit helmet. Physically the Lotophagi are mobile plants described as resembling "an inverted bushel basket" with multiple eyes.

[1] *The Lotus Eaters*

The Moon

Surface gravity:	*0.17g*
Distance from Earth:	*250,000 miles*
Day:	*27.3 days*
Orbital period:	*27.3 days*

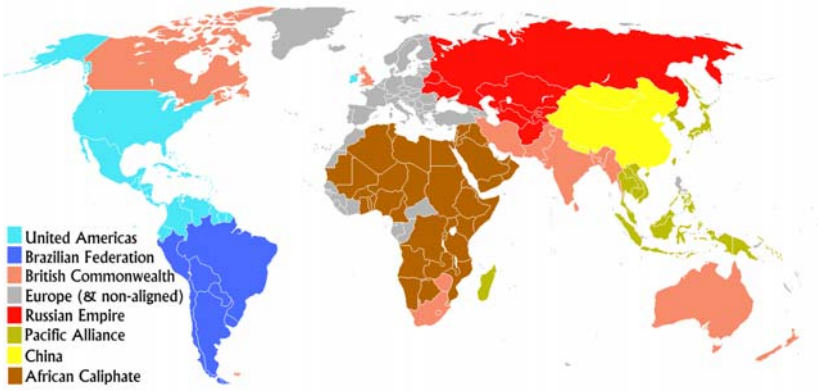
Often dismissed as a "worthless cinder" or worse, Earth's moon offers little that isn't more readily available elsewhere in the Solar System, generally on worlds that have atmospheres and other useful features. While there's evidence for a little mineral wealth, mostly deep underground, the accessible resources are mostly lighter elements that are readily found on Earth. There's no air, water, or life that hasn't been brought there from Earth. About all the Moon has in abundance is rock and vacuum.

Fortunately there are uses for an airless moon; by far the most profitable is the electronics industry. Lunar rock is high in silicates, and most of the vacuum tubes and vision screens sold on Earth come from one or another of the Lunar factories.

Other facilities include an observatory and dumping sites for radioactive materials such as damaged atomic blasts. There are occasional scare stories suggesting that pirates are secretly based on the Moon, or that the waste sites could explode and crack the Moon like an eggshell or drive it out of orbit, but nobody takes them seriously. The reality is that the Moon is useful but boring.

Adventure Idea: Scrapheap

The adventurers need a part that's no longer made to repair their ship's obsolete atomic blast. Nobody has one in stock, but there might just be one in the lunar junkyard, a ship of the same type was scrapped there a few months ago. Of course things won't be that simple… the engine room is radioactive, and there are signs that someone has been removing components, and paying very little attention to safety while doing so. Why do some parts seem to have been nibbled away? And why do the adventurers feel that they're being watched…?



Carol smiled. She had never visited the small pinprick in the black called Earth, but she had read of it, read of its cities built into the air, its underground highways, its beautiful women.

Tidal Moon

Earth: Cradle of Mankind

The home of mankind and cradle of civilization, Earth is still the economic and social hub of the Solar System. Admittedly it's currently a rather *battered* hub, wounded by war and a serious economic recession, but nobody really doubts that Earth will bounce back reasonably soon.

As may be obvious from the map, the twentieth century tendency to form "super-states" amalgamating the political or economic interests of several countries continued in the twenty-first. Some of the changes could have probably been predicted, others must have seemed unlikely until they happened:

- The USA formed economic links to the South, with the United Americas eventually becoming a single economic community. The nations within the UA are still self-governing, to about the same extent that states were in the old USA, but all use a common currency, the dollar, which is now also the main currency used off-world, and owe allegiance to Washington. Canada stayed independent and is on reasonably good terms with the United Americas, but a closer ally of Britain. Southern Ireland joined the UA in the 2040s, as a way of staving off British influence.
- Brazil responded to the rise and southward spread of the UA by forming links with other South American nations, united primarily by their distrust of the UA. In recent years the Brazilian Federation has become a little more relaxed in its dealings with the UA, and there have been joint agreements on trade which some interpret as a prelude to a final amalgamation of the Federation and UA.

Power Bloc	Population Billions	GNP $ Billions	Military Spending $ billions	Average Income (dollars)	Life Expectancy (years)	Infant Mortality per 1000 births	Registered Spacecraft *[LON fleet]*	Off-world Colonies
United Americas	0.96	14,592	583.7	15,200	85	2.7	27 *[3]*	6
Brazilian Federation	0.42	4,620	184.8	11,000	82	4.1	9 *[2]*	2
Russian Empire	0.33	3,036	151.8	9,200	85	3.6	8 *[1]*	3
Europe	0.46	6,164	180.9	13,400	88	2.9	12 *[2]*	5
British Commonwealth	1.05	15,225	761.3	14,500	87	4.5	16 *[2]*	4
Africa	0.60	1,260	68.0	2,100	72	22.8	3 *[1]*	None
Pacific Alliance	0.35	1,925	134.6	5,500	75[2]	16.5	4 *[1]*	None
China[1]	0.70	< 300	< 25	< 1000	70	25.3	None	None

[1]Figures for China exclude occupied zones and should be treated with caution.
[2]Currently reduced due to deaths of Pacific War veterans, will probably rise to 80+ within fifteen to twenty years.

- Russian Communism fell; to avoid anarchy the rebels restored the Tsar as a symbol of unification. The expanded Russian Empire is now a constitutional monarchy, with the monarch having very little real power.
- The smaller European colonial empires broke up, their colonies becoming independent or joining larger local alliances. Europe is now a loose association of states, the United States of Europe, but constant bickering makes this perhaps the least effective government on Earth. Essentially European nations retain most of their independence, paying lip service to the USE when it suits them to combine economic or military forces. Several European nations have their own colonies in space, such as the Dutch and French zones on Venus. Europe still has nominally Communist and Fascist governments, although a 20th century observer would think of both as mild variants on socialism.
- Britain retained most of its Empire, now the Commonwealth, which still encompasses South Africa and Rhodesia, Iran, India, Burma and Hong Kong, with a scattering of other possessions such as the Falklands and Gibraltar; while independent, Australia, Canada, and New Zealand also owe their allegiance to the British Crown. Despite its small size, Britain still packs an enormous political, economic and military punch.
- With the decline of the European empires most of Africa was united by a new Mahdi, and is now an Islamic caliphate. There has been a general liberalization of Islam over the last century; women are allowed to appear unveiled, although they are denied the vote. There are border tensions between the Caliphate and Commonwealth.
- The Pacific Alliance originally formed to resist the Japanese Empire's expansion into the Philippines. This led to the 2075 Pacific War, a Buddhist revolt in Tibet and China, and the surrender of Japan. The current capital is Manila.

The League of Nations

The League, with headquarters in Geneva, is the main forum for resolving disputes between nations. With the exception of China all of the power blocs and independent nations send representatives to the League and for the most part obey its directives and decisions. It's assumed that if any of Earth's colonies become independent they will also join the League.

As originally constituted the League was virtually toothless, and would have been unable to do anything really effective to defend the peace, but in 1935 Italy invaded Ethiopia, and Britain (perceiving the invasion as a threat to its African colonies) blockaded Italian Somaliland, claiming to be acting in defence of League principles. While this was barely justifiable, it set a precedent which led to the defeat of the German occupation of the Rhineland in 1936; Britain blockaded Germany while France sent a division into the Rhineland and drove out the Germans. Recognizing that this was likely to set the pattern for future conflicts, the League treaties were amended to legitimize such interventions.

Eventual results included the slow declines of Fascist and Communist dictatorships in the forties and fifties, with every move to expand their territories blocked before it could really begin. Gradually the League expanded its membership and mandate, opposing militarism and promoting civil liberties, and was one of the principal factors in forming the world as we know it today.

The League of Nations *(continued)*

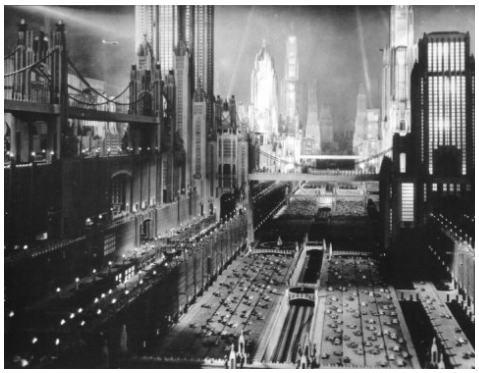
The League controls Earth's space fleet, twenty-two ships including twelve owned by national governments but permanently assigned to League duties. It is used mainly for piracy suppression and rescue operations in the vicinity of the Earth, but patrols take in Venus, Mars, and the outer worlds.

Everyday Life

Generally speaking, most of Earth is peaceful and prosperous; many old political rivalries have now moved to the new frontier of space, others are now mainly economic. Naturally there are still dangers; China and parts of Africa are unsafe for anyone who appears to be wealthy or foreign.

Despite the recent stock market crash, now believed to be the result of a fraud that spiralled out of control, the richer countries are still well off; the average working man owns his own home (or is at least able to pay the mortgage), and is likely to own a ground car, a vision set, a washing machine, telephone and other luxuries. He can probably support a family in reasonable comfort, with access to excellent medical care if needed.

In cities **public transport** uses subways, robo-buses and robo-taxis; monorails and rockets are used for most long distance travel. There are even a few ocean liners left, though their appeal is romanticism and nostalgia, not speed.



Several layers of underground roads surface in midtown Manhattan. *Reuters*

- Finally, China is now ruled by a loose alliance of Buddhist sects, but there are still large areas where the old Japanese garrisons aren't going quietly and sporadic fighting continues. Fortunately nobody is using atomic weapons, although the Japanese may still possess them. Mostly the Chinese are waiting out the aging Japanese forces, and only resort to military action if there is no alternative. Outsiders are asked to avoid giving any aid or support to the Japanese, and there are stringent laws against supplying them with arms etc.

Needless to say there are a good few non-aligned nations, as well as nations with ties to more than one political bloc. For example, Canada has trade and defence ties with the United Americas and France as well as the Commonwealth; Australia has naval treaties with the Pacific Alliance.

There are also cases of nations disagreeing over the goals and alliances of their power bloc. For example, the British Commonwealth has naval treaties with the Brazilian Federation, which amongst other things allows Federation ships to use port facilities on the Falkland Islands to replenish their supplies. Argentina, a member of the Federation, refuses to acknowledge Britain's sovereignty over the Falklands. For this reason any Argentinean ships accompanying the Federation fleet fly Chilean colours if they have to use the Falklands facilities; it's a legal fiction to avoid acknowledging British sovereignty.

Most governments are currently reasonably liberal; the twentieth and early twenty-first centuries saw huge infringements of civil liberties, and there has been a backlash against unnecessary controls and monitoring of the population. Even the Caliphate and Pacific Alliance follow broadly democratic principles, despite their relative poverty. Sometimes this freedom might seem to go too far; it's easy for criminals to vanish, since few nations require proof of identity on a routine basis. Most of the perpetrators of the Planetary Trading Corporation scam dropped out of sight and seem unlikely to be found, and it is known that the pirate "Red Peri" and her associates spent time on Earth without detection. It's possible that they still do so.

One thing common to most nations is cheap electricity. It's easy to build a power plant based on a uranium-sodium atomic blast; sea water is fed in, a small proportion of the sodium in its salt is converted to energy, and superheated steam comes out to drive a turbine. If the steam is cooled afterwards it can be used as pure distilled water – the tiny amount of radioactive material that gets into the water as it boils is usually left behind with the salt, or diluted so much as to be harmless. The Sahara desalination project depends on this technology, and most of California and Nevada would be uninhabitable without it. Land-locked nations such as Switzerland and Bolivia must make other

arrangements, of course, but salt is found nearly everywhere and can easily be shipped where it is needed. Most ground vehicles, motor boats, etc. are electrical, run off high-capacity batteries; aircraft and ships are usually atomic, propelled directly by an atomic blast or indirectly by some version of the sea water turbine system. Electricity isn't free – there are still construction and infrastructure costs, and some uranium is needed to replenish the blast occasionally – but on average it's negligibly cheap compared to food, rent, and other expenses.

The most notable exception to the general prosperity is China, where fighting continues and the Japanese hold-outs still continue to loot the countryside. The general lawlessness of the occupied areas make them a haven for every sort of scum and villainy; several gangs of air pirates operate from Chinese territory, and until the discovery of the *Red Peri's* lair on Pluto it was believed that the fabled space pirate might also be based there. The League of Nations has repeatedly offered to help China deal with the situation, but the Chinese politely point out that the League originally supported the Japanese occupation of Manchuria, and did little to prevent their eventual conquest of China as a whole. Outside help is *not* required, but the Chinese government will always be happy to help the League should the need arise. The League has yet to take up the Chinese offer.

Adventure Idea: Mercy Flight

The adventurers are hired to help rescue a group of medical missionaries who are trapped between Japanese and Chinese forces somewhere in Manchuria. They might own the spaceship or atmospheric rocket used for the rescue flight, or might be mercenaries hired to protect it while it's on the ground.

In theory the job is simple; fly in, land, load the missionaries, and fly out. Of course things aren't that simple; the nearest suitable landing site is nearly a mile from the hospital, and the route is exposed to enemy fire. There are more doctors and patients than the ship can carry in a single flight. And optionally at least one of the doctors is trying to smuggle out stolen Ming dynasty art or other bulky valuables disguised as "essential records" or "medical specimens."

Alternatively, the hospital has already been captured by the Japanese by the time the adventurers arrive; the doctors are being held at gunpoint, and will be used as hostages to make the adventurers give up their ship.

Visiting Earth

It can probably be assumed that most readers either live on Earth or were born there; for the rare exceptions, it may be necessary to explain that due to the crowded nature of most areas of the planet flame pistols and explosive bullets are banned nearly everywhere, while most other weapons will at the very least arouse considerable comment. There are also various restrictions

An NYPD officer boards a hovering gyro to issue speeding and lane violation tickets. His own gyro hovers to the right, out of shot.

Everyday Life *(continued)*

For the wealthy, **gyros** were at one time the "must-have" status symbol, but as the price of basic models fall they are becoming more common for the merely well-to-do who need to commute long distances, since they can be flown without a full pilot's license. Most modern cities have flight lanes and landing pads for them.

The main **entertainment** mediums are the vision and radio channels; most cities have as many as six or eight vision stations, and even isolated areas can usually receive two or three. A typical family vision receiver has a 24" 3D colour screen and stereo sound; larger receivers are available, but cost as much as a gyro. One of the most popular shows is the *Yerba Mate* hour, shown every week since the early 21st century, with a succession of hosts, and is now syndicated globally. It's almost impossible to think of a vision star that *hasn't* appeared on the show at some point in their career.

Fashions change almost daily in the modern world, spread globally by the costumes of celebrities seen on screen, but for many years the prevailing women's leisure styles have been minimalist; a tabard or cuirass over abbreviated shorts, semi-transparent fabrics, metallic brassieres, and so forth. Men's clothing, and women's clothing for harsher environments, tend more towards the utilitarian.

Industries

Earth is the home of most of the industries in the Solar System, and the hub for nearly all trade.

The **Interplanetary Corporation** is based in New York, and famous for the ferocity with which it tries to maintain a near-monopoly on the technology of space travel[1]. This has led to allegations of patent theft and corruption, a recent stock market investigation[2], and a slump in its share value. Financial journalists believed at first that the company's current troubles might be the prelude to a hostile takeover bid, but there is no evidence that any mayor investor is trying to acquire shares, let alone a controlling interest in the company; the general downward trend suggests dumping of poorly-performing stock, with small investors buying most of the shares.

Boyds of London is the global market leader in insurance. Its economic importance is so great that Britain still enforces the death penalty for acts of piracy[1], regardless of other factors, where most other nations reserve it for murder. Piracy often involves murder, so this distinction isn't always clear, but where an American court might hand down a ten or twenty year sentence for bloodless piracy, a British court will hang.

There is no clear leader in the lucrative extraterrestrial pharmaceutical industry; in the USA **Pfazer** and **Jenson and Jenson** are the major players, in Britain **Galaxo** and **Imperial Chemical Enterprises** dominate, with at least a dozen other companies active around the world. Competition is fierce, on and off the Earth, since the first company to identify a new alien drug and bring it to market can earn hundreds of millions of dollars. The spectacular successes of anti-aging drugs based on *Xixtchil* pods and medicines based on Ganymedan *Cree* moss show how high the stakes can be.

[1]*The Red Peri* [2]*Redemption Cairn*

on the import of plants and animals that might be able to survive on Earth; these apply especially to Venusian plants and animals, the slinkers of Io, and Plutonian crystal "organisms." Most long-term off-world residents will find the gravity unpleasantly high and the crowds somewhat daunting. Visitors are strongly advised to employ a reputable guide for the duration of their stay.

Although the first alien contact was more than a century ago, only a handful of aliens have visited Earth; the League has made it clear that any attempt to transport aliens to Earth unwillingly will be treated as kidnapping and enslavement, both serious offences under international law. To date three Martians, two Venusians and one Ganymedan Nympus have made the trip voluntarily; so far as can be determined the Martians seemed to enjoy themselves but were tired by Earth's gravity and spent much of their time rooted, while the Venusians felt that the Everglades were "too bland" (despite one of them having been bitten by a water moccasin) and said that they would not be returning. The Nympus is currently a guest of the Smithsonian institution, and under their auspices is recording an anthology of traditional Ganymedan folk tales, most of them revolving around a trickster god or gods who delight in tormenting lesser beings with complicated natural disasters.

Adventure Idea: Innocent Abroad

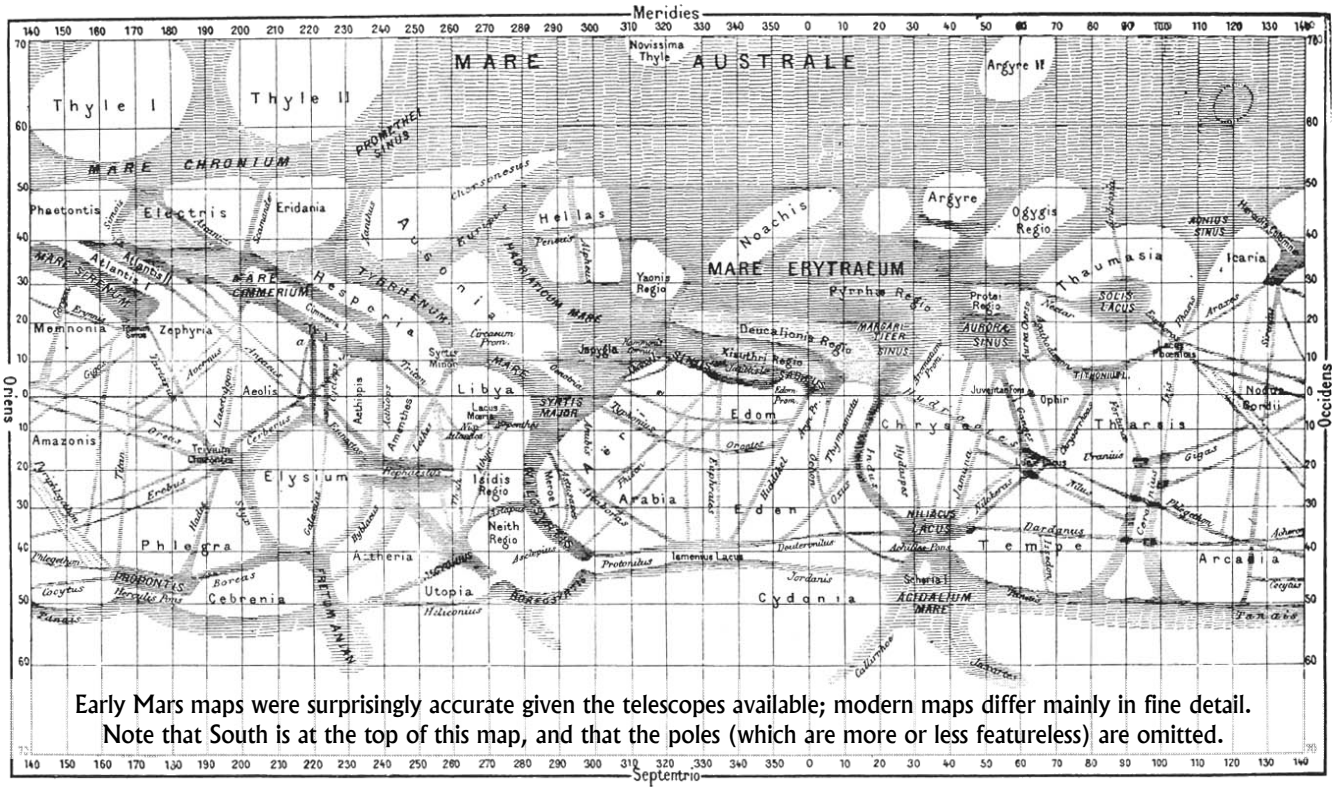
The adventurers stumble across two thugs beating up a visitor to Earth; Greg Grady, a Venus colonial. When the adventurers arrive the thugs run off. Grady doesn't want to go to the police; he's worried that they might be in the pockets of the Interplanetary Corporation. If anyone asks why (and they probably will) he explains that they want his land, and will stop at nothing to get the title deeds.

Naturally it's a scam; the thugs work for Grady. Exactly what is supposed to be on the land (about five hundred square miles in the Venusian Cool Country) is left to the referee, who ought to be able to tailor the story to the gullibility of players. For example:

- "A vein of pure Venusian silver as thick as your arm."
- "A whole damn *Xixtchil* forest, no need to trade with the natives to get the stuff."
- "That freighter that crash-landed last year; the crew are dead, but it's on my land fair and square, and the courts have given me six months to salvage it. The cargo's worth millions if I can just get it out."

The objective, of course, is to trick the adventurers into buying the land or investing in the scheme, whatever it is. Needless to say the land is more or less worthless, the deeds (and any other papers that might be produced) are forged, and the Interplanetary Corporation has no interest in it at all.

As an alternative, maybe the story is entirely true, and the Corporation really is after the land. The snag, of course, is that anyone associated with Grady becomes a target as soon as they get involved, and the Corporation really is as ruthless as he claims.



Early Mars maps were surprisingly accurate given the telescopes available; modern maps differ mainly in fine detail. Note that South is at the top of this map, and that the poles (which are more or less featureless) are omitted.

The thin air, still scarcely warmed by the rising sun, bit flesh and lung like needles, and they gasped with a sense of suffocation. They dropped to a sitting posture, waiting for their bodies, trained by months in acclimatization chambers back on earth, to accommodate themselves to the tenuous air. **Valley of Dreams**

"…the city rose out of the desert as abruptly as a cliff. Only a few little sand mounds marked the division, and then the walls of those gigantic structures.

"The architecture was strange, too. There were lots of devices that are impossible back home, such as set-backs in reverse, so that a building with a small base could spread out as it rose. That would be a valuable trick in New York, where land is almost priceless, but to do it, you'd have to transfer Martian gravitation there! **Valley of Dreams**

"…You know civilization isn't the personal prerogative of mankind, because look at the mighty decadent culture on Mars and the dead remnants on Titan." **The Lotus Eaters**

This painting in the Smithsonian's Mars gallery depicts Jarvis and Tweel at the end of their adventures. The artist worked from monochrome photographs and colours are not entirely accurate; in particular, the plants should be greener since their encounters took place in irrigated areas near the Martian canals.

Mars: Planet of the Thoth

It's extraordinarily lucky that the first successful interplanetary expedition found friends – the beaked *Thoth* people who we generally think of as the "true" Martians – and a world where humans could survive without any of the impediments that make life on Venus so uncomfortable. A properly acclimatised human needs no life support equipment, other than a Thermo-

Phobos and Deimos

	Phobos	Deimos
Orbital Height:	3700 ml.	12400 ml.
Surface Gravity:	~ Negligible ~	
Orbital Period:	7.5 hrs.	30 hrs.

The moons of Mars are tidally locked captured stony asteroids.

Phobos is about fourteen miles wide, seems about a third the diameter of Earth's moon from the surface of Mars, and is below the horizon at any point within about 700 miles of the Martian poles. It orbits faster than the rotation of Mars so rises in the West and sets in the East on an eleven hour cycle. It is eclipsed by Mars for a few minutes during most orbits.

Deimos is roughly eight miles across, but shaped more like a potato than a normal moon. It looks like a bright planet or star in the sky, and it takes a keen eye to spot its comparative closeness.

Radio beacons have been installed on both moons, and there is a League of Nations rescue cache on Phobos, containing fuel, medical supplies, tools, and other equipment and goods that might be useful in the event of an emergency.

Adventure Idea: Beacon

Last year a freighter with a faulty radio came close to running into Deimos. The powers that be have decided that lights will be mounted on the moon, covering every angle except straight down towards the surface – nobody is sure how the Thoth would react to new lights in the sky so they will be fitted with shades and angled so that they can't be seen from Mars. The adventurers have the job of installing them. While doing so they stumble across something unexpected; the wreck of an ancient chemical rocket built for a Thoth pilot. It's the first absolute proof that the Thoth travelled in space, although this has long been suspected; what will the adventurers do about it?

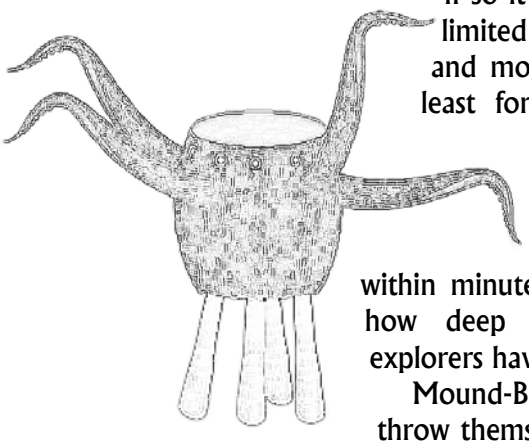
Skin™ sleeping bag and warm clothing, and can stay out in the open without any risk of disease or poisoning, in perfect safety, other than the slight risk of encountering one of the so-called Dream Beasts or another of the rare Martian predators. There are disadvantages, of course; we probably understand the Thoth less than any of the other intelligent races we've encountered, which is surprising considering the efforts that both sides have made to establish communications. We have no common ground with the other Martian races.

It was clear from the outset, of course, that Mars was home to an advanced civilization; we can see evidence of their engineering works from Earth! The *Ares* expedition made friendly contact with the Thoth and established that the canals were exactly what they appear to be; broad strips of irrigated land bordering artificial waterways. For at least ten thousand years the Thoth (with their even more enigmatic "Mound-Builder" allies) have built and tended the network of canals, pumping stations, and power plants needed to distribute a dwindling water supply around the planet, overcoming unimaginable odds to keep their world alive. With atomic power now added to their capabilities the balance has begun to tilt in their favour, although the supply of water to the equatorial cities is still limited.

It's fashionable to refer to the Thoth as 'decadent', because they have deserted most of their cities and obviously declined enormously in number. But it seems likely that this was a deliberate decision, a rational response to the dwindling supply of fuel which kept the race alive. Uncontrolled expansion would have surely doomed them long before humans arrived on the scene. Their ingenious solar power stations and windmills make the most of the limited energy available from the Sun, and their designs are now in use on Earth in areas where it isn't practical to install atomic power plants. While there was an initial theory that they might be tending this equipment by rote, it's now clear that they understand the technology; for example, when a group of Martians were shown plans for an adaptation of their windmill designs to Earth's gravity and wind forces they initially seemed surprised and drew a revised version more suited to Martian conditions, following human drafting conventions although this was the first time they had seen such plans. Once they understood that it was a design for Earth, not Mars, they made several useful changes suggesting a detailed knowledge of aerodynamics. It should be noted that they and the Mound-Builders continue to tend and use the older power systems, even though they now have several atomic power plants; it's probable that this is

simple caution, but some observers believe that this is "make-work" intended to keep the mound builders usefully busy.

There are many theories about the Mound-Builders, but little has been learned since the first landing on Mars. There is evidence to suggest that each mound is to some extent a hive mind, whose members share a single consciousness and will, but if so it must presumably be a very limited form of intelligence; time and motion studies suggest that at least forty percent of the activity inside their mounds is wasted effort, cancelled out by the activities of another Mound-Builder within minutes. Nobody is entirely sure how deep the mounds go; several explorers have been lost in their depths.



Mound-Builders have been known to throw themselves into the fertilizer they mix to support their colonies, and some writers have suggested that they regard the Thoth as another source of nutrient chemicals, pointing to Wells' Morlocks and Eloi as an analogy. In fact there is very little evidence to support this hypothesis; Mound-Builders have been seen removing Thoth corpses on only two occasions, and there is every reason to believe that both of the Thoth in question died naturally.

Since it has never been entirely clear that the Martians would welcome large-scale colonisation, there is only one permanent human settlement, a few miles outside the largest inhabited Martian city, Syrtis Parva at 0°N 255°W. It's jointly administered by the United Americas and British Commonwealth under a League of Nations charter. Explorers only venture far North or South in the appropriate hemisphere's summer. It has sometimes been argued that there would be more colonies if the Martians hadn't been given atomic power, but there is no way to put that particular genie back into its bottle. Although the Martians were only given one atomic blast they now have five atomic power plants; it is believed that the Thoth use specially bred biopods to extract minute traces of uranium from the soil, but the processes used to concentrate it and obtain usefully large pure samples remain a mystery.

A more practical reason for the lack of colonies is a lack of raw materials on Mars; as already noted, it has taken the Thoth nearly a hundred years to obtain enough uranium to fuel five power plants. Gold and the other precious metals are similarly rare, and gems seem to be very scarce; most of the geological processes that produce them are minimal on Mars. This leaves

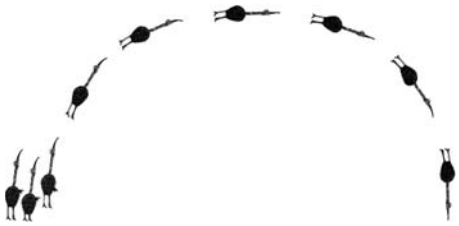
Kingdom *Areobiota*

Most Martian species are members of the kingdom *Areobiota*, which literally means "Martian organisms." All members of the phylum are carbon-based life-forms sharing some of the characteristics of plants and animals; they can photosynthesise and fulfil some or all of their biochemical needs by making complex chemicals from the atmosphere, soil chemicals, and water.

To supplement their diets many of the higher forms also eat the lower forms, while many of the lower forms eat carrion, since there are no decay organisms in the conventional sense. While it was previously thought that "hybrid" organisms of this type would be woefully inefficient and slow, experience on Mars has shown that this is simply not the case; the chemical processes used by Martian life have evolved to greater efficiency than those of Earth, presumably a response to the harsh environment. This efficiency and the simplified food chains made possible by the dual nature of *Areobiota* more than compensate for the reduced amount of solar energy reaching the planet.

Reproduction of all *Aerobiota* species is via parthenogenesis; there is only one sex, and any two members of the same species can join, share genes, and bud to produce offspring. There is some evidence that in the case of the Thoth the offspring inherit skills and knowledge from their parents, but this has never been proved conclusively since communications difficulties are so great. The criteria for pairing are unknown; nothing analogous to a mating ritual has been observed, and relationships appear to last only as long as it takes for the offspring to reach a suitable size for separation; the child separates from both parents when it is about two thirds of adult size (about 250 Mars days after parthenogenesis), and then appears to be cared for by the community as a whole.

The Thoth



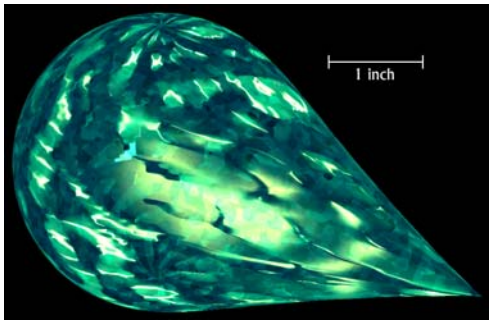
The Thoth are the most advanced *Aerobiota*. They are erect bipeds adapted to travel by walking or leaping; taking off by explosively fast contraction of the leg muscles, and landing head-first! As shown above the legs first contract then extend very rapidly, propelling the Thoth high into the air; it controls its "flight" and descent by flexing its neck, arms and legs. Heights of up to 80 ft and a maximum distance of 170ft have been reported. The brain of a Thoth is located in its body, not the head, and the long flexible neck and beaklike snout act as a shock absorber in the landing. It's notable that on rocky terrain their leaps tend to be much shorter, suggesting that the soft Martian soil also absorbs some of the impact of landing. They have occasionally been seen leaping from ground level to openings high overhead in their cities.

The Thoth obtain most of their nutrition from the soil and sunlight, but sometimes eat immature biopod buds, the Martian equivalents of fruit and seeds. Thoth have been offered human foods on numerous occasions but have never eaten it.

Biologists speculate that there may have been dangerous predator species on Mars in the past; the shape of the Thoth head and placement of eyes give them panoramic vision, while their leaping ability would allow them to escape from most threats. Both suggest a species which evolved to evade something considerably more active than the "Dream Beasts" of Mars.

Continued next page

the main Martian exports as antiques removed (with Thoth permission) from the abandoned cities, various biopod-derived chemicals with minor medical importance, and an occasional "Jarvis Crystal," the cancer-cure discovered by the first expedition. After the first expedition there were numerous attempts to find more crystals in occupied and abandoned Mound-Builder burrows, and most of the fatalities of the early years were due to accidents underground. All of these attempts failed; the Mound-Builders seem to have taken steps to prevent further thefts, presumably by moving the jewels to more secure locations, and can't be reasoned with or threatened.



The Thoth apparently know more, but don't seem to be interested in answering questions. Occasionally the Thoth give a crystal to one of the colonists, usually in exchange for something that seems to interest them; to date the trades have included a case of empty beer bottles, passages to Earth, a fork-lift truck with a burned-out motor, a poster of Woody Woodpecker, a wrist watch, and an incomplete collection of *Popular Mechanics* magazines from 2047 to 2053. They have ignored subsequent attempts to trade more bottles, watches, posters, trucks, etc. On two other occasions the crystals seem to have been outright gifts to humans who have helped a Thoth in some way. Crystals are worth between $25,000 and $100,000 on Earth, depending on their size. They are the only known cure for several of the most deadly cancers, but prolonged exposure has been known to weaken the immune system, sometimes before the original cancer has been cured.

The Thoth probably explored the Solar System when they were at the height of their power, circa 15,000 BC. Murals in several Martian cities depict scenes of Martians surrounded by humans who appear to be worshipping them[1]. Leroy, of the *Ares* expedition, believed that the picture resembled pre-Dynastic Egyptian images of the god Thoth; on hearing the name the Martians became excited and confirmed that it was their name for their species. Other evidence includes the presence of at least one off-world species on Mars; rat-like creatures described by the first expedition and subsequently captured by later explorers are larger but degenerate relatives of the Slinkers of Io[2]. It's possible that these creatures were brought to Mars by explorers from yet another world, of course, but the simplest explanation is that they are descended from specimens brought back by Martian explorers.

[1] *Valley of Dreams.* [2] *The Mad Moon.*

Since the Martians didn't have atomic power their flights must have taken years, and can only have been possible if the Martians slowed their plant-like metabolisms and took root for the duration of a low-energy Hohmann-type orbital flight. If it's true that the Martians deliberately transported slinkers to their home-world it's possible that they had some means of suspended animation. Alternatively, slinkers may have simply stowed away aboard a Martian ship, though how they survived such an extended flight remains a mystery.

How advanced are the Thoth? Nobody is entirely sure. Their architecture is impressive, even given the lower gravity of the planet, and their success in building more atomic blasts suggests considerable engineering skill. Most Thoth equipment, including their guns and ammunition, is hand-crafted in small workshops, not factories, but while they seem simple their "simplicity" is actually evidence of good design, and seems to be standardised to a remarkable extent. A gun built near one of the poles can exchange parts and ammunition with one built at the equator.

Although many aspects of Thoth society and personality are still mysterious, they are avid consumers of Terran animated films and seem to be in awe of certain characters, most notably Warner Brothers' "Road Runner" and to a lesser extent Universal's "Woody Woodpecker". There are obvious reasons for their love of these characters; they are vaguely similar in body form to the Martians, and some of the behaviour shown in these cartoons looks a little like the fast erratic movement of a Martian. Within months of the first cartoon screening on Mars it was noticed that Martians had begun to use the word-sound "beep-beep" for extra emphasis.

It was initially thought that the Thoth might be worshipping these characters as gods, but there is ample evidence that they understand the animation process, and realise that the characters are human creations. In 2076 a Thoth known as Ch'tiiiiir visited Earth; while in Washington it gave the Smithsonian institution fifty-six pictures which were eventually deciphered as a crude "storyboard" outline for a film based on the characters, in which Wile E. Coyote chases the Road Runner to Mars, falls into a series of traps based on peculiarities of the Martian environment, and is ultimately eaten by a Dream Beast, which he sees as an attractive female coyote. The Institutution contacted Warner Brothers and arranged to have the aimation made, with Ch'tiiiiir witnessing the production process from beginning to end. The cartoon was popular enough that several more cartoons have been made with a Martian setting, which often appear on children's television programmes. This has helped to reinforce the idea of the Martians as the friends of humanity.

The Thoth *(continued)*

Despite nearly a century of colonization Martians and humans still suffer from immense communications difficulties. Most concepts seems to involve elaborate mime and huge amounts of guesswork. It's very frustrating for linguists.

The Thoth see humans as clumsy, over-muscled, slightly stupid clowns. There's nothing cruel in this; humans can't see the fun in leaping into the air and landing head-first, understand Martian logic, and so forth. Thoth like to play linguistic games, so most conversations tend to be a mixture of Martian, pidgin English, and mime. This game is rarely abandoned entirely, even in life-threatening emergencies, and no Martian would dream of explaining the rules to a human. It will be more fun if humans work it out for themselves!

Thoth player characters should be built on 25 points, and begin with no knowledge of human languages or skills.

Chk'Treeeee - A Typical Thoth

BODY 4, MIND 6, SOUL 4

Beak, Effect 6 A:B/F, B:F/I, C:I

Kick, Effect 9, A:F, B:I, C:I/C

Pistol, Effect 6, A:F, B:I, C:C/K *

* The pistol fires 128 poison darts; the poison is harmless to humans but the darts can still do serious damage. The poison adds Effect 4+1/round if used against Martian organisms.

Skills: Athlete 8 (Jump only), Brawling 5, First Aid (Thoth only) 7, Linguist (English) 1, Marksman 7, Mechanic 9, Scientist (Engineering) 9

Quote: *"Wreeble ktok atomic blast beep-beep." [waves arms excitedly]*

Notes: Chk'Treeeee is a descendent of "Tweel," the first Martian to contact humans, and shares its ancestor's interest in alien life forms. It regards itself as a student of human nature and occasionally tests humans with situations where it appears to be in danger, visual puns, and so forth.

A 'mound builder' gathers vegetation for its colony's nest

My First Book of Mars (Puffin 2026)

Mound Builder

BODY 5, MIND 1, SOUL 1
Pincers, Effect 4 (x4) A:B, B:F, C:I
Darts, Effect 5, A:F, B:I, C:C/K
Skills: Brawling 4, Marksmanship 4
Quote: *"'We are v-r-r-riends! Ouch!"*
Notes: Lone mound builders are not in themselves intelligent or particularly dangerous, but if disturbed will attack in very large numbers and swamp their enemy under sheer weight of numbers. They appear to be indifferent to death or injury. They are normally unarmed, but their mounds contain stocks of metal darts for use against intruders.

False-colour infra-red photograph of the rat-like Martian species. The distribution of heat (red) and cold (blue) shows that they are warm-blooded, which implies that they could adapt to a warmer climate.

Scientific American

Pseudo-Rat

BODY 2, MIND 2, SOUL 1
Bite, Effect 4 A:F, B:F, C:I
Skills: Brawling 3
Quote: *"Squeak!!"*
Notes: These creatures look like large rats with capes, but appearances can be deceptive; they attack intelligently and in packs, and delight in leading their "enemies" into pits, deadfalls, and other hazards.

The Other Martians

While we generally think of the canal–building Thoth as "the Martians" several other Martian species show signs of intelligence. The most notable are, of course, the **mound builders** described above. They are tool-makers and seem to demonstrate telepathy, in the form of a communal hive mind, but their large head diaphragms suggest that they can hear noises well outside the range audible to humans. It's possible that this ability is actually continuous communication at frequencies humans cannot hear; more work is needed. They appear to be unable to communicate with other species, but are excellent mimics and cooperate with the canal-builders to keep the canals operating, although it may be that they do so by instinct. They are generally considered harmless if undisturbed, but Jarvis's account of a mound builder attack following his theft of a cancer-curing crystal shows just how dangerous they can be if provoked. In some respects they seem to be the most successful species on Mars, with colonies more widely spread than the Thoth cities, but observation suggests that many of the more isolated colonies are stagnating, with the population declining in response to dwindling supplies of the vegetation used as fertilizer in their mounds. The mounds in proximity to Thoth cities seem to be the most successful, reinforcing the idea that the species are to some extent dependent upon one another.

The caped **rat-like species** found in the ruined Martian cities shows disturbing signs of a degree of malevolent intelligence and are capable of bipedal locomotion. They are now known to be related to the 'Slinkers' of Io, their distant ancestors probably spread from one world to another by the early Martian explorers. They are larger and considerably less intelligent than their relatives on Io. Their size is probably an adaptation to conditions on Mars, which is considerably *colder* than Io and has stronger gravity. They are true animals, not the usual Martian plant-animal hybrids, warm-blooded, and omnivorous.

The exact relationship between these creatures and the Thoth is still unclear. It's apparent that the Thoth regard them as unwelcome visitors to their cities, but seem to be unwilling to do anything to exterminate them. They have been seen to handle Thoth personal belonging and books, but there is no evidence that they actually damage them. The Thoth resent their presence, but do not harm them.

Some ethnologists have speculated that the Thoth consider them to be holy, comparing them to the sacred animals found in India, Ceylon, and elsewhere on Earth; in particular, to the monkeys that roam free in some villages. Further research is needed.

The **dream beasts** use illusions to lure victims into striking range. While the mechanics of this process are far from clear, there is every reason to believe that it requires some intelligence, although in the case of the 'dream beasts' dissection has found no brains as such. Neural matter is distributed throughout the body, as in the hydrozoa these creatures resemble.

Life on Mars

While most attention has naturally been devoted to the sentient species of Mars, the planet has many other species.

It is believed that all of the native Martian species are *Areobiota*, the hybrid plant-animals described above, but it should be emphasised that many species have yet to be examined; Mars may still hold some surprises.

There are virtually no free-living Martian **microorganisms**, and the first explorers believed that there were none. In fact the harsh conditions and the presence of peroxides in much of the soil mean that most microorganisms are symbiotic with more advanced life forms, carried in root nodules and other specialised organs. The nodules protect the bacteria; in return they help their hosts to break down organic debris and use it as food. In the event of death these organisms will eventually destroy the corpse, but it can take several days for this process to start, one of the reasons for the erroneous reports of a bacteria-free world.

Biopods are the most basic of the higher organisms. They produce energy by photosynthesis[1] and find water and the minerals they need for growth by "walking" on their tendril-like roots, which are tipped with fine hooks and hairs. The contractile tissue is similar in structure to the muscles of Terrestrial animals, though the chemical process is different. When a source of nutrients is found, rapidly-growing root-hairs burrow into the soil.

A specimen of Martian 'Walking Grass' grows in a refrigerated dish of nutrient gel.
Kew Gardens, London

Since this process requires considerable energy, biopods always move out of shadows – reduced photosynthesis in the coiled roots causes them to slacken, so that tension in another root moves the plant into the light.

This was initially misinterpreted as a directed flight mechanism, since they seem to move away from danger, but in fact they simply move out of the shadow of the thing that endangers them.

[1]Their green photosynthetic pigment is not chlorophyll, but a chemical similar to the xanthophylls found in algae on Earth.

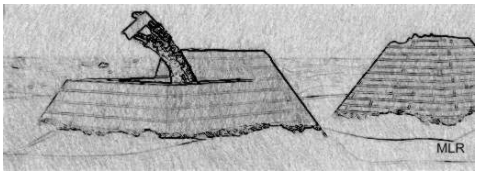
A young Dream Beast extends its fanged tentacles and mouths.
Time-Life 2027

Dream Beast

BODY 5, MIND 1, SOUL 1
Wrestle, effect 5, A:F, B:F/I, C:I
2-4 Bites, Effect 7, A:F, B:I, C:C/K
Skills: Brawling 5, Hypnosis 6
Quote: -
Notes: This creature induces believable hallucinations of something or someone the victim particularly desires if its Hypnosis overcomes the MIND of the victim. Once the victim is close it attacks with its tentacles and multiple mouths. Victims of multiple dream beasts may see multiple hallucinations, which sometimes breaks the illusion.

Adventure Idea: Dream a Little Dream

Terran organised crime is interested in the hypnotic power of Dream Beasts, and there's a rumoured $50,000 reward for anyone who can bring one back to Earth, packaged so that it can't hurt anyone. If the adventurers can manage it they'll be rich. Always assuming that they know the right criminals and that the rumour is true…



The silicon-based pyramid builder eats sand and excretes "bricks" which are used to build a protective structure around the creature inside. Periodically it completes its outer shell, and almost immediately shatters it to start anew.

Sketch by Leroy, Ares expedition

Pyramid Builder

BODY 20, MIND 1?, SOUL 1?
No attacks
Skills: -
Quote: -
Notes: Pyramid-builders seem to be completely indifferent to other forms of life. If their path from an old pyramid site to a new one is obstructed they simply climb over the obstruction, regardless of its size or nature. Since they are essentially living rocks they are immune to most physical attacks; even small quantities of explosive have failed to elicit any reaction. In view of their rarity such extreme experiments are now banned under colonial law.

These basic processes are easily seen in the simplest biopod, 'Walking Grass'; If the above-ground portion of any root is suddenly cast into shadow the hooks disengage and the plant literally springs an inch or two in a random direction, repeating the process until at least one root is in sunlight. They seem to be able to distinguish between shadow and nightfall, and do not continue hopping at night.

More advanced biopods resemble tumbleweeds with some control over their travels, mobile shrubbery, and the 'hopping mushrooms' made famous by Disney's live-action *Fantasia IV*. Some of these species are sensitive to touch, vibrations, etc. as well as light and the presence of water and nutrient elements.

No discussion of Martian life can be complete without mention of the enigmatic "pyramid-builders," immensely long-lived silicate life-forms. Only five are known, all at least 20,000 years old, but it's possible that smaller specimens have gone unnoticed. Their biology is a mystery; it's possible to chip samples from their bodies, but specimens crumble to dust in a few hours, leaving behind powder made up mainly of aluminium silicate with traces of other silicates. In summer they produce glassy gas-filled spheres believed to be eggs or spores; despite numerous tests none have ever been persuaded to "hatch." Further investigation is needed.

It may be that they are not native to Mars; a silicon species has been reported on Ganymede, but very little is known about it. It is unlikely that they were imported by the ancient Martians, since some of their pyramids are older than the earliest likely date for Martian space travel.

Pyramidology

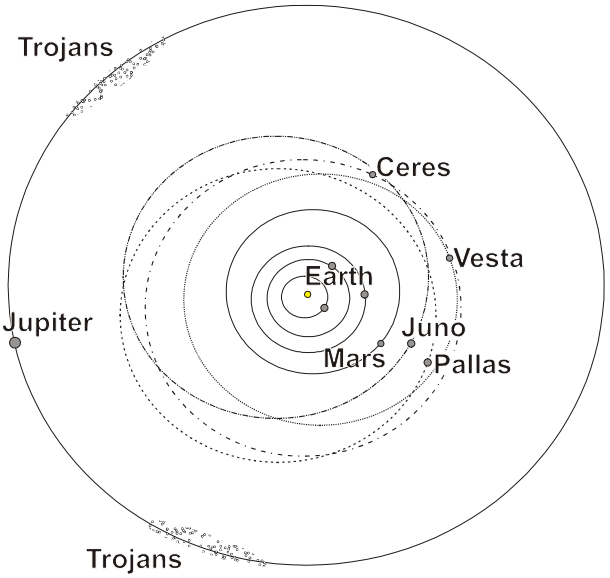
Contact with alien worlds sometimes has odd results; one has been a revival of interest in the 19th century fad for pyramidology, theories which claim that the pyramids of Egypt (and sometimes Mexico etc.) have immense symbolic and mystical significance, above and beyond their status as tombs. Details such as their precise dimensions are believed to predict the future, sharpen razor blades, or have other occult significance.

The revised theory claims that the pyramid-builders of Mars are the larval form of an advanced space-faring race which lays its eggs on planets, builds a series of ever-larger pyramids until it is ready to pupate, then spends thousands of years slowly changing to its adult form, buried deep below its final pyramid. Eventually the adult will emerge, possibly helped by its parents returning from space, and begin the cycle anew. They laid eggs on Earth hundreds of thousands of years ago. Humans, having long forgotten this ancient truth, adapted the upper levels of their pyramids as tombs and temples, unaware of the sleeping colossi that will eventually emerge. Needless to say there are numerous flaws in this theory, but nothing that a true believer can't explain away or ignore, and it's popular enough to have inspired numerous books and at least one vision series.

Exactly how the adventurers get involved in this is up to the referee. For example, it might be part of an eccentric adventurer's back-story, a reason for them to be in space. Adherents of the theory might charter a flight to Mars to visit one of the active pyramid-builders, or plan an expedition to the outer planets or the asteroids to look for the spacefaring adults or more pyramids. The adventurers might discover a more sinister version of the cult, or a scam that is using it to raise money for organised crime. Or it might turn out to be true... Whatever you choose, keep the adventurers guessing!

Suggested by Brian Ameringen

The lair of the Red Peri *remained a mystery, though League ships scoured asteroids, the far side of the desolate Moon, and even the diminutive satellites of Mars.* **The Red Peri**



The Asteroids: Cosmic Rubble

Most explorers regard the asteroids as a dangerous nuisance; navigation in any asteroid field is difficult and dangerous, with meteors and other space debris a small but constant threat. League ships have surveyed some of the larger asteroids during piracy suppression operations, but most are only known as dots on photographic plates. The chart shows positions in January 2115; in this view the planets and asteroids orbit in an anticlockwise direction.

Astronomers believe that one of the early proto-planets was ripped apart by the gravity of the newly-formed Jupiter, forming hundreds of small bodies rather than a single planet. Early theorists thought that Ceres, the largest and most spherical asteroid, was the core of the proto-planet, but exploration suggests that it is simply the largest fragment, and is made mostly of water ice with an outer layer of rocky dust.

The first four asteroids discovered, and the best known, are the "classic" asteroids; Ceres, Vesta, Juno, and Pallas. All are visible from Earth with relatively small telescopes, and easily spotted with shipboard instruments. Ceres, Vesta and Pallas are the largest asteroids; since their discovery several other asteroids which are smaller than Vesta but larger than Juno have been discovered, but they are made of dark carbonates and difficult to find in the darkness of space. All of the asteroids are considerably smaller than the Moon, with much lower gravity, and have no appreciable atmosphere. However, "smaller" is a relative term; Ceres is a sphere wider than Texas, its mass several hundred *million* times that of Mount Everest.

While the asteroid "belt" is the most familiar location for asteroids, there are two other large swarms; the Trojans, in Jupiter's orbit, grouped approximately 60° ahead of and behind Jupiter, and on average as far from Jupiter as Jupiter is from the Sun. Asteroids ahead of Jupiter (at the bottom of the diagram above) are referred to as the 'Greek camp', those behind as the 'Trojan camp.' The largest is 624 Hektor, actually a pair of similarly-sized and roughly spherical asteroids in contact with each other. Ironically, it was misplaced in the Greek camp, despite its Trojan name. The Trojan asteroid swarms have a much higher density of meteors and micro-meteors than the main asteroid belt.

Finally, the asteroids 433 Eros and 1566 Icarus are outliers, with orbits coming much closer to the Sun than the main asteroid belt. Eros orbits between 1.78 AU and 1.33 AU, crossing the orbit of Mars and approaching within 17 million miles of Earth every 81 years. Icarus is even more extreme, orbiting from 1.97 AU to 0.19 AU and crossing the orbits of all of the inner planets to approach nearer to the Sun than Mercury.

Data for these asteroids is summarised on the next page.

Asteroid	Dimensions (km)	Rotation Period hours	Orbital period years	Average distance from Sun (Earth = 1 AU)	Orbital eccentricity	Orbital inclination (degrees)	Gravity
Ceres	960 x932 km	9.08	4.60	2.77 AU	0.0789	10.58	0.028g
Pallas	570 x525 km	7.81	4.61	2.77 AU	0.2299	34.84	0.017g
Juno	240 km spheroid	7.21	4.36	2.67 AU	0.2579	12.97	0.012g
Vesta	530 km spheroid	5.34	3.63	2.36 AU	0.0895	7.14	0.022g
Hektor	Two 190km spheres	6.92	11.93	5.10 AU	0.0240	18.19	0.007g
Eros	34 x11x11 km	5.25	1.76	1.46 AU	0.2230	10.82	0.0006g
Icarus	1.4km irregular	2.26	1.12	1.08 AU	0.8270	22.85	0.0004g

The Case for the Asteroids

The asteroids contain more metal, in relatively accessible form, than has been mined throughout the history of the human race. Getting at it is simply a matter of power – and the power of atomic blasts is steadily increasing as new technology is developed and comes into use. Already radium-catalysed atomic blasts are powerful enough to melt much more metal than they consume; the new protactinium-initiator blasts will have several times more power. Given the low gravity of the asteroids, and sufficiently advanced engines, it ought to be possible to extract minerals at a fraction of the cost of conventional mining on Earth or the other planets; vaporize them, then purify them by magnetic or electrostatic separation.

Admittedly the technology is in its infancy, and most experiments to date have concentrated on molten rock, not gases, using centrifuges to separate metals. But there is nothing intrinsically impossible about asteroid mining, and sooner or later it will become the most cost-effective and pollution-free source of many of the metals needed by industry and commerce.

If industry doesn't appeal, there are thousands of unexplored worlds out there. Ceres alone has about an eighth the surface area of the old USA. Most of the asteroids have never even been visited. There could be *anything* out there; we'll never know unless we look.

Despite the League's claims to have "scoured asteroids" for the *Red Peri*, it seems likely that in many cases the search consisted of little more than telescopic observation from a ship on a very different orbit. Records of only eighteen asteroids are known to have been updated as a result of this search, all of them in the main belt.

The largest asteroid, and the most extensively explored, is **Ceres**. It consists of a stony core surrounded by an ice / water layer approximately a hundred kilometres thick (more fresh water than the entirety of Earth's ice caps, lakes and rivers), with an outer crust of carbonaceous rock, a few hundred metres thick, accumulated from meteoric dust. Water vapour occasionally reaches the surface, forming transitory areas of frost around cracks, but soon evaporates into space. Surface minerals include iron carbonates and clays, which can be used to fuel radium blast engines, but they're thoroughly mixed with other minerals, and extraction of sufficient iron for a flight to one of the habitable worlds is a difficult and lengthy process. To date no other useful minerals have been found there.

Although the temperature and pressure inside Ceres should theoretically keep water frozen, seismology suggests that the ice layer is a roughly 70:30 mixture of solid ice and supercooled water (average temperature -20°C), possibly kept liquid by some sort of natural anti-freeze. There appears to be some circulation of the liquid component, while the frozen portion is more or less immobile; the best theory is that the structure is a spongy matrix of ice containing interconnecting "bubbles" and "veins" of liquid water a few hundred metres across. The Smithsonian Institution has announced that it plans to explore the ice layer as soon as a suitable submersible vessel can be developed.

Pallas is a rocky asteroid whose composition (determined by spectroscopy – due to its eccentric orbit there have been no recorded landings) is a mixture of silicates and carbonaceous chondrites, meteoric rocks containing a mixture of silicates, oxides and sulphides and varying quantities of water. Its mass

suggests that it lacks a dense core. Chondrites often include simple organic molecules, but samples found on other asteroids and in meteors originating in the asteroid belt contain nothing especially noteworthy or useful, and there is no real reason to expect those of Pallas to be any different.

There's reason to believe that many of the iron meteorites landing on the inner planets originated on **Juno,** a smaller rocky asteroid composed mainly of iron-bearing silicates. These meteorites are debris thrown into space by an asteroid collision several thousand years ago, which left a hundred-kilometre wide crater. Despite Juno's eccentric orbit there have been attempts to exploit the iron, using radium blast engines to melt the iron out of the ore. Since radium engines break down iron there is no shortage of fuel, and there should theoretically be a good market for iron on Mars.

Unfortunately the Martians don't actually seem to be very interested, preferring glass and lighter metals, while the small number of colonists makes them a very limited market, and one that generally prefers manufactured goods to raw iron. A few cargoes were sold for modest profits in 2005-10, but not enough to justify continued exploitation in the aftermath of the 2110 recession. Economists believe that if there is a sustained recovery it should be worth resuming operations towards the end of the decade, taking advantage of Juno's next conjunction with Jupiter to fly cargoes to its moons as well as to Mars.

Vesta is the heaviest asteroid after Ceres. It consists of a range of stony minerals, most of them dating back to the original formation of the solar system, with a nickel-iron core. Mining the core would be extremely difficult, and currently there are many more accessible alternatives including Juno and the mines of Earth.

The largest Trojan asteroid is **Hektor**, actually a twin world consisting of two roughly spherical asteroids, each about 190Km across, which orbit around their common centre of gravity. They haven't been visited, but long-range photographs suggest that they may actually touch at times. They are orbited by a third asteroid, about 15Km across and 1000Km away, which acts as their moon. Photographs also show numerous faint glints of light which may be fragments of meteoric rock, also orbiting Hektor, and possibly debris thrown up by the occasional collisions of the main pair of asteroids. Some of these fragments may be large enough to endanger spacecraft.

The asteroid illustrated is **Eros**, an irregular rock whose orbit lies much nearer the Sun than most of the main belt asteroids, passing inside the orbit of Mars, although there is no risk of a collision within the next few million years. Eros has been visited several times, and is possibly the most promising candidate for future mining operations, since its rocks contain

The Case *against* the Asteroids

While explorers have visited Ceres and some of the other asteroids, there are major obstacles to thorough exploration and exploitation. The most obvious is distance; usually the major asteroids are further apart than Earth and Mars, and getting to the Trojans needs as much fuel as a trip to the moons of Jupiter. It's necessary to match orbital eccentricity and inclination to make a landing, which often adds significant fuel costs. Pallas and Hektor are barely reachable using the best modern ships, Icarus will have to wait for protactinium blasts – and there is unlikely to be much lead in the asteroids to fuel the return journey.

All of the asteroids lack air, and most lack water; the main exceptions are Ceres and a few other ice asteroids, none of which have any other readily exploitable resources. Without life there are none of the exotic biochemicals that make the colonisation of Venus and the moons of Jupiter worthwhile. Some asteroids have marginally worthwhile mineral resources, but there is nothing that can't be found more readily, and exploited far more easily, on Earth or one of the other worlds. The high density of meteors and micro-meteors is also a problem, especially in the Trojans, adding insurance costs as well as a small but real risk of damage to ships.

Of course it's possible that something will eventually be found to justify more intensive exploration, but for now the asteroids are primarily a nuisance which hinders traffic to the outer planets.

relatively high levels of several precious metals; for example, it's estimated that it contains more gold and silver than will ever be mined on Earth. However, these metals are thoroughly mixed with the other minerals that constitute the asteroid, and a hold full of raw ore would barely be worth the expense of a trip. As with the main belt asteroids, it will be necessary to extract and purify them on site. A factory ship, the *Thomas Bessemer*, was commissioned for this purpose by the Interplanetary Corporation in 2111, but vanished en route to Eros in 2113. It's suspected that the *Red Peri* may have captured it.

Another inner system asteroid is **Icarus**, one of the so-called Apollo asteroids whose orbit crosses those of Mercury, Venus, Earth and Mars. Its orbit is both eccentric and inclined to the plane of the Ecliptic, making an expedition very unlikely at any time in the near future – even the next generation protactinium engines would have difficulty coping with the huge velocity and angular changes. Although there is no reason to believe that Icarus is in any other way remarkable, this inaccessibility has naturally led to suggestions that it might be the hiding place of the *Red Peri*…

Adventure Idea: Make Money Fast…

Whenever a ship vanishes it's rumoured that the *Red Peri* or another pirate must have captured it. In the case of the *Thomas Bessemer* this theory is incorrect; the officers and crew committed barratry (see page 80), "borrowing" the ship from its rightful owners and taking it to a different asteroid.

The *Bessemer* is equipped to reduce rock to white-hot gases, and separate them electromagnetically. If the crew had followed the original mission profile they would have returned to Earth after a few months with a hold full of uranium and other useful metals. The crew decided to simplify the process; they're concentrating on collecting gold, plus just enough uranium and sodium to fuel the atomic blasts. The drawback is that gold isn't a major component of asteroid rocks, and collecting it is taking much longer than anticipated – two years after they stole the ship supplies are running low, they only have about half as much gold as they can carry, and there are signs that they are close to exhausting the main ore lodes of the asteroid.

It's time to move on, either returning to Earth to sell the gold, or finding another asteroid to plunder.

At current values there is enough gold aboard to make everyone very rich, but selling it will be difficult; a middle-man is needed to broker the sale and legitimise the transaction, and is bound to want the lion's share of the profits. The Captain claims to know someone, but is being very cagy about the details. Getting the ship to Earth without incident may not be entirely straightforward; the *Bessemer* is a large and distinctively designed ship, and will be recognized immediately if it is spotted by a League patrol ship or Earth's authorities.

Finding another metal-rich asteroid would be relatively easy, and might allow more time for the ship to be forgotten, but supplies are a problem; air can be extracted from rock, but food and many other everyday items (such as clothing and toilet paper) are impossible to synthesise with the equipment aboard the *Bessemer*. It might be possible to land on Earth and buy them, but sneaking in and out without detection would be difficult, and the captain suspects that the crew will mutiny and take the gold if he tried it.

There's one obvious solution – intercept a freighter or liner soon after it leaves Earth and "liberate" its supplies. But that's an act of piracy, which so far the *Bessemer* has avoided; stealing the ship (or rather diverting it from its original mission) is a moderately serious criminal offence attracting a few years of imprisonment, piracy often carries the death penalty. Everyone aboard is aware of the distinction and reluctant to go that route.

There's one thing everyone aboard the *Bessemer* has overlooked – the value of gold only remains stable so long as no new cheap sources appear. If it becomes public knowledge that it's possible to produce hundreds of tons this easily, the price will plummet. Powerful forces in government and the financial world will go to almost any lengths to ensure that this does not happen.

Exactly how the adventurers become involved in this is left open – they might be members of the crew, or members of the crew of a ship that runs into or is intercepted by the *Bessemer*. In an Earth-based campaign they might work for the Captain's black-market contacts, or might be police assigned to track them down. In a League of Nations Patrol campaign they might be sent to search for the *Bessemer,* or have to rescue another ship the *Bessemer* has attacked. One interesting approach is to give a Patrol crew the job of capturing the *Bessemer*, then conduct the Board of Enquiry, an in-depth review of everything that went wrong (or right) with their mission, with the players taking on the additional roles of lawyers for the ship owners, the crew of the *Bessemer,* and the Patrol itself.

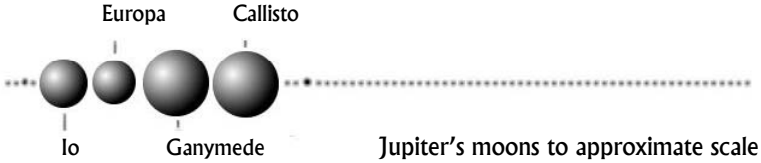
…he had visualized Io as something like Titan, cold but clean.

Instead it was as hot as the Venus Hotlands because of its glowing primary, and subject to half a dozen different forms of steamy daylight—sun day, Jovian day, Jovian and sun day, Europa light, and occasionally actual and dismal night. And most of these came in the course of Io's forty-two-hour revolution, too—a mad succession of changing lights. **The Mad Moon**

Europa, like the Moon, keeps one face always toward its primary. Here in this vast depression, all of the tiny world's scanty atmosphere is collected, gathered like little lakes and puddles into the valleys between mountain ranges that often pierce through the low-lying air into the emptiness of space.

Often enough a single valley forms a microcosm sundered by nothingness from the rest of the planet, generating its own little rainstorms under pygmy cloud banks, inhabited by its indigenous life, untouched by, and unaware of, all else. **Redemption Cairn**

Jupiter shone pale and ghostlike in the night sky and far off, a tiny pinprick in the black, was Earth… …A few land leets, disturbed by their presence, dragged themselves slowly from the rock. Amherst, who always preferred fresh food to the concentrates of his kit, caught and cooked them in the ray stove for dinner. The octopus-like animals were good eating… **Tidal Moon**



Jupiter's moons to approximate scale

Jupiter: King of the Planets

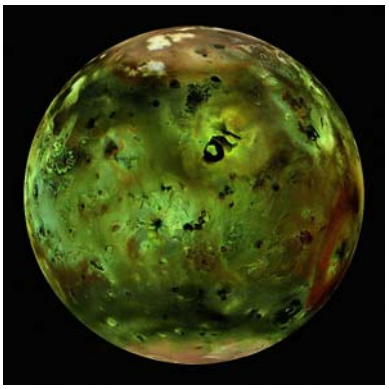
A solar system in miniature, Jupiter has more than twice the mass of the other planets combined, and is orbited by dozens of moons, most notably the four classic Galilean satellites; Io, Europa, Ganymede and Callisto. Jupiter itself is uninhabitable; a gas giant whose heat and pressure will destroy any ship, with gravity strong enough to trap any vessel that ventures much closer than the orbit of Io, periodically bombarded by asteroids and comets sucked in by its gravity, wracked by gigantic magnetic storms whose static makes radio communication difficult for millions of miles around. However, these properties combine to make the inner Galilean moons habitable – Jupiter radiates enough heat to give life a chance, and the moons are stressed by tidal forces, leading to volcanism and renewal of their atmospheres. As a result Io has a positively tropical climate, Europa has temperate microclimates, and survival on Ganymede requires little more than warm clothing. Callisto has no known life and only traces of an atmosphere, and is covered in a layer of ice several miles thick, but exploration has been minimal and it is possible that something has been missed. The four minor moons closer to Jupiter are tiny baked airless hells, the outer fifty or so are airless and perpetually frozen – essentially they are captured asteroids, mostly less than a hundred kilometres across, in highly eccentric

orbits, destined to circle Jupiter for a few hundred thousand years before gravitational forces rip them apart or throw them into Jupiter's atmosphere or into the depths of space. A few have been explored, but little of interest has been found. They are accompanied by swarms of meteors and fine meteoric dust, effectively forming a miniature asteroid belt. The outer belt is so dusty that it forms faint rings around Jupiter, but they are virtually invisible from the equatorial plane occupied by all of the major moons.

	Diameter km	Orbital radius (AU)	Orbital Period (years)	Gravity Earth = 1	Day	Atmosphere
Jupiter	143000	5.2	11.86	2.5	9hr 54m	Hydrogen, helium, trace gases
Major moons	**Diameter km**	**Orbital radius (km)**	**Orbital Period (days)**	**Gravity Earth = 1**	**Day**	**Atmosphere**
Io	3660	421,800	1.77	0.33	21 hrs.	Oxygen, nitrogen, methane[1]
Europa	3121	671,100	3.55	0.13	3.55 days	Oxygen, nitrogen
Ganymede	5262	1,070,400	7.16	0.52	6.5 days	Oxygen, nitrogen, ammonia[1]
Callisto	4820	1,882,700	16.69	0.13	16.69 days	None

Europa and Callisto are tidally locked, with one face constantly turned towards Jupiter. Io rotates at double its orbital speed, so that from its surface Jupiter appears to rise, set, and rise again once for each orbit, an apparent day of 42 hours; this is caused by orbital resonance, another form of tidal locking[2]. Ganymede's day is a little shorter than its orbital period, so that it rotates once every six months relative to Jupiter. Massive tides sweep around the moon in time with its rotation. The orbits of the inner three Galilean moons are also gravitationally locked in 4:2:1 resonance; one Ganymede orbit takes as long as two orbits of Europa or four of Io. Occasional alignments of these moons can be another cause of high tides on Ganymede.

Io: The Jungle Moon



Io from Space - *National Geographic 2086*

Warmed by the immense heat of Jupiter, Io's equatorial jungles have been compared unfavourably with those of Cambodia or the Venusian Hotlands, but opinion is divided as to which is worse.

There are temperate conditions within 20° of the poles (references to this limit as the 'twentieth parallel' are incorrect but unfortunately very common; it is actually the *seventieth* parallel[3]). These temperate zones are larger than they might at first appear; each has an area of about a third of a million square miles, but much of this area is rocky volcanic barrens. There are two polar cities; Junopolis at the North Pole and Herapolis at the South. Communication between these cities is by rocket or winged aircraft, flight is complicated by dense cloud and mountain ranges which extend beyond the atmosphere. Radio is almost useless, due to interference from Jupiter's constant electrical storms. Jupiter looms huge in the sky, more than 19° wide; by comparison, Earth's moon covers 0.6°

[1] Io is described differently in different stories, and there are inconsistencies within the most authoritative source, *The Mad Moon*. Briefly, this story describes Io as a tropical environment requiring no special protective equipment; but *Tidal Moon* describes the atmosphere of Io as "mostly methane" and mentions that the atmosphere of Ganymede contains ammonia. For game purposes Io's atmosphere contains methane traces as a greenhouse gas, too dilute to pose problems for human visitors.

[2] *The Mad Moon* states that Io's day is 42 hours, the same as its orbital period. This implies tidal locking – but Weinbaum also describes Jupiter rising and setting in the sky. The best explanation is that Io spins twice as fast as it orbits Jupiter, so that its day *relative to Jupiter* is 42 hours.

[3] If the geography described in *The Mad Moon* is taken literally, Io's tropics are small and the temperate zones are larger than the USA, but it's obvious that this is not what was intended. Confusion over parallels seems the most likely explanation – the main protagonist of *The Mad Moon* is delirious for much of the story!

The denser parts of the jungle are lethally dangerous to humans; there are several deadly plant species, most notably stinging palms (whose leaves are edged with scores of poison-tipped spikes), spike-tipped arrow vines, giant venomous carnivorous worms known as "toothers," and corrosive bullet-head frogs:

	Body	Weapon	Effect	A	B	C
Stinging Palms	12	Spikes[1]	6+1D6 poison	F	I	C/K
Arrow Vine	6	Fangs[1]	4+1D6 poison	F	I	I
Toother	16	Fangs[2]	12+2D6 poison	I	C	K
Bullet-headed Frog	12	Fangs[2]	9+1D6 poison	F	I	C/K
		acid spray[3]	3D6 poison	F	I	I/C

[1] Attacks with Brawling 4. [2] Attacks with Brawling 8.
[3] Attacks with Marksmanship 8, Acid spray, cone 3ft radius, causes burns to skin etc., critical injuries can include blindness.

Elsewhere the main hazards are White Fever (see side text) and the malicious slinkers, intelligent rat-sized nuisances living in "villages" which they are willing to defend to the death.

Io's main export is ferva leaves, which contain a range of medical alkaloids. In their crudest form the leaves can be chewed to combat the effects of *blancha*, but chemical processing converts the raw leaves into a wide variety of medical alkaloids – ferverin, which is ironically most useful on Io for treating the effects of blancha, and a much wider range of painkillers and anti-inflammatory drugs useful in alleviating the effects of a wide variety of illnesses including the common cold and influenza. Care must be taken in the use of these drugs, especially the raw leave, since they also have euphoric and hallucinogenic effects.

Currently most of the leaves that are exported are collected by one of the native species, the so-called Loonies, but recently Neilan Drug began to cultivate the plants in cleared plantations at the polar edges of the jungle, with encouraging results. It's anticipated that prices will fall as production increases, but new markets and uses should easily make up the loss.

While Neilan Drug specialises in ferva leaves and their derivatives, their smaller rival Ionian Products (primarily a skin exporter) has found red *Cree* moss growing in the temperate zones, and hopes to duplicate the process pioneered by Cree Inc. of Ganymede, which converts worthless red moss to medicinally valuable blue.[1] Most experts believe that there is little hope of success, since the blue moss is affected by Ganymede's atmospheric chemistry and unique insect life, neither of which can readily be adapted to Io's conditions. It's predicted that Ionian Products will either abandon the project or form some sort of partnership with Cree Inc., exporting moss to Ganymede for final processing.

[1] *Tidal Moon*

Blancha (White Fever)

Blancha, or white fever, is the most common illness on Io, affecting most visitors to the tropics of the moon. Its effects most closely resemble those of malaria, with similar causes, and include nausea and hallucinations.

The main vector for the disease is the virtually microscopic swamp midge, smaller than the mosquitoes of Earth and almost impossible to keep out of clothing, huts, etc. They swarm in large numbers whenever they feel a ground disturbance that might indicate the presence of an animal whose blood is worth sucking.

Their saliva is infected with a miocro-organism very similar to *plasmodium vivax*, the malaria parasite, but its life cycle is far less predictable – bouts of fever can last from a few hours to several days, and the period between bouts is also very variable.

The disease is rarely fatal, but chronic infection can lead to permanent neural damage similar to multiple sclerosis.

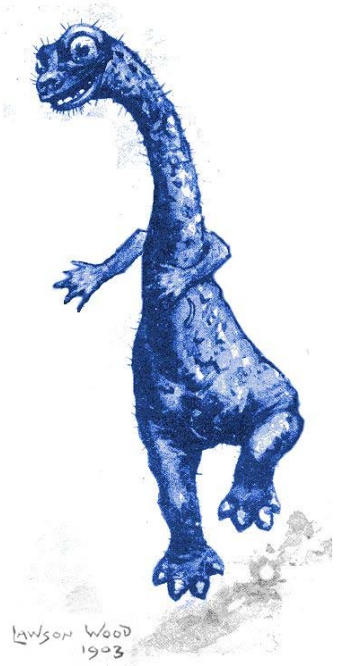
Studies of the native loonies show that most are infected with the parasites, but seem not to be greatly affected by it. Slinkers appear to be relatively immune.

Sleep Deprivation

Io's confusing day-night cycle can cause disrupted sleep patterns and associated medical and psychological problems. When combined with *blancha* the effects can include apparently lucid dreams, vivid hallucinations and sleepwalking.

Vitamin Deficiencies

Visitors to Io (and the other Galilean moons) should be alert for vitamin C and D shortages; Io's plants and animals do not produce either vitamin, and Jupiter receives insufficient sunlight for vitamin D to form in the skin, even in the equatorial zone. The polar cities have artificial solariums and farms with full-spectrum lighting to grow terrestrial plants, but these facilities aren't available elsewhere, and residents must be sure to keep a good stock of diet supplements.



A typical Loony jumps with excitement when offered candy *Pearson's Magazine 2103*

Loony
BODY 3, MIND 1, SOUL 2
No attacks
Skills: Linguist 1(?)
Quote: "*Canny!" (giggles idiotically)*
Notes: Adult Loonies are about nine feet tall including their heads and necks. They are vegetarians and reproduce sexually, the females laying large eggs which are incubated by both parents. The adults have few natural predators, but Slinkers have been seeing smashing and eating their eggs. There is evidence that there was once a relatively advanced Loony civilization, and that the Loonies still dimly remember it, but whatever spark of greatness they once had is long gone.
Role Playing: Loonies are profoundly stupid and should be played mainly for comic effect, with an edge of pathos. They have little or no "common sense" and seem to lack basic survival instincts; they often die through stupid accidents or by apparently deliberate but motiveless suicide. They like candy and occasionally manage to obey very simple commands to get it, but are more likely to misunderstand completely.

Io has two native "intelligent" species, but the intelligence of both is a matter of debate and prejudice.

…The loonies—Lunae Jovis Magnicapites, or literally, Bigheads of Jupiter's Moon—backed away, giggling plaintively. Beyond doubt, they considered Grant fully as idiotic as he considered them, and were quite unable to understand the reasons for his anger. But they certainly realized that no candy was to be forthcoming, and their giggles took on a note of keen disappointment.

So keen, indeed, that the leader, after twisting his ridiculous blue face in an imbecilic grin at Grant, voiced a last wild giggle and dashed his head against a glittering stone-bark tree. His companions casually picked up his body and moved off, with his head dragging behind them on its neck like a prisoner's ball on a chain. **The Mad Moon**

The childish **loonies** were until recently considered to be a race that had never evolved true intelligence, but the discovery of an abandoned loony city in the Idiot's Hills suggests that they have instead regressed from more human levels of intelligence. Exactly why this occurred is open to question, since there does not appear to have been any sudden change in conditions on Io. There is no evidence of war. One theory is that as the loony civilisation expanded they were unexpectedly exposed to blancha fever for the first time, and suffered a pandemic which obliterated most of the race and left a tiny number of survivors, inbred to such an extent that hereditary idiocy became the dominant genetic trait. A related theory suggests that their behaviour is a drugged response to the disease plus heavy consumption of ferva leaves. The most plausible theory, however, suggests that their decline is linked to the rise of the rat-like omnivorous slinkers, which have been seen to eat their eggs. It's hoped that future archaeological work will provide more information.

A minority and somewhat far-fetched theory suggests that the loonies are actually considerably more intelligent than they appear, and are faking their stupidity to discourage human contact. There is little evidence to support the hypothesis, and some aspects of their behaviour, most notably their indifference to their own safety, argue against it.

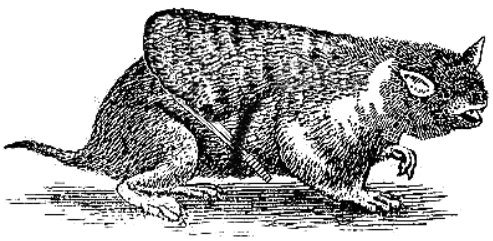
A variant of this theory, popular amongst certain circles on Earth, suggests that the human colonists are somehow responsible for their lack of intelligence, or greatly exaggerate it, to excuse their "theft" of loony lands. It would be tedious to list all the flaws in this argument; all explorers and colonists agree that loony behaviour has changed little since the first landings, and that the loonies have no interest in the polar regions, the most habitable parts of the moon, preferring to stay in the jungle.

"…They learn so quickly, and they breed like flies. Suppose they pick up the use of gas, or suppose they develop little rifles for their poisonous darts. That's possible, because they work in metals right now, and they know fire. That would put them practically on a par with man as far as offense goes, for what good are our giant cannons and rocket planes against six-inch slinkers? And to be just on even terms would be fatal; one slinker for one man would be a hell of a trade." **The Mad Moon**

The **slinkers** (*Mus Sapiens)* have been described as exhibiting "pseudo-intelligence," but this term is a misnomer, usually used to condone their mistreatment; slinker intelligence is very real. Their civilization includes agriculture (with a field system which suggests that they understand crop rotation), metal-work, crude chemistry, and an obvious ability to make plans for activities such as raids against human targets. They mostly appear to be indifferent to humans, or regard them as a target for theft and cruel jokes, but react violently to any intrusion on the areas they control. Naturally they have good reason – they are tiny compared to humans, and dozens of lives might be taken by a human who blunders through a village without regard for its buildings and inhabitants. The League regards the situation with some concern, and hopes that as ferva production moves to a plantation system and to the edges of the jungle there will be less cause for humans to disturb slinker settlements.

One unanswered question is the degree of cooperation between slinker villages. Most evidence suggests that in general they handle their own affairs, without concern for a wider slinker community. Should they begin to unite against humans and develop higher technology it is possible that they would be able to drive the colonists from the jungle completely, or even force a complete evacuation of Io.

Numerous "experts" have commented on the association between the slinkers and the decadent loonies, and the similar association between the related Martian species and the decadent Thoth, suggesting that they might in some way be responsible for the downfall of these civilisations. This seems highly unlikely – while the exact cause of the loonies decline is unknown, the Martian decline is clearly related to a lack of resources and deliberate population reduction, and is already reversing as the Martians begin to use atomic power. There is evidently some animosity between the Thoth and the Martian subspecies of *Mus sapiens*, but this seems unlikely to be the cause. Despite this the League has ruled that these species may not be transported from their respective worlds, for fear that they might one day reach Earth and become a serious pest.



A slinker, its crude sword partially concealed by its "cape" of fur-covered skin and held in place by a belt of woven plant fibres.
Scientific American 2079

Slinker

BODY 1, MIND 2, SOUL 2
Bite, Effect 2, A:F, B:F, C:F/I
Sword, Effect 3, A:F, B:F, C:I
Dart, Effect 1, A:F, B:F, C:F, plus poison Effect 1 + 1/round, A:F, B:F, C:I
Skills: Athlete (run, climb) 3, Brawling 2, Mechanic 2, Marksmanship 3, Melee weapon 2, Stealth 8, Thief 4
Equipment: Knife, poison darts
Quote: *"Squeek!"*
Notes: The skills shown are for a typical slinker that might be encountered hunting; in their villages there are also farmers, smiths, and other more specialised workers, and for all that is known to the contrary there may be equivalents of doctors, scholars, scientists etc.

Little is known of slinker society, but their technology and behaviour suggests that they have reached medieval levels of organization, science and technology, and may have progressed further. They actively pursue intruders that damage their villages, and may be developing more powerful weapons to deal with the threat they perceive from human interlopers.

Role Playing: Generally slinkers are not a serious threat, but if they are hurt or their homes are threatened they become vindictive and very dangerous. Run them in pairs and small groups at first, then hit human characters with an army of dozens or hundreds, possibly armed with spears as well as darts, if they don't take care. Although they have short lives the arms race between humans and slinkers will evolve over years, not days, and their weapons won't change much in the course of an adventure (but see below).

Recent papers in the *Journal of Life Studies*[1] suggest that Earth may have had a lucky escape; if slinkers were indeed spread to other worlds by a prehistoric Martian expedition, Earth's relatively high gravity plus the presence of domesticated cats in Egypt may have prevented infestation – unable to attain their normal speeds, the slinkers would have been easy prey for cats and other predators. It may not be entirely coincidental that the origins of Egyptian cat-worship can be traced to the approximate period of Martian exploration.

Adventure Idea: Arms Race

…he knew that a tiny slinker village was over in that direction, for once he had glimpsed the neat little buildings, constructed of small, perfectly fitted stones like a miniature medieval town, complete to towers and battlements. It was said that there were even slinker wars. **The Mad Moon**

The slinkers have a plan. They see the human colonists as a threat and plan to deal with them, as they previously dealt with the loonies. But humans are a tougher proposition than the relatively fragile loonies (who were virtually wiped out by the slinkers systematically spreading disease to their food and destroying their medical supplies). This time they're going to have to resort to direct violence. They're going to have to think big – and some slinker genius comes up with the idea of giant steam-powered mecha… The term 'giant' is relative, initially they'll be about 3ft tall and armed with relatively small steam-powered guns. But with each generation they'll get bigger and nastier.

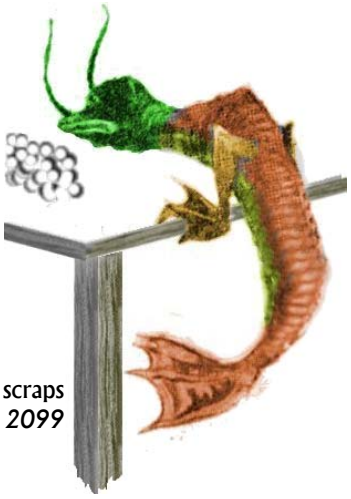
Exactly how the players get involved is up to you – they might be:

- League of Nations marines or civilian mercenaries brought in to pacify Io at colossal expense, but fighting at the wrong end of a ridiculously long supply line.
- Civilians caught up in the war and trying to reach the poles for evacuation off-world.
- Space-crew trying to organise the evacuation to one of the other Jovian moons and finding more of a slinker threat with every flight. And of course having to deal with occasional slinker stowaways, odious colonial officials and plantation owners, etc.
- Diplomats or scientists trying to find a peaceful solution (good luck with that one…)

See *Forgotten Futures IX* for some simple automaton design rules – for the purposes of this scenario the resources available to the slinkers are represented by a cash budget. Substitute slinker pilots, gunners, etc. for the mechanical "brains" etc. they mention, with controls and passenger space costing about half as much as the equivalent brain and program cylinders. Start off with a budget of say £25 per village for the initial designs, escalating to £50 after 1D6 Io days, £75 after another 1D6 days, and so on. Of course there are a LOT of slinker villages, and they'll all have their own ideas – one may build a single "giant" machine, another several smaller models. Any technology they can steal will be incorporated – after a while some of the mecha will have flame pistols and fully-sized guns, eventually some may be atomic powered or fly. Don't be afraid to get silly!

Useful references here are the films *Apocalypse Now, Alien(s)* and *Starship Troopers*, the TV series *Battlestar Galactica*, Larry Niven's *The Mote In God's Eye*, and books about the Vietnam war, jungle warfare, etc.

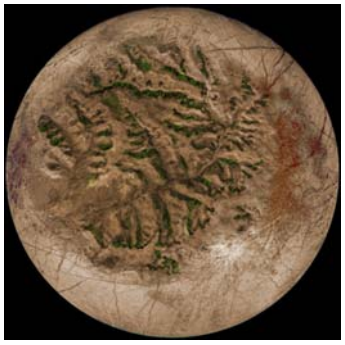
One other Ionian species should be mentioned – parcats are roughly cat-sized animals with one rear leg and two front paws. They are excellent mimics and, like parrots, can be trained to learn simple phrases (and often pick them up after hearing them once). They are not intelligent or dangerous, and have no other useful skills, but happily live on table scraps and basic vegetable foods, eat insects and other pests (but avoid slinkers) and can easily be house trained. They can't adapt to conditions on Earth or Venus, the gravity is too strong, but they thrive in free fall and are a good pet for spacemen and colonists on low-gravity worlds and moons.



Parcat foraging for food scraps
Saturday Evening Post 2099

[1] Most notably *Limiting Factors in the Spread of Mus Sapiens* by Nicoll, Jordan, *et al.*

Europa: Small Edens



Europa viewed from Io
Herapolis Observatory, 2102

Tidally locked to Jupiter, Europa is the smallest of the Galilean satellites, and in many ways the strangest. The surface is airless, but the side of the moon facing Jupiter is marked by an enormous depression (covering about 30% of Europa's surface) containing dozens of small deep air-filled valleys separated by mountain ranges. The valleys are home to a startling variety of plant and animal species, and have been compared to the Galapagos Islands as an example of evolution in action. The terrain is constantly disturbed by quakes, tidal forces, and other geological phenomena, and the valleys occasionally merge then separate again over a few years or decades. Biologists have successfully tracked the evolution of species as they move from one valley to another, either by crossing the airless peaks or by taking advantage of temporary gaps caused by these natural forces.

Europan life usually hybridises plant and animal characteristics, in a manner similar to the *Areobiota* of Mars. Most "plants" have some animal characteristics, while most "animals" can photosynthesise and produce some or all of their food from sunlight. All are asexual. To date explorers have found no dangerous or toxic species and no bacteria harmful to humans, and it is possible to live on Europan species for several weeks without ill-effects, although vitamin supplements are essential. Some examples:

- **Bladder-Birds** look like large flying squirrels at low altitudes, but are able to inflate a large air sac and hold their breath long enough to travel small distances through vacuum. Naturally they cannot fly in these airless regions, they must travel on foot. Their "blood" resembles dense sap and doesn't readily boil at low pressure, which helps to prevent decompression illnesses.
- **Song-Bushes** are inedible but notable for their tinkling scaly leaves, which rattle in the wind to create a melody explorers have described as "sweet and plaintive." Specimens have been grown from seeds at the Botanical Gardens at Kew, London, but quickly succumbed to fungal infections when removed from the laboratory.
- **Nutsies** are aquatic creatures which resemble small walnuts with shells. They live in salty pools on the valley floors.
- The **Liver-leaf** is a bush with large thick edible leaves. Unsurprisingly, they taste like liver.
- Finally, Europan **Truffles** are brown, fungus-like lumps that grew under song-bushes, and taste like Earth truffles with an added meaty flavour.

Naturally there are hundreds of other Europan species, several having the ability to survive vacuum for short periods, or produce seeds which can survive in vacuum for weeks to years, and thousands of subspecies, but the variations are mostly of interest to biologists.

It's Life, Jim... But Is It Kosher..?

One of the odd questions to come out of interplanetary travel is the religious status of alien foods. Many faiths have dietary codes, and edible species must be tested to see if they conform. Europa is an extreme case because it has so many edible species, but the question has vexed clerics and scholars since the first landing on Mars. In the case of Europa, for example, the Reform Jewish interpretation is as follows:

- **Bladder-Birds** are not predators and do not have cloven hooves or chew cud. They are Kosher *if prepared correctly;* they must be drained of blood and the heart, lungs, and air bladder must be removed as soon as they are killed.[1]
- **Nutsies** are Treif (non-Kosher) since they resemble shellfish and their diet includes decaying material.
- The **Liver-leaf** and **Truffles** are both considered to be plants, so Kosher if washed to remove insects etc.

Orthodox Jews and Buddhists refuse to eat *all* Martian and Europan species since they are neither animal nor vegetable.

These debates are common to many religions; for instance, the Vatican took several years to rule that Venusian fish can be eaten on Fridays!

[1] A variant opinion compares bladder-birds to bats, which are Treif, and refuses to eat them.

Cycle of Fire

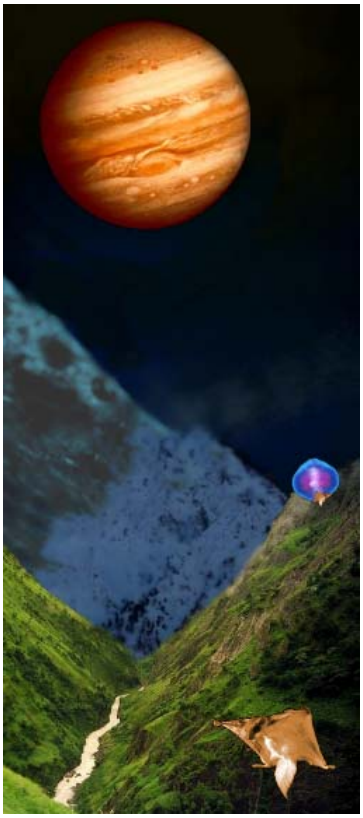
Geologists have begun to realise that Europa's terrain and atmosphere are truly transitory, sculpted by titanic tidal, volcanic, and radioactive forces, and continually shifting over the millennia:

- Jupiter's tides left Europa with an asymmetrical core, a bulge towards Jupiter containing a concentration of heavy radioactive elements.
- Heat generated by this radioactive core material causes volcanism, which is again concentrated on the hemisphere facing Jupiter. There are currently at least eight active volcanoes in the 30% of Europa's surface nearest to Jupiter, none elsewhere. Rapid mountain-building causes the underlying rock to melt and the surface to subside elsewhere in this basin – the rock of the rest of the moon is too cool to be so drastically affected.
- Huge quantities of rock and ash are thrown out by the volcanoes; in Europa's low gravity most of it travels far beyond the volcanic zone, building up the surface elsewhere.
- Over millions of years this has resulted in the whole volcanic basin effectively sinking towards Europa's core, while the surface around it has been built up by the deposited volcanic ejecta. Many valleys are three to four miles deep; the basin's average depth is roughly two miles.
- Gas released by the volcanoes tends to be pulled towards the side of Europa facing Jupiter, filling the volcanic basin; these volcanic gases are initially toxic, but bacteria similar to those found in sulphurous water on Earth break them down via thermosynthesis, releasing carbon dioxide, methane, and other gases. Photosynthesis then makes the atmosphere breathable.
- Fossil evidence shows that volcanic gas production occasionally overloads the capacity of this ecosystem, leading to mass extinctions which may have prevented evolution of intelligent life.

While Europa's life attracts considerable scientific interest, most recent expeditions have searched for much more material rewards; the mountains of the habitable zone have deposits of protactinium, a highly radioactive mineral that has only been found in traces elsewhere, which will eventually be important for the next generation of atomic blast engines. It seems unlikely that it can be mined on any large scale without serious damage to the valleys, and currently several law-suits are working their way through the League's courts, with various groups vying for mineral rights and to have Europa declared a wildlife sanctuary. Until these cases are resolved there is unlikely to be legal commercial exploitation, but there is evidence of "hit and run" expeditions in defiance of the courts, in which ships have landed, identified an ore deposit, blasted it free without concern for the environment, and left before they could be intercepted.

No protactinium has been found elsewhere on Europa; it's believed that the peculiar geology of the region has exposed minerals that are otherwise only found miles below the surface.

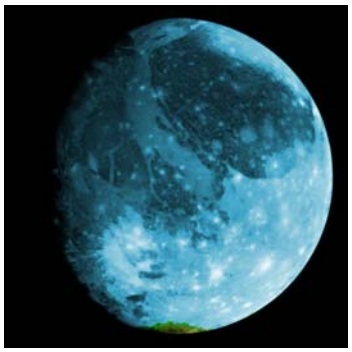
In the long run it is likely that mining will be approved, and a permanent colony set up on the strangest and most hospitable of Jupiter's moons. How this will affect life and the environment of Europa remains to be seen, but the League and the scientific community in general will be watching very carefully. Nobody is entirely sure how stable Europa's atmosphere might be; wholesale damage might upset the delicate balance of gas exchange to such an extent that the moon experiences one of the mass extinctions that fossil evidence suggests occurs every few thousand years, leaving Europa uninhabitable.



A bladder-bird (bottom right) glides over slopes near the floor of an Europan valley. Higher up the slope, another has inflated its air bladder in response to low pressure; after landing it will crawl up, cross the ridge in vacuum, and drop down into the next valley. Jupiter covers 12 ° of the sky.

Exploring Europa – Penguin 2096

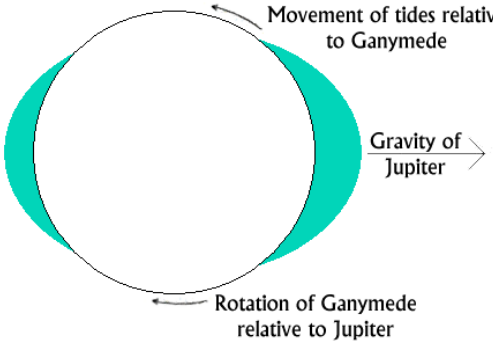
Ganymede: The Tidal Moon



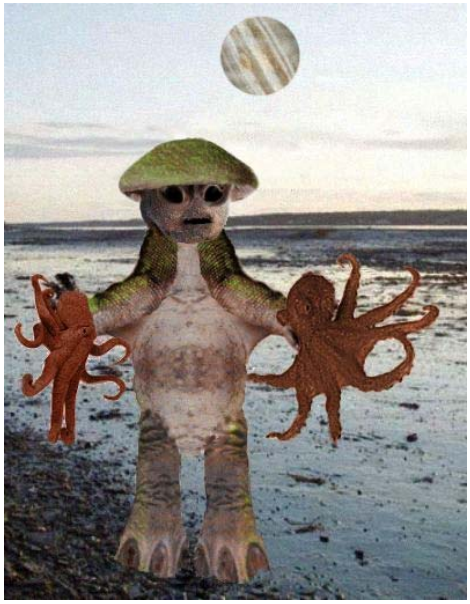
Ganymede photographed from Earth's Moon
Smithsonian Institution 2038

First visited in the 2040s, Ganymede is the biggest, coldest and wettest of Jupiter's habitable moons, and the first to be colonised. With the exception of a region of a few thousand square miles of stable land centred on Hydropole, the south polar colony, the entire surface is a mixture of swamps, mud flats and shallow seas, interrupted by occasional rocky outcrops and mountains, periodically inundated by tidal floods that may exceed fifty feet in height. Even the mountains are transitory, continually eroded by water and occasionally shattering under the weight of the water trapped behind them, and slowly replaced by geological processes.

Ganymede's day is a little shorter than its orbital period, so that it rotates once every six months relative to Jupiter. Although Ganymede is more than a million kilometres from Jupiter, the planet still covers nearly 8° of the sky, and its gravity raises huge tides. As with Earth's tides there are two tidal bulges in the sea, one facing Jupiter and one on the far side, so that every part of the moon apart from the poles experiences a high tide every three months. Tides are higher on the side facing Jupiter and very slightly higher when Jupiter, Ganymede and the Sun are in line, but at this distance the Sun's gravitational effect is minor compared to the influence of Jupiter. Ganymede's rotation is slowing towards a tidal lock, with the friction of the tides releasing heat (which keeps the seas from freezing) at the expense of rotational energy; recent observations suggest that Ganymede will finally synchronize with Jupiter in roughly 950,000 years. Once tidally locked, the seas will mostly freeze in a permanent ice age, apart from a permanent sea on the side warmed by Jupiter, surrounded by glaciers. For the moment the temperature averages a little below freezing at the poles, rising to 40-50°F at the equator.



Currently life flourishes on Ganymede, with numerous animal species including the intelligent Nympus. Since most organic material is swept out to sea almost as soon as it forms, there is no soil as such over most of the moon. Plant life is thus confined to the seas and the South Pole (there is no north polar land mass); the exception is tenacious *cree* moss, which successfully resists all but the strongest waves. The Nympus harvest it and bury it in caves excavated under their villages, using relatively sophisticated construction techniques to build domes over the entrances which can usually withstand the pressure of high tide. During the flood the farmers stay underground for several earth days; since there isn't room in the caves for everyone, the remaining villagers stay on the surface, living in stilt houses made of compressed dead cree. These houses float if necessary, but some are lost with each tide.



A Ganymedan nympus offers to sell his catch, an amphibious land-leet (left) and an aquatic sea-leet (right). Both are edible by humans, but the land-leet is generally considered "good eating," the sea-leet is not.
Holiday Magazine 2090

Soon after the first landing it was learned that the blue form of cree contains a powerful analgesic and curative drug, later named *Crephine*, which is now the main export of Ganymede. A colony soon built up around the south pole, servicing cree collectors and explorers, most notably Cree Inc. and its employees. The city of Hydrople now has a population of several thousand, most either

Cree and *Crephine*

Red cree moss grows almost everywhere on Ganymede. It's widely used by the nympus, most notably as fertiliser and, pressed and dried, as a construction material. It has little value to humans.

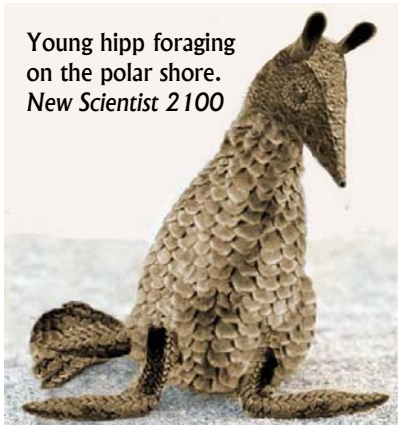
Periodically the red moss turns blue, usually a week or two before the next high tide. Blue moss contains *crephine*, a powerful drug which relieves pain and promotes healing. A bale of moss can be processed to produce an ounce or so of crephine. Unfortunately blue cree isn't stable; it contains organisms that only thrive in the presence of the ammonia in Ganymede's air. Ammonia is water soluble and gradually used up as the moss ages; if it is buried or submerged in water for an extended period, it turns red and its curative powers are lost. The best time to pick it is just before the tidal flood, but this is the most dangerous time to be on the surface. Cree Inc. traders hire natives to gather the moss and pack it for shipment to Earth, but there is only a limited time window before it turns red, and one when the natives are at their busiest, preparing for the inundation. In 2083 Carl Kent, a cree trader, found a better answer.

The Kent process uses a mixture of ammonia and natural ingredients such as gall-ant eggs to turn red cree blue. The process only works with living moss, not the huge masses of decaying moss the nympus have collected over thousands of years, but still dramatically increases the quantities of blue moss that are available for shipment, and expands the time window for collecting it. Crephine production trebled in the years after this discovery.

To date nobody has been able to duplicate this process off Ganymede; the living ingredients are too specific to this moon to be duplicated easily. It's rumoured that Ionian Products, an Io fur trading and drug house, backed the theft of the formula in 2083; they have yet to sell any blue cree or crephine.

working in the cree industry or in one of the service industries connected with it, such as warehousing and the spaceport.

Hydropole has an automated transport system based on wire-guided buses, which can navigate through the pole's occasional blizzards without problems. Elsewhere the most common means of transport is the Hipp *(Hippocampus Catamiti)*, an amphibious animal named for and resembling the mythical Terran "Sea Horse". They have bodies about twenty feet long, two front legs, and a muscular finned tail instead of rear legs. On land their broad feet help them to avoid sinking into mud; in the water they can swim very strongly, essential in the turbulent tidal floods.



Young hipp foraging on the polar shore. *New Scientist 2100*

Amphibious trucks are becoming more common as the colony expands, but are less capable of coping with extreme conditions and rarely venture far north of Hydropole.

Adventure Idea: The Last Round-Up

All of the hipps used around Hydropole come from a single herd. After several decades of domestication the colonists start to notice that they are no longer thriving; their endurance and speed is deteriorating, and they seem to suffer more illnesses. The natives claim that the herd is too small, and is becoming too inbred; unless new blood is introduced things will only get worst, and the herd will be headed for the last round-up. Needless to say the Nympus don't use that exact phrase, but that's what they mean.

Adventurers with suitable skills such as Scientist (zoologist), Doctor (veterinary surgeon), Riding, etc. should be recruited for a mission to save the herd – they're to take the best hipps and ride North, find wild herds, capture the best animals, and bring them back to Hydropole. Just to complicate things, *National Geographic* happens to have a camera crew on Ganymede, and wants to film the expedition; *Blasters and Ammo* wants the adventurers to field-test some new weapons designed for Ganymede's conditions; and the local Ford dealership plans a rival expedition by amphibious truck to prove that hipps are no longer needed. And needless to say there will be problems with the tide, dangerous animals, etc. etc.

Hipp

BODY 9, MIND 1, SOUL 1 Scales, Armour -3
Bite, Effect 6, A:F, B:F, C:I
Tail "kick", Effect 10, A:F, B:I, C:C
Skills: Athlete 10 (swimming), Athlete 4 (running), Brawling 6
Quote: *"ooooooruuuuunnnngggg!"*
Notes: Hipps are essentially amphibious horses. If stressed they may forget that their riders are less amphibious and need air occasionally...

Naturally Ganymede has many other animal species, some of them extremely dangerous:

The giant "**amoeba**" *(gigamoeba proteus)* is actually a multicellular predator which steals the form of its victim, though they remain semi-transparent and cannot easily be mistaken for their prey by any intelligent observer. For example, after eating a land leet one might have tentacles. They are usually small, but occasional examples are large enough to eat a Nympus, a hipp, or even a gamma rorqual. They have been known to attack and even kill humans, but cannot absorb their forms.

Gamma Rorquals are a whale-like species with a spiked tooth and greatly resemble the narwhal of Earth. They have been described as mammals in behaviour and body temperature, although their cellular structure is naturally very different to the mammals of Earth; one of the best examples of convergent evolution. They aren't aggressive, but will defend themselves if they feel threatened by e.g. an approaching boat. Their pods are sometimes accompanied by hipps, whose armour makes them relatively immune to being impaled; there is some evidence that they band together against predators.

The amphibious **Land Leet** greatly resembles a Terran octopus but its physiology actually bears more resemblance to echinoderms such as starfish. They vary from mouse to rabbit sized, with larger specimens occasionally reported. They are not dangerous, and are generally considered to be "good eating"; all that's needed to cook them is a knife and a portable ray stove or other source of heat.

The four-winged **Blanket Bat** can grow to thirty or more feet across. It feeds on electrical signals from the nervous system of its victims, leaving them weakened to the point of helplessness, but does no physical damage. There are unconfirmed reports of a similar species on Io. Since their attack is primarily electrical, it can be defeated by grounding the bat with a metal cable, such as a harpoon line, but shooting it in the heart (which is on the centre line of the body) is usually more practical.

From the side a huge, black bulk, that blinding light in its center, moved toward him.

…he felt himself being drawn. Ahead was the light, bright, warm, hypnotizing—at either side was nothing.

…he could make out a great, yawning hole, inside which a piston-like rod moved up and down. **Tidal Moon**

Finally, there has been one unconfirmed report of a silicon species resembling the pyramid-builders of Mars, but mobile and taking the form of a rectangular **black monolith** rather than a pyramid. This species allegedly eats meat as well as minerals, and is reputedly able to emit a light beam which takes control of the mind of victims so that they are forced to move into its

The *Nympus*

The Nympus are often considered the most intelligent species after humans and the Thoth. Their underwater domes are impressive feats of engineering, incorporating complex hydraulics and sophisticated construction techniques and chemistry. They seem to be capable of learning reasonably good English, though they are unable to speak it clearly due to anatomical differences from humans. Yet they appear to have little or no ambition, and seem to share a fatalistic approach that assumes that everything always ends in disaster, and that it is pointless to try to evade it. A typical example is the construction of rickety floating homes, which must surely be death traps if they are ever caught in the full fury of a tidal surge.

Anthropologists have learned that the Nympus believe in trickster gods which delight in tormenting the Nympus, but reserve the most horrible disasters for those who try to evade them. For example, workers in the underwater farms pray that if their dome collapses they will be allowed to die quickly; it's better than praying to be allowed to escape, because if that happens something worse is bound to occur. While the equivalent human gods are generally believed to respect those who outsmart them, the Ganymedan gods resent and punish them.

Physiologically, the Nympus most resemble Terran amphibious reptiles such as turtles, but are less well adapted to aquatic life; they can hold their breath for several minutes, but lack most of the mechanisms that are common amongst animals that spend extended periods at sea. Their webbed arms and hands suggest that at one time they were more aquatic.

The Nympus attitude to humans is simple; they think that we are presumptuous fools with too much pride in our technology, who are likely to suffer some particularly nasty fate when the gods get bored with us.

Continued next page

The *Nympus (continued)*

Despite these reservations the Nympus are generally willing to work with humans and have grasped the idea of wages, which they use to buy tools, knives, and crops from the farms around Hydropole.

Nich'thtell - ATypical Nympus
BODY 2, MIND 3, SOUL 2
Skills: Athlete (swim) 5, Brawling 2, First Aid (Nympus only) 5, Mechanic (air purifiers) 4, Linguist (English) 1, Melee weapon 3, Riding (hipp) 4
Equipment: Knife, fishing spear, tools.
Quote: *"Yeh, shuth phulph!" ("yes, shut valve")*
Notes: Nich'thtell is a cree gatherer and farm mechanic. Between tides he gathers red cree for use as fertiliser and blue to sell to Cree Inc. traders. As the tide comes closer he moves into his villages' underground farm and tends to its life support machinery.

The village shaman has prophesised that a blanket bat will drain his life force, after which he will drown. This is generally regarded as a *good* death, fast and relatively painless, and he is envied by those who have been told that they will be skewered by gamma rorquals, trampled by hipps, sacrificed to eldritch demons by the human colonists, etc.
Role Playing: Nich'thtell is very much a fatalist, convinced that his lot in life is to die, and eager to get it over with if it will save him from the torments of the gods. This doesn't mean he deliberately goes out looking for death; any attempt to cheat the gods that way inevitably leads to a much more horrible death! Until his happy release he will be a dutiful widowed father to two young Nympus (three others have died horribly in childhood) and a hard worker who helps to keep his village fed. A useful role model is Marvin the Paranoid Android.

Nympus player characters should be built on 15 points, and begin with no knowledge of human languages or skills.

maw, which is basically a powerful rock crusher. Victims are aware of their condition but have no free will, unless something interrupts their line of sight to this peculiar creature.

	BODY	Weapon	Effect	A	B	C
Amoeba	3D6	See notes[1]	BODY	F	I	C/K
Gamma Rorqual	10	"Spear"[2]	12	F/I	I	C/K
Land Leet	1-3	None	-	-	-	-
Blanket Bat	15	See notes[3]	10	F	I	C
Black Monolith	20	See notes[4]	15	I	C	K

[1] The Amoeba's attack (made with BODY+1 Brawling) varies according to whatever it last ate; it might use tentacles for strangling or wrestling damage, fangs, a spear, etc. They are not known to be venomous, but Ganymede does have venomous species, and it is possible that this attribute could be added to another attack; if so, its Effect will be BODY /2. *OPTIONALLY* their attack injects chemicals which start to convert native species to another amoeba whilst still alive; if so, Terrans will just be poisoned, not transformed, but Nympus will be at risk.

[2] Attacks with Brawling 6

[3] Attacks with Brawling 8, attacks target BODY first, then MIND or SOUL (whichever is lowest)
- On an F result the characteristic is reduced by 1
- On an I result it is reduced by 1D6
- On a C result it immediately drops to zero.

If any characteristic is reduced to zero the victim will become unconscious; if there is only one target the bat continues to feed until all characteristics are reduced to zero, otherwise it attacks someone else. After an attack it takes 1D3 hours for characteristics to rise from zero to 1, after that recovery rolls against Difficulty 3 can be made for each characteristic once an hour:
- On an A result there is no improvement.
- A B result restores 1D3 to the characteristic.
- A C result restores 1D6 to the characteristic.

[4] This creature has Armour -4. It can move about 20ft per round, but once moving does not easily change direction. Its initial attack targets the MIND of anyone looking at the monolith's light with Effect 8; on a B or C result the victim cannot do anything except move towards the monolith by whatever means they were previously using, or walking at a normal speed if they were previously stationary. If a roll of MIND against the attack's Effect gets a C result the victim can look away in subsequent rounds, but not in the first round. Otherwise, the hypnotic effect will only be interrupted if something obstructs the monolith's light. Victims who cannot break free continue to move forward until they enter the monolith's maw. Once inside the maw they are attacked by the equivalent of a large rock crusher, taking damage each round, but will be free of the compulsion. Since they are also probably badly injured this isn't necessarily much help!

Callisto: Cold to the Core

In this tracking experiment a Patrol vessel running its atomic blast at full power while orbiting Callisto is visible in photographs taken from a ground-based telescope on Io. The ship is in the top left corner of the picture, and appears to be an unusually bright star.

The exhaust was ***not*** readily detectable at the reduced power levels typical of cruising speeds.

League of Nations Patrol: Confidential Report on Piracy, 2082

There's very little to be said about Callisto; it's nearly twice as far from Jupiter as Ganymede, and due to a variety of factors including distance, weaker gravity, weaker tidal forces, and little or no internal heat is roughly a hundred degrees colder. It's essentially a rocky globe with an average surface temperature around -70ºF (-57ºC); its core is solid, with no molten centre. There is no atmosphere except for traces of various inert gases, no known life, and nothing especially interesting has ever been found there; certainly nothing to justify the cost of another expedition.

Callisto has been relatively unchanged for several hundred million years, without any of the geological upheavals of Jupiter's other moons. Asteroid and meteor collisions have left the surface covered with hundreds of thousands of craters of various sizes, but there are no great "seas" or other distinctive features. One consequence is that the accessible minerals are too poor for it to be worth setting up mining operations; without volcanism heavy elements such as gold or uranium stay close to the core.

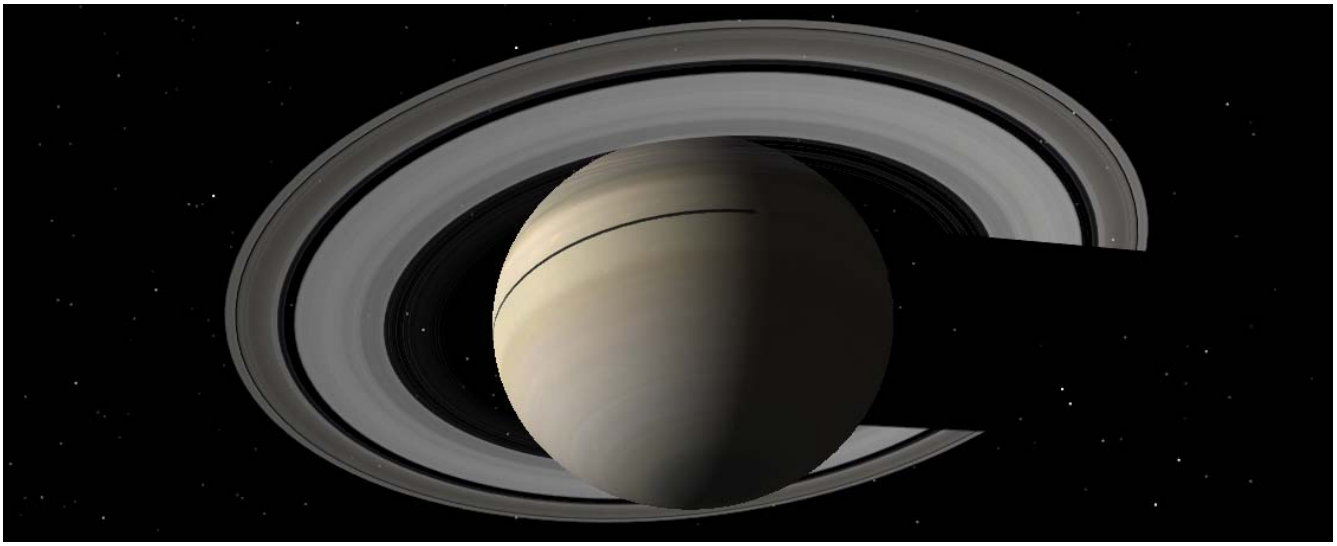
In 2093 Patrol ships searching for the pirate *Red Peri* detected wreckage in one of the moon's larger craters. This was initially thought to be the *Peri,* which had not been seen in several months, but was soon identified as the gutted hulk of the Planetary Lines freighter *Sirius,* whose crew mutinied en route from Earth to Mars in 2091. The ship was missing its engines, air purifiers, fuel, etc. Four bodies were identified as the ringleaders of the mutiny – the Captain and passengers had earlier been marooned on Phobos but fortunately rescued by the Patrol. Five other mutineers were never found. Forensic evidence suggests that the Sirius was intercepted by pirates several weeks after the mutiny, and that the pirates executed mutineers who refused to cooperate. Forensic evidence suggests that the pirate ship was *not* the *Red Peri;* surface dust near the wreck was fused by the exhaust of another ship with a uranium engine, the *Peri* is believed to have radium or protactinium blasts.

Prior to this, Callisto had been suggested as a possible hiding place for pirates, but it seems implausible that they would dump the wreckage close to home. Additionally, there are none of the minerals and other resources that would be needed to sustain a pirate base, and Callisto is usually visible from the inner moons and from ships travelling between them – it seems unlikely that a pirate ship could come and go without being noticed sooner or later, especially when running its engines at full power to take off or land. An argument in *favour* of the idea of Callisto as a pirate base is its relative closeness to the populated moons of Jupiter, and some of the richest cargoes in the solar system, and one line of thought suggests that dumping the *Sirius* there might be a double bluff, with a well-concealed base elsewhere on the moon. There is little evidence either way.

Statistical analysis of recent attacks shows that ships on routes from Venus and Mars to Earth are most at risk, with the majority of ships attacked being Planetary Lines vessels, and no special emphasis on ships on the Jupiter routes, but this may simply reflect higher traffic levels on the inner system routes.

Adventure Idea: Spares

Components from the *Sirius* are found aboard the *Taltos,* a ship mothballed on Earth's moon. They aren't original equipment; they must have been fitted as replacements before the ship was scrapped in 2105. *Taltos* also belonged to Planetary Lines, and would have been serviced in their own yards, but the service logs (which would have recorded serial numbers of any components removed or replaced) were discarded when the ship was decommissioned. It's possible that for some reason parts from the Sirius were legitimately removed and fitted to the Taltos prior to the mutiny, but the insurers suspect some sort of scam, and hire the adventurers to investigate.



A rare view of Saturn from below the plane of its rings. Most of the brighter "stars" in the picture are Saturn's smaller moons; Titan and the other major moons are in much more distant orbits. ***National Geographic 2098***

Saturn: The Ringed Wonder

Saturn is the largest planet after Jupiter, and like Jupiter radiates enough internal heat to warm its moons a little. It has an incredibly diverse system of rings and more than sixty moons and moonlets, but only two, Titan and Iapetus, have atmospheres. The others have been mapped from space but for the most part have not been visited; their extremely low mass and gravity suggests that there are no heavy metals, the main reason for visiting airless moons.

The rings of Saturn are about 300,000 kilometres wide, beginning roughly 6,630 kilometres above the atmosphere, but average only about twenty metres thick. They're made mostly of ice and meteoric dust, and in general aren't dangerous, but they do include tens of thousands of "bergs," lumps of ice as large as a gyro or an old-style automobile, and a few hundred ranging in size from a small house to the iceberg that sunk the Titanic. All are large enough to destroy any spacecraft that runs into them. Several of Saturn's smallest moonlets orbit in the belt, or inside it, and are simply larger versions of the "bergs." Only the major moons listed below are considered to have any permanency.

Some of the statistics below may be a little misleading; for example, while Saturn's gravity is 0.95g at the "surface" this is simply the top of its cloud layer, and gravity is considerably higher (and the pressure and temperature would destroy any imaginable craft) nearer the solid core. Escape velocity is three times that of Earth, around 35.5 km/sec. With the exception of Titan, all of Saturn's major moons are tidally locked to the planet, and keep the same face turned towards Saturn all the time.

	Diameter km	Orbital radius (AU)	Orbital Period (years)	Gravity Earth = 1	Day	Atmosphere
Saturn	60,268	9.55 – 10.12	29.46	.95g	10.6 hours	Hydrogen, helium, trace gases
Major Moons	**Diameter km**	**Orbital radius (km)**	**Orbital Period (days)**	**Gravity Earth = 1**	**Day**	**Atmosphere**
Mimas	400	185,000	0.9	0.006	0.9 days	None
Enceladus	500	238,000	1.4	0.001	1.4 days	None
Tethys	1060	295,000	1.9	0.001	1.9 days	None
Dione	1120	377,000	2.7	0.006	2.7 days	None
Rhea	1530	527,000	4.5	0.003	4.5 days	None
Titan	5150	1,222,000	16.0	0.557	18 hours	Oxygen / Xenon
Iapetus	1430	3,560,000	79.0	0.023	79.0 days	Oxygen / Neon

…his description of the Titan climate had sounded rather like a word picture of an Eskimo hell. He hadn't exaggerated, either…

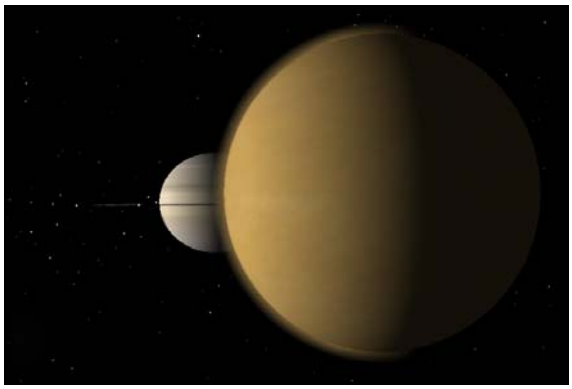
… Outside was the unbelievable Titanian night with its usual hundred-mile gale screaming against the curved walls, and the glitter of ice mountains showing green under the glare of Saturn with its rings visible edgewise from the satellite since it revolved in the same plane…

…surely no one could survive a cross-country journey here through nights that were generally eighty below zero, or even days that sometimes attained the balmy warmth of just above freezing…

… Tim shivered as the grinding roar of a shifting mountain sounded above the scream of the wind. That was common enough here; they were always shifting under the enormous tidal pull of the giant Saturn and the thrust of that incredible wind. **Flight On Titan**

Titan: Eskimo Hell

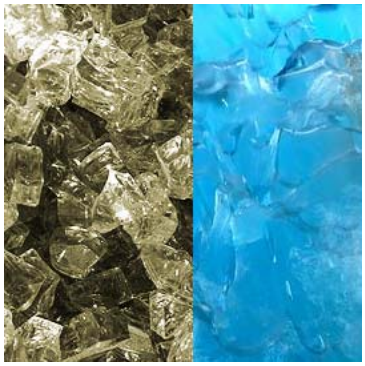
Titan is in many ways an anomaly – a world in miniature with gravity that belies its relatively small size, a dense atmosphere, and a climate which, though horrible by normal standards, is considerably warmer than it should be for a moon so far from the sun and its primary[1]. The explanation isn't complicated; Titan's core is massive, dense, and highly radioactive, producing about half of the heat needed, the remainder is supplied mainly by heat radiated from Saturn, supplemented by the Sun and heating from by tidal effects.



Approaching Titan the rings of Saturn are almost invisible, most noticeable as a black shadow across the planet's equator. Some other moons, closer to Saturn, are visible in the plane of the rings. Titan's dense atmosphere conceals surface features.

National Geographic 2098

Titan's axis is inclined 29° relative to the plane of its orbit, so that most areas experience small seasonal changes in temperature during its 16-day "year." There are also tidal effects from Saturn's gravity. Together, they cause cessation of the 100 MPH prevailing winds during the "equinoxes," lasting an hour or so, followed by a switch in their direction, from Easterly to Westerly or vice versa. This occurs every eight Earth days, roughly every ten and two thirds Titan days.



Sample from one of Titan's ice "mountains" (left) compared with ice from Earth's Arctic. Although they were taken from similar depths, the sample from Titan consists largely of unfused crystals.

Scientific American 2103

Titan's atmosphere is usually too cold to absorb enough water vapour to allow snow to form, and most of the moon's water is on the surface as ice, much of it in the form of unstable ice "mountains" which superficially resemble glaciers (but without a supporting mountain underneath), but are actually dunes composed of billions of ice crystals, and shaped by the wind; on Earth the crystals would be compacted under enough pressure to force them to melt and merge into homogenous blocks of ice, but on Titan the low gravity, low temperature, and lack of humidity tend to prevent this from happening, and the crystals can easily be separated. As a result these ice dunes slowly shift as crystals are blown from the windward side and settle in the lee, and can occasionally move much faster if for any reason their foundations are undermined. This is most common after periods of warm weather, since melt water sinks into the ice and causes crystals to fuse, which

[1] Weinbaum's version of Titan's climate, day/night cycle, eclipses, and seasons, as described in *Flight on Titan*, has several internal inconsistencies. Some parts of the description have been modified or ignored for game purposes. This story's version of history and some details of the rest of the solar system are also at odds with the other stories of this sequence. See the sidebar on page 12 and the adventure outline *Time Slip on Titan* on page 66 for more.

Superficially resembling a seal, this native of Titan has evolved to live in 100 MPH winds. Its eyes are adapted for dim light, but are usually covered by nictitating membranes to protect them from damage in ice storms.

Time-Life, 2092

Ghurrr – a Titan native

BODY 8, MIND 2, SOUL 2
Bite Effect 9, A:F, B:I, C:I/C
Blubber, armour -2
Skills: Brawling 4
Equipment: Jack knife, small mirror (both Terran), three smooth shiny stones, one flame orchid.
Quote: *"Ugha! Huss!"*
Notes: This is the human view of a typical native, and may be entirely accurate; a species only slightly brighter than dogs. Alternatively, they may have hidden talents; it's possible that they have a rich life of the mind, a complex verbal culture of philosophy and poetry which is inaccessible to humans. They seem to have no technology, but perhaps they have cities somewhere on or under the ice, or an intuitive understanding of science. If so, modify MIND and other characteristics to reflect this, and add suitable skills.
Role Playing: The natives are friendly, and shouldn't give humans any surprises unless provoked. If they *are* provoked – for example, if humans take to hunting them for their pelts or for sport – they may start to fight back, by e.g. teaming up to ambush hunters, or burying themselves under the ice for surprise attacks. Even as described they are powerful and dangerous enough to be a real problem.

may change the underlying structure. Titan does have real mountains, of course, such as the Mountains of the Damned where Nivia (the only city) is located, but the lower slopes are covered in loosely packed ice to depths of hundreds of feet.

Twice every Saturn year, roughly once every fifteen Earth years, Titan is eclipsed by Saturn in several successive orbits. These eclipses last up to six hours, and can have a significant effect on Titan's weather; the actual temperature change is small, but occurs at the same time as the strongest combined tides from Saturn and the Sun's gravity, and eclipses are often thus associated with unusually severe storms which have been known to last several days, and cause major ice movements.

Titan's main exports are gold, uranium, and flame-orchids, pearl-like thermoluminescent stones which convert body heat into dazzling and ever-shifting coloured light. The first flame-orchid brought to Earth sold for $500,000, but later stones sold for less, as they were no longer unique. Nevertheless a good stone about the size of a pigeon's egg will still sell for around $50,000, and their value, combined with their tiny size and weight, makes them a near-perfect spaceship cargo. By contrast, gold is barely worth shipping from Titan to Earth when the costs and insurance fees are taken into account.

Cultured Flame-Orchids

Recently the colonists learned that they could culture flame-orchids by placing fragments of a broken stone onto gravel found in caves on the Mountains of the Damned. It isn't yet clear how this process works, if it can be made to work with gravel from other areas, or if it will work on Earth. But regardless of the practicalities, if the news comes out the value of flame-orchids will plummet. The colonists are agreed that this will be a bad thing, and have decided to conceal the news as long as they can, sell as many stones as possible without bringing the market value down, then eventually cash out before the bubble bursts. The minority that actually *like* living on Titan are looking for alternative exports, such as biochemicals, furs, etc. It's an unstable situation, and there will be a lot of *very* angry colonists if the news gets out too soon, or outsiders discover the secret…

Despite its horrific climate Titan has several known life-forms. The chemistry of life is based on arsenic compounds, not iron, and humans can only eat native organisms after complex chemical processing.

The intelligent natives superficially resemble seals, but their internal anatomy is unlike that of any terrestrial vertebrate, and more closely resembles molluscs such as slugs. They are generally considered to be slightly more intelligent than dogs, but this may be an underestimate; they cope very well with their environment, and appear to be able to communicate with one another – when humans began to trade for flame-orchids

most natives seemed to know what they wanted after a few days – but humans have never learned their language, and they appear not to understand human speech. Despite this they are friendly to humans, apparently seeing some advantage in trading. They prefer manufactured goods, especially jack-knives and can open and close the blades with their three-clawed hands, but have never been seen using them; it's possible that owning them is considered a sign of status, giving some advantage in mating rituals. Goods are carried in pouches located under folds of skin on the back.

Some other species include:

Whiplash trees are a carnivorous plant species resembling dwarf willows which tries to ensnare and strangle animals for use as fertiliser. Their whips generally can't hurt a human wearing cold weather gear, but they have been known to entangle people's legs, and it's possible that someone could be caught or injured by a fall.

Knife-Kites superficially resemble birds with razor-sharp beaks which fly before the oncoming wind and attempt to impale any other animals they encounter. Their wings are more like those of bats, with a leathery membrane stretched over supporting ribs. Their birdlike appearance owes nothing to Terran biology; it's simply a coincidence of form following function.

Ice Ant - *Smithsonian Institutin 2111*

Ice-Ants are a communal species of three-legged animals, averaging about three inches in diameter, which build colonies under the ice. Their tunnel complexes are topped by artificial ice domes resembling thin-walled igloos. Air warmed by their metabolic processes enters the dome, and the warmth is used to cultivate moulds and melt ice for drinking water. Their domes are actually constructed from the inside out, initially as bubbles forming in the ice, with the ice-ants extending them sideways and upwards to maximize water recovery and the area available for growing fungus. Explorers have used the domes as shelters occasionally; they are much warmer than Titan's surface, especially at night, and the ice-ants generally ignore intruders, apart from sometimes digging channels underneath them if they are blocking the drainage of the dome. They have been known to scavenge organic wastes such as food scraps, pieces of leather, etc., carried by human intruders, and it's assumed that they use them to fertilize the mould they live on.

Ice-ants cooperate to build their domes and harvest mould, and use simple tools such as sledges made from the leaves of whiplash trees. The name given to this species is more descriptive of their life style than their true nature; they are not insects (or particularly close in anatomy to any other Terran animal, except possibly sea urchins or starfish); the combination of radial symmetry and jointed legs is unique to Titan.

Titanian threadworms are telepathic, with hypnotic powers, and may be intelligent. If so it is an inimical intelligence which seems to be focussed solely on obtaining food. In view of the dangers of approaching these creatures very little is known of them; however, the rough description is of a wormlike creature with at least one eye stalk, which may possibly exhibit radial symmetry, so it seems possible that the species may be related to ice-ants.

Some carved pillars were found in the first threadworm burrow explored, which suggests that at some point Titan supported a more advanced civilisation. It isn't clear if they were the work of the seal-like species, of the threadworms, or of another intelligent species; since this discovery is linked to the discovery that flame-orchids can be cultured, the news may take some time to reach Earth.

A Note on Iapetus

Titan is generally considered Saturn's only habitable moon, but Iapetus also has life[1] – which survives at -100 degrees with air pressure about a fifth of that at the top of Mount Everest. The main forms are small to microscopic worms, bacteria, algae and fungi, all toxic to humans since their biochemistry is based on arsenic, like that of Titan. There are no known biological or mineral resources worth exploiting, no intelligent life, there is no colony, and the gravity is so low that most visitors suffer from vertigo. It's a small unpleasant ice-ball, like Ceres but solid to the core, and usually ignored.

[1] *The Lotus Eaters*

	BODY	Weapon	Effect	A	B	C
Whiplash Tree	2D6	See notes[1]	BODY/2	B	B/F	F
Knife Kite	3-6	"Spear"[2]	8	F	I	C/K
Ice Ant	1	None	-	-	-	-
Threadworm	8	See notes[3]	10	F	I	C

[1] Whiplash trees attack to pummel and entangle small prey. They aren't really evolved for an upright large target such as humans. They attack (Brawling 4) with 1-3 whips per round; if they hit they will try to wrap around the target and secure it (as a "wrestling" attack), then continue to hold it until the target is dead. This is unlikely to work against humans.

[2] Knife kites rely on the power of the wind for their attacks, and will only be encountered when it is blowing. They only get one chance to attack (Brawling BODY+2) – if they miss the target they must fly on and are unlikely to be seen again.

[3] Threadworms use a hypnotic attack similar to the Dream Beasts of Mars, in this case to induce sleep, then if successful bite their prey and drink its blood. The initial attack is made with MIND 6 against the victim's MIND; if there is more than one target the attack is made with MIND reduced by 1 per additional victim.

- On an A result the victim feels very slightly drowsy and is aware that the creature is attempting hypnosis
- On a B result the victim feels very drowsy, attempts to become more comfortable, and is unaware that the creature is attempting hypnosis.
- On a C result the victim falls asleep.

Once the victim is asleep the threadworm attacks with its mouth, Effect 6, and starts to drain blood, inflicting injuries as above.

Adventure Idea: Time-Slip on Titan

The version of history described in *Flight on Titan* doesn't quite match that of Weinbaum's other Planetary stories. For game purposes these differences have been ignored, but what if there are two parallel universes, somehow overlapping and merging in a weak point of the space-time continuum on Titan?

- In one universe the year is 2115; Venus only has a narrow habitable zone, mostly consisting of deadly swamps, and Mars is inhabited by the Thoth, mound builders, etc. The Planetary Trading Corporation failed in 2110, leading to a stock market crash, but the market is slowly recovering.
- In the other universe the year is 2146; Venus is much more widely habitable and has seas, but the last Martians died thousands of years ago. Because Mars had little to offer, expansion into the outer Solar System was slow, and spacecraft are still more primitive than they are in the other universe. The PTC failed in 2142, taking the stock market with it, and there is little sign of recovery.

Somehow the adventurers find a portal between the universes; there must be ways to take advantage. For example, the 2115 world has better spaceships, 2146 has a more colonisable version of Venus. A few patents could make you very rich. Of course there are bound to be snags… Make them nasty and hard to spot!

Adventure Idea: Rough Justice

Ten months after the first flame-orchid gems are found (and some time before it is learned that they can be cultured): Interest in these gems is soaring, and a new breed of colonists has started to arrive, men prepared to venture into the wilderness in search of a quick profit. Most have no long-term commitment to Titan, their goal is simply to get in, make a killing, and get out again.

Unfortunately someone has taken this all too literally. The colony's military chaplain, Captain John Bennett, has been found dead, stabbed with a knife of the type used as trade goods, just as prospectors are converging on Nivea for the next flight back to Earth. The assumption is that one of the prospectors stabbed him, the question is why. The adventurers are given the job of finding some answers; exactly why is left to the referee.

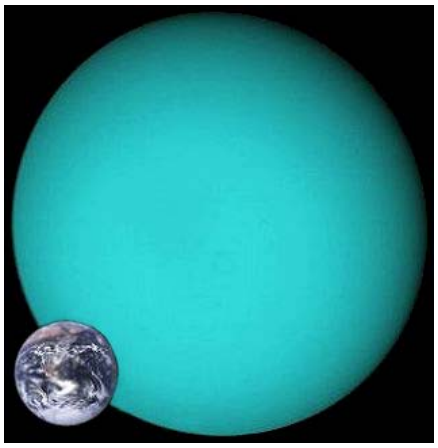
They should soon learn that Bennett's brother Paul was another trader, but he had vanished when the colony's shuttle flew to pick him up. His cabin was found abandoned, and there is virtually no chance that he has survived. Everyone assumes that he was lost as the result of an accident or animal attack.

In fact both brothers were murdered by another trader. Arthur Wolfe, who was camped a few miles from Paul, had no luck finding flame-orchid gems, and eventually killed Paul to steal his stones. He also took Paul's rifle. Chaplain Bennett recognized it and unwisely confronted him, and was stabbed to keep him quiet.

Solving this is relatively easy once Wolfe is a suspect; he was the only trader camped near Paul, and the rifle is engraved with Paul's initials. But a lot of people liked Chaplain Bennett, and will want to see Wolfe punished, possibly without the formality of a trial. The adventurers need to defuse the situation and ensure that proper justice is done.

See the final adventure, *Earth Girls aren't Easy*, for more on Titan and Nivea.

Comparison of Uranus and the Earth
Smithsonian Institution 2102



So inconceivably remote is Uranus that the distance to its travelled, Saturn, is actually greater than the total distance from Saturn to Jupiter, from Jupiter to the asteroids, from these to Mars, and from Mars to the Earth. It is a wild, alien, mystery-cloaked planet with only icy Neptune and Pluto between it and the interstellar void…

…He had explored, out of all the millions of square miles of surface, just one square kilometer forty-five thousand miles away from where they stood. All the rest was mystery…

The Planet of Doubt

Uranus: The Shrouded World

Perhaps the oddest of all the outer worlds, Uranus superficially resembles the other giant planets, but is actually a rocky world with a breathable atmosphere, oceans, and life, but almost sixteen times the surface area of Earth. Volcanic processes keep the surface warm and maintain a steady temperate climate regardless of day and night; this is fortunate because the axis is inclined to 97.7° from the ecliptic, so that each of the poles in turn is in darkness for nearly forty Earth years. Dense clouds help to maintain the climate, acting like a greenhouse to reflect heat back to the surface, but this allows very little heat to escape to warm any of the planet's moons.

Because of Uranus's distance from the sun and from Titan, the main staging post for expeditions to the outer Solar System, there have only been two brief visits, in 2060 and 2100; the next conjunction will occur in 2140, by which time improved engines should allow an extended stay. The first expedition explored a small area of the planet near its south pole, the second went north. There has as yet been no opportunity to explore the equatorial zones or the seas.

A major difficulty facing all explorers is the opacity of the atmosphere. Essentially, the planet is permanently enshrouded in green-grey fog, which absorbs sound and radio transmissions, and limits visibility to approximately fifty feet. The colour does not indicate any dangerous chemical composition; it's made of water vapour, like fog on Earth, but the atmosphere as a whole is so thick that only a restricted portion of the spectrum can penetrate to the surface. Because the ground is always warmer than the air, at around 10°C, there is a continuous cycle of warm moist air rising from damp ground, condensing in the cool upper atmosphere as cloud, and slowly settling again as dense mist, then evaporating again. Since the climate is more or less independent of the Sun and other outside influences, there is no reason to believe that storms ever occur, except as an accompaniment to volcanoes and other geological phenomena. It should be stressed that things may be very different at the equator, or at the poles at when they are tilted away from the sun. In particular, there may be tropical storms resembling the hurricanes of Earth, but centred on heat sources such as volcanoes.

Because of the poor visibility and communications both expeditions were very limited in their range – to avoid getting lost the explorers had to stay tethered to their ships. The map of Uranus thus consists of a few circles, with a maximum diameter around 2000ft, the rest is *terra incognita*. Anything could be out there, but it may be centuries before there is anything like a complete map of the surface.

Anticipating the next conjunction, there has been some discussion of methods for extending visibility – the most promising involves using an atomic blast to heat the atmosphere and create a continuously-replenished "bubble" of warm dry air. Although it would naturally tend to rise, if the temperature was carefully controlled it might raise visibility to several hundred square feet. If there is ever permanent

colonization domed cities seem the most likely solution; since the air inside such a dome would be at more or less the same pressure as the outside atmosphere, just less saturated with moisture, there would be no need for great structural strength. A bubble of cellulose would probably suffice.

Despite its huge size Uranus has a limited range of plants and animals – but again it should be stressed that explorers have only visited regions close to the poles, things may be very different at the equator.

The second expedition recorded a dozen or so species of cryptogamoid plants (plants which reproduce via spores) which resemble the aquatic pond-weeds and sea-weeds of Earth, ferns, etc., but found nothing analogous to trees. Since the light is diffuse plants generally spread outwards, rather than upwards, and the forty-year night presumably kills off most plants, making long-term growth impossible.

Only one species of animal has been observed in any detail, but since the "caterpillar beast" is a carnivore it must be assumed that there are smaller animals for it to feed on. These creatures resemble the processionary caterpillars of Earth, moving in long lines with their nervous systems linked by a disc-shaped organ whose structure is not clearly understood, but also appears to be used to sense sound and possibly to smell. Each "segment" is eight foot long and about four wide, with six legs, but otherwise almost completely featureless. The front creature in each line directs the rest of the line, so that they appear to move as one long animal; if the line is cut, for example by shooting one of the animals, each separate part carries on; the first animal behind the break takes over as leader for the rear part. These creatures are blind, but very sensitive to vibrations and noise. They are believed to be the larval stage of a flying animal, but because of the limited visibility the adult creatures have only been seen as shadows.

A "caterpillar-beast" of Uranus forages at the edge of a rock pool. The disc-like sensory organ of the lead organism is extended to smell the ground. The colours and shadows are the result of the use of a powerful flash gun, anti-haze filters, and special processing; the scene would look grey and hazy to the unaided human eye.

Photograph by Dr. Patricia Hammond, 2100

Caterpillar-beast

(Each segment) BODY 8, MIND -, SOUL -
Bite, Effect 9, A:F, B:I, C:I/C
Trample, Effect 8 (x6) A:B, B:F, C:I
Skills: Brawling 4
Notes: These creatures attack in complete silence, apart from the pounding of their feet. Once they have identified a target each segment bites at it and attempts to trample it. Chains initially consist of 10-30 animals; at least half must be killed or wounded before the beast will retreat.

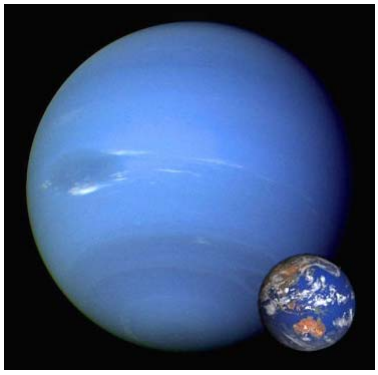
There is little more to be said about Uranus; pending another expedition all that remains is guesswork.

Moons

Uranus has numerous moons, all of them orbiting in the plane of the planet's equator and sharing its axial tilt. Due to the limited time available for the expeditions the moons have not been explored, although several have been photographed from space. None has a detectable atmosphere, and it is thought that they are bitterly cold and (like Uranus itself) poor in heavy elements. Details of the five largest are in the table below; all are tidally locked to Uranus:

	Diameter km	Orbital radius (AU)	Orbital Period (years)	Gravity Earth = 1	Day	Atmosphere
Uranus	51,120	18.3 – 21.1	84.3	0.91	17h 14m	Argon / Oxygen
Major Moons	**Diameter km**	**Orbital radius (km)**	**Orbital Period (days)**	**Gravity Earth = 1**	**Day Earth = 1**	**Atmosphere**
Miranda	471	129,390	1.4	0.008	1.4	None
Ariel	1158	191,020	2.5	0.027	2.5	None
Umbriel	1169	266,300	4.1	0.023	4.1	None
Titania	1578	435,910	8.7	0.038	8.7	None
Oberon	1522	583,520	13.5	0.035	13.5	None

Neptune: The Last Enigma



Comparison of Neptune and Earth
Smithsonian Institution 2096

As of 2115 only one world remains unexplored. An expedition scheduled for Saturn's conjunction with Neptune in 2096 lost radio contact soon after leaving Titan and is assumed to have been lost *en route;* the next conjunction is in 2132. Spectroscopy shows helium, oxygen and water vapour in Neptune's atmosphere, suggesting that it may be a world somewhat like Uranus. The presence of oxygen implies plant life, and measurements of infra-red radiation suggest a good deal of internal heat, more than Uranus, although it should be remembered that Uranus's dense atmosphere blocks heat very effectively, helping to keep the planet warm – if Neptune's atmosphere isn't an effective "greenhouse" surface temperatures may be lower.

Astronomers have noticed cloud vortexes near the equator which are probably large tropical storms, with winds more powerful than are ever seen on Earth or Titan. It's hoped that these are confined to the upper atmosphere, with conditions more reasonable nearer the surface, but nobody really knows.

Neptune has several moons, but very little is known about most of them. Only one, Triton, is large enough to have any hope of retaining an atmosphere; it is also the only one of Neptune's moons that is visible via Earth-based telescopes, being about the same size as Earth's moon. Triton's orbit is retrograde; it rotates in the opposite direction to Neptune's rotation, implying that it is a captured body rather than one that formed with Neptune. It's by far the largest retrograde moon known to science. Observations suggest that its density is low, and that it may be made largely of ice and lighter forms of rock, with little or no internal heating. If so it is probably extremely cold and airless. All of the other moons are so small that they were only discovered after the Io observatory was built; the largest is about 400km in diameter. Names are still being discussed by the International Astronomical Union.

	Diameter km	Orbital radius (AU)	Orbital Period (years)	Gravity Earth = 1	Day	Atmosphere
Neptune	49,428	30.06	165	1.1g	14 hours	Helium / Oxygen
Major Moon	**Diameter km**	**Orbital radius (km)**	**Orbital Period (days)**	**Gravity Earth = 1**	**Day Earth = 1**	**Atmosphere**
Triton	2,707	354,759	-5.9	0.08g	??	??

Neptune and Pluto

Neptune was first discovered when astronomers noticed anomalies in the orbit of Uranus, and realised that another massive planet must be present. Pluto was discovered after it was realised that there were similar anomalies in the orbit of Neptune. This isn't coincidental; Pluto's orbit crosses the orbit of Neptune, and the planets have 3:2 mean motion resonance; for every three of Neptune's orbits around the Sun, Pluto makes two. For various reasons this is a stable relationship, and although the effects of their mutual gravitational attraction are noticeable with sensitive instruments, they cancel out in successive orbits. There is no danger of these worlds colliding! Pluto's orbit is highly inclined, and even at their closest, when Pluto's orbit briefly crosses that of Neptune, they are about 8 AU apart. Initially it was thought that Pluto might be a moon of Neptune, somehow displaced from orbit, but Pluto is too big and the relationship between their orbits is too stable for that to be possible.

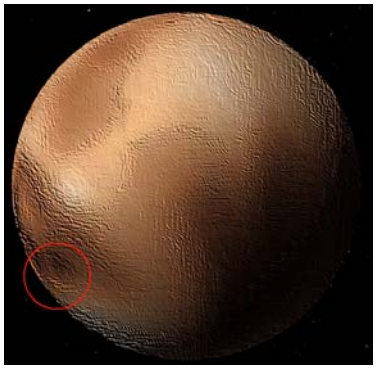
"Come on," he said, turning to a space suit swaying on its hook. "No use wasting time. We'll take a look around." He clambered into the heavy garment, noting irritably its greater weight on the surface of the black planet. The Plutonian gravitation added thirty-six pounds to his Terrestrial hundred and eighty…

… he was the fourth man and Nestor the fifth to set foot on the black planet. Atsuki, of course, was the first, if one credits his figures and photographs, the intrepid Hervey the second, and Caspari the third. Here on this lonely outpost of the solar system, high noon was hardly brighter than full moonlight on Earth, and the queer, black surface that gives Pluto its low albedo made it seem still darker…

…"Would you like to stroll outside?" she gibed. "It's not cold—just ten above zero. Above absolute zero, I mean. Cold enough to liquefy and freeze all gases but hydrogen and helium. How long do you think it would take to freeze that hot blood and hotter head of yours?"

The Red Peri

Pluto: Lair of the Pirate Queen



Pluto – the approximate location of the Red Peri's lair, now believed to be abandoned, is ringed.
Boyd's Marine Annual Report, 2090

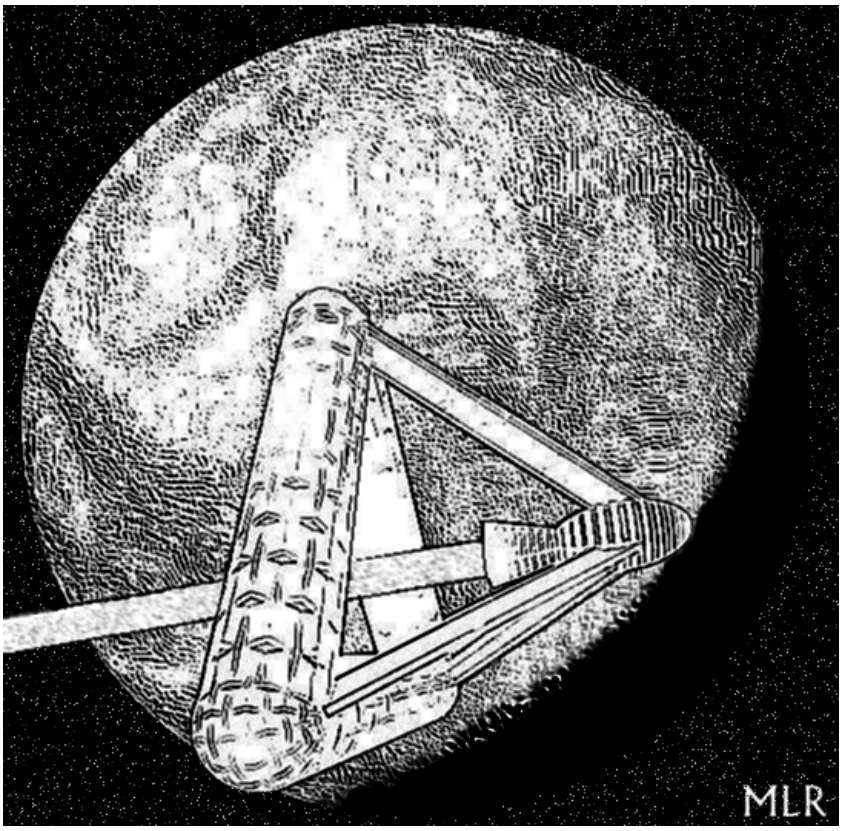
First visited in 2053, Pluto is slightly larger than the Earth and has higher gravity, but its remote position means that it can only be reached during conjunctions with Saturn; at other times the distance is beyond the capability of current engines. Despite this, it's actually easier to travel to Pluto than to Uranus or Neptune; due to their sheer mass and size both of the latter planets have high escape velocities, about twice that of Earth or Pluto, which adds hugely to the amount of fuel needed to decelerate and land on a world or its moons, and the amount of fuel needed to leave again afterwards. This has a knock-on effect on the weight of supplies that can be carried and the time that can be spent exploring, and means that there is a wider "window" for travel to Pluto either side of conjunctions.

Although metals of all sorts are abundant on Pluto, travel is still prohibitively difficult and too expensive for most commercial purposes. For example, shipping gold from mines on Pluto would cost considerably more than the gold was worth, and even radium would barely pay its way.

The overwhelming impression left by the planet is cold dark desolation. The surface is jagged rock with "snow drifts" of frozen air. The Sun is a pinpoint in the sky which seems to illuminate the surface about as well as a full Moon illuminates the Earth, but this is actually an illusion[1] caused by the tiny size of the Sun in the sky and other factors. The terrain is chaotic, covered in ridges and valleys which were formed by the surface of the planet buckling as it cooled. There appear to be no internal heat sources, and the core is believed to be solid and cold.

In view of these facts it seems incredible that Pluto should harbour life, but Keene's report makes it clear that there are several species of so-called **crawlers** on Pluto. These extraordinary creatures are crystalline life-forms, aggregates of crystals held together and moved by powerful electrostatic charges, which seem to live solely to add more material to their structure, reproducing by splitting off smaller crystals. Keene describes three species, all apparently specialised to absorb a single element, and allegedly confined to a single complex of caves, and states that he heard of several others.

[1] Pluto's daylight actually ranges from two hundred to six hundred times brighter than moonlight on Earth, comparable to a badly overcast day on Earth or the lighting in an average home. It generally appears to be much darker because the Sun is perceived as a bright star, there is no atmospheric scattering of light, shadows are completely dark, and most of the surface materials absorb light with minimal reflections.



The rustling crystals moved in glittering chunks from thumbnail size to aggregations as large as dogs. They crackled and rustled along, apparently moving by a slow shifting of the lower crystals, much as a snake moves on its scaly belly, but far stiffer and slower. Abruptly Keene sent his metal boot crashing into one. It shattered with a blue flash of released static electricity, and the pieces passively resumed their progress…

…"They're—well—on the borderline. They're chemical-crystalline growths, and their movement is purely mechanical. There are half a dozen varieties—aluminum feeders and iron and silicon and sulphur feeders, and others."…

The Red Peri

Aluminum Feeders take the form of greyish-white accretions of crystals. They move in "streams" which flow from one deposit of aluminum to the next. If they come into contact with aluminum compounds (such as a spacesuit boot) they immediately start to spawn seed crystals which incorporate the metal into their structure, leaving the metal pitted as they grow. Although they are slow-moving, they can eat through pure metal very quickly, and were seen to absorb alum compounds; it seems likely that they would be able to eat the aluminum in concrete in a similar manner.

The Pirates

After the first expeditions Pluto languished in relative obscurity; scientists were interested, but although there were abundant metal deposits none were quite worth the immense costs of transportation, and it was simply too remote and inaccessible for casual visits. All of which made it the perfect lair for pirates with an unusually fast ship…

If Keene reported his conversations with Peri Maclane accurately, and they are assumed to be an accurate account of events, construction of the pirate base must have begun circa 2068-70. Losses to piracy rose dramatically from 2071, with most of the increase blamed on the *Red Peri*. It's likely that the base would have remained undiscovered if not for sheer chance; in 2086 Keene's ship made an emergency landing near the pirate base. He was captured, but made a daring escape, capturing the pirate leader herself. Unfortunately she escaped *en route* to Earth, and it must be assumed that the pirates subsequently moved their base to a new location.

The base was built into caves and its facilities included gardens and a farm, accommodation for about a hundred pirates and their dependents, atomic power plants, life support equipment, mines, workshops, and everything else needed to support their operations. Air was obtained by melting the frozen atmosphere that surrounded the base, which made complex recycling unnecessary.

The base seems to have been a test-bed for new technology such as the electrostatic field used to keep air inside the base. Construction must have been fraught with difficulties, especially since the caves were home to most of the crawler species.

It's generally assumed that it was abandoned after Keene escaped; anyone who finds it may be able to salvage some interesting equipment. Always assuming the owners aren't still there…

Crawlers

Each crystal "organism" has
BODY 1-3, MIND – , SOUL –
They do not attack in any conventional sense – they seem to have some ability to sense the materials they feed on and move towards them, but don't use any skill to do so. If they make contact they start to convert the target material into more crystals. This should be handled by rolling the crawler's BODY against the target's BODY, with the following results:

A. Minor damage (equivalent to Flesh wound if the target is human)
B. Serious damage (equivalent to Injury if the target is human)
C. Critical. The crawler's BODY is increased by 1; the target's BODY is reduced by 1 PERMANENTLY, as a portion of the target is converted to crystal.

Attacks continue until the crawler is somehow removed from the target, e.g. by amputation, by rubbing off the crystals, or by damaging them so severely that they can no longer grow. Most forms of damage simply split the crystals and turn the crawler into two or more smaller organisms, but repeated damage such as crushing or fire will eventually reduce the crawler to inanimate components.

Since this can very easily be a lethal or permanently disabling attack referees are encouraged to give players ample warning of the danger, and set things up so that there is an escape route that avoids contact with the crystals. Kill off NPCs or important bits of equipment first!

While *The Red Peri* doesn't explain how the iron feeders were kept under control, it's obvious that there was some way to handle them without them spreading uncontrollably. One possibility is a chemical treatment that disrupts their crystalline structure; it's mentioned that there are no copper feeders, so perhaps a little copper sulphate kills them. Their "life" is based on electrostatic charges, so something like a bug zapper might work. Whatever is used will work on all types.

Carbon Feeders are described as needle-like black crystals. They appear to move faster than aluminum feeders and can eat through a leather shoe in seconds, going on to attack the flesh underneath. They could devour a man in minutes.

Keene did not see **Iron Feeders**, but the pirate Peri Maclane used them to eat through the doors of safes and other steel objects. It's apparent that she could control them; if they were uncontrolled they would have reduced the entire safe to crystals, soon to be followed by the ship!

Since Keene's report was published most of Earth's governments have banned the importation of crawler crystals; penalties range from heavy fines to imprisonment. Boyd's of London has announced that carriage of crawlers invalidates their policies, and most other insurers have followed suit. They are too dangerous to be allowed anywhere near modern technology.

Does anything eat crawlers? If they are confined to a single complex of caves there may be nothing, but it seems unlikely that Maclane's father just happened to pick the only site where they occur. It's more likely that they are widespread, found in many caves on Pluto. If so there may be undiscovered species. Predators are an obvious possibility – the crawlers have to work hard to find and extract the metals they need, and their bodies are made of nearly pure metal. Something that ate them would save energy, and might be more intelligent than the essentially mindless crystals.

Adventure Idea: Big Bang Theory

Crawlers would be a perfect tool for mining, if they could be handled safely and modified to extract something more useful that iron or carbon. Gold or uranium would be good, for example…

The adventurers should be scientists, hired by a major mining company to work on the problem. The company owns several old uranium mines which probably still contain ore traces but are uneconomical to work by existing methods. Somehow a small batch of iron feeders has fallen into company hands; nobody seems to know where they come from, in anything other than the vaguest of terms, and anyone who asks too many questions may find themselves looking for a new job. The project has several phases; the scientists need to develop a way of controlling the crystals and persuading them to breed, preferably at temperatures a little higher than Pluto, somehow modify them to extract uranium or radium, and work out how to recapture them and extract the metals. It's just a little illegal to work on this on Earth, but the company has enough clout to keep inspectors off the scientist's backs.

Of course a project that works well in the lab may not necessarily work so well in the field. And if there's more uranium than anticipated in the mine, it's possible that things may eventually get a little critical…

A League of Nations Patrol ship passing Phobos en route to Earth. ***Detail from Patrol recruiting poster, circa 2110***

"…they don't realize that you have to land blind, because three hundred feet down from the ground the blast begins to splash against it.

"You watch the travelled poles at the edge of the field and try to judge your altitude from them, but you don't see the ground; what you see under you are the flames of Hell… … lowering a ship is like bringing down a dinner plate balanced on a fishing rod. If she starts to roll sideways—blooey!..."

… Piloting a ship is just a question of following directions, but plotting a course involves the calculus of function, and that, let me tell you, takes a mathematician. I could do it, and Claire handled a simple route well enough—one had to in rocket racing—but astrogators were not common even among pilots.

You see, the difficulty is that you don't just point the ship at your destination, because that destination is moving; you head for where the planet will be when you arrive. And in this case, assuming Gogrol meant to make for Io, a journey from Europa to that world meant speeding in the direction of the colossal mass of Jupiter, and if a rocket once passed the critical velocity in that direction—good night!

Redemption Cairn

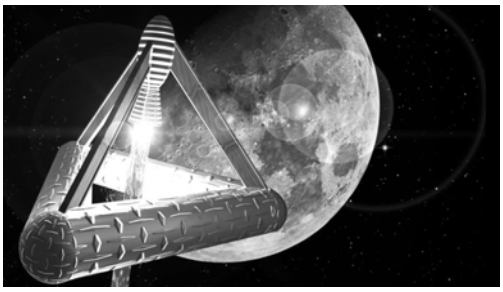
Between Planets

SPACE is big and inhospitable, and travelling through it is a highly skilled job, whose main features often seem to be a lack of sleep, long hours of tedious but painstaking routine, and occasional moments of terror. Stress-related illness is common; pilots are especially likely to burn out comparatively young, but engineers and other personnel aren't immune from problems. Most think it's worth it; they're working at the cutting edge of technology and pursuing man's oldest dream, to reach for the stars.

That's one way of looking at things. Another is that space travel is one of the main driving forces of Earth's economy. Every ship represents at least ten thousand jobs on the ground, and an investment of millions of dollars. Their cargo is essential for dozens of industries, from the luxury fur trade to power production and pharmaceuticals.

There are dozens of other viewpoints, of course. For colonists and explorers space is the ultimate frontier, for scientists it's an endlessly interesting field of study, for hopeful hunters, prospectors and merchants it's where they'll get rich. But for most of these people space travel is simply a means to an end, a necessity that makes these pursuits possible but is otherwise irrelevant to their interests. They're interested in the destination, not the journey itself, and the actual nuts and bolts of spacecraft only become important if something goes wrong.

The technology that makes it all possible is the atomic blast, and a major part of pilot and engineer training is taken up with these deceptively simple devices. But life support, astrogation, and dozens of other technologies are almost as important and should not be overlooked, especially when a ship is being designed. What follows is a very brief overview of a very complex subject.



Tetrahedral Hulls

Tetrahedral hulls were tested early in the history of space flight then for the most part abandoned when it was found that their apparent advantages were illusory. Recent interest mostly stems from descriptions of the pirate ship *Red Peri*, which tend to minimise the drawbacks.

Briefly, ships of this design mount their main engine *above* the hull, attached to a tripod girder arrangement. The hull forms an equilateral triangle, with the engine firing down through the triangle.

There is a widespread but erroneous belief, even amongst scientists and engineers who should know better, that tetrahedral hulls offer advantages over conventional designs. This is untrue, and there are several snags:

- Fuel must be conveyed "uphill" to the engine; at emergency power, with high "g" forces, this imposes considerable strain on the fuel handling equipment.
- Great care must be taken to keep weight of fuel and cargo distributed symmetrically through the hull, much more so than for a conventional hull. With a conventional hull heavy items can be stowed near the central axis of the ship, to minimise turning forces; with a tetrahedral design this is impossible.
- The hull is exposed to hot exhaust and radiation from the engines, especially during takeoffs and landings, and is more likely to be damaged by it.
- The girders are heavier than engine supports in conventional ships.
- It is difficult to service the engine and fuel system in flight.

Continued next page

Hull Design

Most civilian spacecraft are built to a simple vertical cigar design; the ship takes off and lands vertically, and all engines (apart from a few small jets used for steering) are permanently aimed aft. Usually such ships are fitted with retractable tripod landing gear or fixed fins (as in the racing ship shown landing in the illustration) which incorporate steering jets and fixed landing gear. These designs are simple and reasonably robust, but difficult to handle (especially in atmosphere and during landings) and may be unsuitable for poorly prepared landing sites. The main advantage is high capacity – since the hull layout is kept simple and there is only one flight mode, a relatively small part of the hull is occupied by engines and other engineering components. This ratio improves with larger hulls, since there is an irreducible minimum size for atomic blasts and many other components. Decks are circular, making it very easy to stow cargo as near as possible to the central axis of the ship.

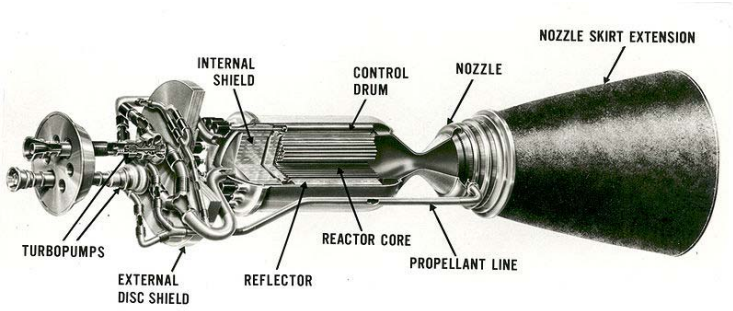
The main alternative, preferred for military and exploratory ships, is a streamlined hull capable of sustained horizontal flight in atmosphere, often adding small wings for extra lift. Ships of this design usually take off and land on underjets, auxiliary blasts pointed downward at 90° to the length of the hull, and the deck layout is optimized for the horizontal orientation used when the ship is under gravity. Not only does this add considerably to the mass and complexity of the atomic blasts and associated engineering components, the extra complications of operating with two "downs" invariably leads to engineering complications in other areas; for example, the plumbing must be designed so that it works when the ship is on the ground, with gravity pulling water etc. downwards, as well as in space, when acceleration pulls water etc. aft. Although spacecraft cruising acceleration is low, the extra direction adds considerably to the cost and complexity of fittings such as showers and lavatories, galley facilities, etc. Rockets for point-to-point flights in atmosphere (e.g. on the London to New York route) are invariably built to this design; while the fastest ships take ballistic routes and leave the atmosphere for at least part of each flight, they are essentially rocket planes, not spacecraft.

"…they use a minute amount of uranium or radium as catalyst to release the energy in the fuel. Uranium has low activity; it will set off only metals like the alkalis, and ships using uranium motors burn salt. And radium, being more active, will set off the metals from iron to copper; so ships using a radium initiator usually burn one of the commoner iron or copper ores."

"I know all that," I grunted. "And the heavier the metal, the greater the power from its disintegration…"

"…Well, Gunderson wanted to use still heavier elements. That required a source of rays more penetrating than those from radium, and he knew of only one available source—Element 91, protactinium…"

Redemption Cairn



An early brine-fuelled atomic blast used in the ***Ares*** – ***Time-Life***

Atomic Blasts

Atomic blasts are deceptively simple; reactor chambers in which radioactive rays break down the atoms of fuel to release energy, which in turn helps to break down more fuel. Uranium-based blasts convert sodium compounds into energy; radium blasts use iron or copper compounds; experimental protactinium blasts run on lead. Only a small proportion of the fuel is converted to energy; the rest is converted to basic particles which are thrown away as the reaction mass whose recoil propels the ship. The proportion is lowest in uranium blasts, highest in protactinium blasts.

Blasts are most efficient and reliable when fuel passes through *slowly* and there is time for as much as possible of the fuel to disintegrate and convert to energy, but at the most efficient settings the total energy output is insufficient for takeoffs and landings. Higher power can be achieved by feeding the fuel more rapidly, but this is wasteful; at full emergency power (the term "emergency" is used advisedly, prolonged use leads to damaged engines) nearly all the fuel is wasted. A side effect is a flare of energy – a bright exhaust in space, flames in atmosphere – as unused fuel is released as superheated gas. This limitation applies to all atomic blasts, regardless of type.

Tetrahedral Hulls *(continued)*

The only real advantages of these designs are that they are slightly more manoeuvrable than a cigar-shaped hull, and that they keep the engine in a position that allows it to be jettisoned relatively easily. This can be advantageous when dealing with unstable engines; with sufficient warning the engine can be released, usually with a small supply of fuel, so that it accelerates ahead of the ship and is a few miles away by the time it explodes or melts. A replacement can then be fitted, hopefully before the ship has gone off course or crashed.

It should be noted here that the designer of the *Red Peri*, Perry McClane, was an expert on atomic blasts, and may have "souped up" the engines to an extent that would be illegal for commercial or military use.

If You Have To Ask...

Spaceships are designed and built by gigantic corporations, not individuals, and for the most part are operated by corporations, governments, and large scientific institutions. Exceptions (such as the racing craft *Golden Flash* described at the beginning of *Redemption Cairn*) are toys of the rich; if you have to ask how much they cost you probably can't afford one.

In short, the captain of a ship may know how much it's worth, and probably several of the officers know roughly how much it costs to run, how much cargo it can carry, its range, etc., but for game purposes these details are usually best left as vague as possible. This section includes very simple construction rules, which do include prices if they are needed, but it's mainly an overview of the technology which can be used for plot ideas etc.

Higher sustained power can be achieved with existing technology, but all methods are expensive, decrease reliability or add significantly to the proportion of the size and weight of the ship taken up by the engines, fuel consumption, etc. While progress is being made, only a few specialised courier ships are known to have sustained cruising acceleration better than 0.03g – the *Red Peri* may achieve 0.05g or better, but features of its design, discussed above, suggest that it does so at the expense of safety. The table shows accelerations for the *Ares* (the first ship to Mars) and some modern vessels, and travel times from Earth to Mars when the worlds are closest.

	Cruising Acceleration	Emergency Power	Earth – Mars (days)
The *Ares*	0.010g	2.5g	20.2
Modern freighter	0.015g	3.0g	16.5
Modern liner	0.030g	3.0g	11.7
Fast courier	0.040g	2.5	10.1
The *Red Peri*	0.050g ?	5.0g ?	9.0

If range was the only consideration all current ships would have radium blasts, but things aren't that simple. Uranium engines are cheap, reliable – they've been around for a century, and most bugs are engineered out – and use evaporated sea water, or salt from the flats of Venus or the silted canals of Mar, as fuel. Ground-based power plants and short-range craft (e.g. from London to New York, between the moons of Jupiter) often use sea water as fuel, accepting that most of the mass will be wasted. Sodium salts are abundant and readily available on Earth and most of the rest of the solar system; iron is even more abundant, but less likely to be found in easily-used forms. Copper gives a little more power, but the ore is too expensive for routine use. Although protactinium drives will be more powerful, the radioactive component will be in short supply for the foreseeable future, and lead is comparatively rare and expensive; it seems likely that these drives will only be economic for flights to the most inaccessible metal-rich worlds, Mercury and Pluto.

Uranium-fuelled spaceship engines generally run on granular salt, with density around 2 tons per cubic metre. It's often asked why salts are preferred to metallic solids – in this case the explanation is simple; metallic sodium is *less* dense (and would take up more room aboard ship) and much more dangerous to handle than salt, and very expensive to manufacture. When the atomic blast is operating at its highest efficiency about 80% of the fuel is eventually converted to elementary particles; this includes the chlorine in salt, so its mass isn't wasted. It's obviously more efficient and considerably cheaper to run on salt.

With radium engines the answer isn't so simple. Iron and copper are denser than their salts, so it would be preferable to feed these engines the pure metals, and some experimental engines run on copper or iron wire, iron filings, etc. The problem is that all of the prior engineering art relates to salt, and pure metal engines have a distressing tendency to overheat, jam, explode or otherwise malfunction. Insurers refuse to cover their use in civilian spacecraft. For now most radium engines run on powdered iron ore, with density about five tons per cubic metre. If these problems can be solved iron-fed engines would store up to 7.8 tons of fuel per cubic metre, copper-fed engines up to 8.9 tons per cubic metre.

The development of protactinium engines is focusing on designs which will use pure lead as fuel, either molten metal or fed in as wire or lead shot, with density 11.3 tons/m^3. So far progress is slow.

When planning a flight it's necessary to take numerous factors into an account; these include the positions, distances and orbital speeds of the planets, whether the ship is going "uphill" away from the Sun or "downhill"

Planet	Distance from Sun (AU)	Solar escape velocity KPS	Surface Gravity	Escape Velocity KPS	Orbital velocity KPS
Mercury	0.39	67.7	0.4g	4.3	47.9
Venus	0.72	49.5	0.7g	10.3	35.0
Earth	1.00	42.1	1.0g	11.2	29.8
Mars	1.52	34.1	0.4g	5.0	24.1
Ceres	*2.77*	*25.3*	*0.03g*	*0.5*	*17.9*
Jupiter	5.20	18.5	2.5g	59.5	13.1
Saturn	9.54	13.6	1.1g	35.6	9.6
Uranus	19.22	9.6	0.9g	21.2	6.8
Neptune	30.06	7.7	1.1g	23.6	5.4
Pluto	29.7 to 49.3	7.8 or less	1.2g	12.9	4.7

towards it, the gravity and escape velocities of the planets themselves, availability of fuel at the destination, etc. Routes between Venus, Earth, and Mars are the easiest to plan; distances, gravitation and escape velocities are comparatively small, and orbital speeds aren't wildly different. Mercury's high orbital speed and position deep inside the Sun's gravity well make it a much more difficult destination, while the huge distances to the outer planets, and their high escape velocities, add their own problems. The table above compares these factors for the planets and for Ceres, the largest asteroid.

For example, a flight from Venus to Earth requires takeoff acceleration to reach an escape velocity of 10.3 KPS (or, rather, to reach an orbit where the escape velocity is lower, then accelerate more gently), a 5.2 KPS change in orbital velocity, and a 7 KPS change in velocity to overcome the Sun's gravity and reach a "higher" orbit, and another 11.2 KPS change to land. Some of these changes add up, others cancel each other out, and all ignore the additional velocity changes needed to make the trip usefully fast. Calculating courses and velocity changes for an entire journey is a hugely complicated process, made possible only by specialised mechano-electrical calculating engines, regularly updated astro-navigation tables, and accurate charts. Fortunately most of the work is now routine; every ship comes with a set of simplified calculation tables, as in the example below, which indicates how much fuel is needed for a given journey, accurately enough to give their owners an approximate cost for the voyage. All other things being equal fuel use is proportional to travel time and distance; there are complications such as the extra power needed to overcome the intense gravity of the Sun at Mercury's orbit, the gravity of Jupiter and other giant planets, eccentricity and inclination of orbits, and so forth, but the simplified table shows the most common routes and compares travel time and fuel consumption when planets are at their closest, with Earth-Mars taken as the "standard" journey: the "fudge factor" is a rough correction, the extra fuel needed to compensate for gravity and other factors in calculations. These factors can be counter-intuitive; for example, Ceres might seem an easier destination than (for example) Mars because its gravity is low, but this is cancelled out by the fact that the asteroid's low gravity makes it *harder* to match orbits with it.

The Asteroid Belt adds an extra complication, since ships must often detour or make emergency course changes, reducing fuel reserves. Most ships passing through the belt allow a 10% reserve for this purpose, and refuel at one or another of Jupiter's moons or Titan, rather than travelling directly to their destinations.

Needless to say, all of the above is hugely over-simplified. While these rough calculations are adequate for estimating rough costs and travel times, a precise analysis may involve twenty or more pages of tables, and dozens of complex equations.

Earth to:	Mercury	Venus	Mars	Ceres	Jupiter	Saturn
Days at 0.015g	18.2	12.4	16.5	31.0	47.8	68.0
Days at 0.030g	12.9	8.7	11.7	22.0	33.8	48.1
Days at 0.050g	10.0	6.8	9.0	17.0	26.2	37.3
"fudge factor" 1.0 x	2.0	1.25	1.0	1.0	1.2	1.1
Fuel	2.2	0.9	1.0	1.9[1]	3.5[1]	4.5[1]

[1]Plus optional reserve for asteroid avoidance

Moons of Jupiter to:	Another moon	Saturn (Titan)	Uranus	Neptune	Pluto
Days at 0.015g	1 to 2	48.4	86.7	116.2	136.7
Days at 0.030g	1 to 2	34.2	61.3	82.2	96.7
Days at 0.050g	1 to 2	26.5	47.5	63.7	74.9
"fudge factor" 1.2 x	0.5	1.1	1.2[2]	1.2[2]	1.1
Fuel	< 0.1	3.9	7.6	10.1	11.0

[2]Assumes a landing on the world itself, not a moon

Saturn (Titan) to:	Uranus	Neptune	Pluto
Days at 0.015g	71.9	105.7	127.8
Days at 0.030g	50.9	74.7	90.4
Days at 0.050g	39.4	57.9	70.0
"fudge factor" 1.1 x	1.2[2]	1.2[2]	1.1
Fuel	5.8	8.5	9.4

"…it would take us just exactly four years and three months. We've got food enough for three months, but what would we live on during the four years? Atomic energy?"

The Red Peri

Life Support

Most people assume that the engines are the most complicated part of a ship. They're wrong. As any spaceship engineer can testify, the most complicated systems, and the ones that give the most problems, are those needed to keep the passengers and crew alive and healthy; water and air purification on all ships, and waste recycling and food production on ships that have the room and need for it.

In the early days of space flight only air and water were recycled, and in fairly rudimentary ways.

Air was cooled to remove water vapour, filtered through charcoal to remove dust and the most obvious odours, then processed through sodium peroxide compounds which absorb carbon dioxide and release oxygen. This was far from a perfect process, requiring large amounts of the chemical which were dead weight for most of the flight, and the air had to be topped up with more oxygen occasionally. While more sophisticated systems are still used today there is always some waste, and some need for additional chemicals and oxygen during the course of a flight.

Waste water and its inevitable contaminants were processed by evaporation, and any dried residues were periodically dumped overboard. Most recent designs work at extremely high pressures and add oxygen to the waste water; high-pressure oxygenated water is an extremely good solvent, and the treatment dissolves most contaminants and breaks them down into their component elements, so that the eventual end products are water, carbon dioxide, nitrogen, and sterile ash, usually a mixture of metal oxides. The power needed for evaporation isn't a problem, but there is inevitably some wastage, and even in the early days occasional passengers experienced psychological problems related to their consumption of water which, for all its purity, had previously been contaminated with human wastes. One reason for this is only obvious in hindsight; recycled water was originally completely flat and tasteless, lacking any of the contaminants and additives found in tap water on Earth, and the *lack* of taste was a subtle reminder of its origin. Today's systems aerate the water and add traces of fluorine, dissolved salts and other impurities, which combine to make it much more palatable.

While these processes get rid of wastes, they require oxygen, water, chemicals, and other consumables. The long-term goal of this branch of engineering is to replace them with systems that waste nothing and if possible produce excess oxygen and consumables such as food. For this biological systems are needed; algae, plants and other organisms which produce food and oxygen directly. Typically a mixture of water and nutrients derived from wastes is used to culture aquatic algae, which produces oxygen by photosynthesis. Mature algae is processed to make foods, or fed to small fish which can eventually be eaten without processing. The largest installations add beds of fungi and small fast-growing terrestrial plants, such as cress and bean sprouts, which thrive in artificial light and low gravity. It can take weeks to months to set up a balanced ecology and keep things stable, and the processes must be monitored and maintained even when a ship is on the ground. But once it's working it can greatly reduce the need for packaged foods and liquid oxygen.

Tubes of chlorella algae growing in low gravity
Scientific American April 2082

Currently this equipment is bulky and heavy, with the most modern and efficient designs weighing several tons plus a quarter ton or so per person supplied, and is impractical for smaller ships and those on short flights; for example, it isn't used on the Earth-Mars and Earth-Venus routes, since ordinary supplies and basic air and water recycling are more than adequate for such short journeys. For longer journeys the equipment is lighter than normal stores, but comparatively expensive; ship owners must decide if the investment is worthwhile. The main goals of research are to reduce costs, and to improve the flavours and varieties of the foods produced this way.

Weapons

"Cut your jets!" it repeated. "Cut your jets, or we'll top you!"

Captain Ten Eyck ended his mutterings in a heavy sigh. He had no wish to have his vessel exposed to the withering blast of the pirate. He grumbled an order into the box beside him, and the roar of the jets ceased. Whatever maneuverability the lumbering freighter possessed was gone now; there was no longer any chance of ramming the agile attacker.

The Red Peri

...[when] a blunt little League rocket appeared in answer to Hawkin's call, he informed its officers flatly that the pirate was hopelessly beyond reach. "Even if your fat beeste of a boat could match its acceleration, which it couldn't."

Ibid.

While the League has a fleet, its role is generally limited to police functions such as piracy suppression, and the weapons carried are much less destructive than the ship's atomic blasts. Most powerful weapons are banned by the Interplanetary Peace Treaty, and are in any case too heavy to be taken into space. The distances involved, and the improbability of forcing another ship into combat, make specialised military spaceships expensive white elephants. League patrol ships are multi-purposed designs whose weapons (heavy machine guns firing explosive rounds, blasters, and repeating flame guns) are mainly intended for clearing a landing area or for use against ground targets such as Venusian "dough-pots." These and other weapons are discussed in a later section. They can fire at another ship if they get close enough, but this is so rare, and the results are potentially so disastrous, that it's very much a last resort.

Piracy is only possible because civilian ships travel on known routes and schedules, so that interception can be planned days or weeks in advance, and because the most successful pirate ship is considerably faster and more manoeuvrable than any opponent. Even the *Red Peri* is essentially unarmed, apart from hand weapons; its captain relies on intercepting and out-manoeuvring slow civilian ships at the beginning or end of their flights, threatening them with the ship's blast, then looting and escaping before League ships can reach the scene.

All modern ships are armoured well enough to protect their passengers against collisions with small meteors and meteoric dust, to resist solar heat while approaching Venus or Mercury, and to withstand the backwash of their own nuclear flames during takeoffs and landings. Their armour is not adequate to resist explosives, blasters, etc. or withstand a serious collision such as an attempt to ram another ship.

The Interplanetary Peace Treaty

Red! The color of the space ships of Io! For, since the signing of the Interplanetary Peace Treaty, each planet colored its space ships differently.

Tidal Moon

Although there has never been an interplanetary war as such, there have been several disagreements which could have potentially resulted in war. The Interplanetary Peace Treaty was framed to limit the damage such a war might cause by regulating the armaments and permitted conduct of spacecraft. Ships which do not obey treaty provisions, such as pirates, are treated as outlaws.

Weapon systems (such as guns and bomb bays) may not be installed on civilian ships. Passengers and crew may carry weapons, but they must not be able to fire at targets outside the ship – for example, it would be illegal to rig a gun port so that someone inside a ship could fire at another ship.

Military ships such as the League fleet and those of national governments may carry external armaments including flame guns, machine guns up to 50mm calibre, and explosive bombs, but may not be equipped to drop atomic bombs or carry heavier weapons.

Ships are expected to obey the laws of all applicable planetary and interplanetary authorities, including flight regulations, prohibited areas, etc.

All ships must be colour-coded and marked to allow easy identification and show their world (or moon) of origin; for example, red in the case of Io. Additional markings might include the flag of the colonial nation which operates a colony world, identification numbers and letters, a space line's insignia, etc.

Finally, every possible effort must be made to minimise casualties, rescue survivors, treat prisoners humanely, etc.

The League fleet is authorised to enforce these regulations and to intercept and inspect ships to make sure that they comply with the regulations.

The Laws of Space

Everyone who works in space is expected to be familiar with the laws applicable to space travel, which for the most part are derived from the earlier laws of the sea.

The most important for civilian vessels are those related to their ownership and command. This sounds simple, but ships are rarely commanded by their owners, and their captains are expected to have a good deal of autonomy, while being responsible for the safety and profitability of the ship. A captain must sometimes disobey the owner's instructions; this can be considered anything from a justified use of authority to outright theft of the ship, depending on the circumstances. Diverting from the instructed course in order to aid other travellers is, as at sea, permitted and indeed expected.

The most serious crimes are considered to be piracy and mutiny.

The textbook definition of **piracy** is "The crime of robbery of ships in flight. Accusation, trial and punishment of pirates may be under interplanetary agreement applicable anywhere, or under the laws of the particular nation or colony where the accused has been captured." The effects of piracy in space are potentially so serious that the British Empire and several of the other League nations automatically treat it as a capital offence, unless there are very unusual extenuating circumstances.

Mutiny is defined as "The unlawful resistance of a superior officer, or the raising of commotions and disturbances on board of a ship against the authority of its commander." It is generally treated as a serious criminal offence, but is not normally regarded as a capital crime unless someone is hurt. Note that it is possible to simultaneously obey the orders of a ship's owners and disobey a superior officer if the captain and/or officers are acting against the wishes of the owners. Other extenuating circumstances might include illegal, dangerous or contradictory orders, etc.

Continued next page.

Shipboard Routine and Duties

…On short runs like Venus or Mars, a vessel could carry three pilots, and then it's a simple matter of three eight-hour shifts. But on any longer run, because air and weight and fuel and food are all precious, no rocket ever carries more than two pilots.

So a day's run is divided into four shifts, and each pilot has one long spell of eight hours, then four hours off, then four hours on again for his short shift, and then eight hours to sleep. He eats two of his meals right at the control desk, and the third during his short free period…

Redemption Cairn

Space travel generally involves some busy moments, especially at the beginning and ends of a flight, with long periods of boredom in between. Outsiders rarely appreciate that boredom is the best sign that things are going well; amongst space crew it's considered bad luck to wish anyone an interesting flight.

Preparations begin days to weeks before takeoff, with careful planning of the route, fuel, food and water, etc. It's essential to know the mass to be carried, although there is some allowance for error. Loading is considerably more complicated than for any surface ship, since mass must be distributed as symmetrically as possible around the main axis of the ship. Most ports employ a ***loadmaster***, an official whose job is simply to superintend this process and make sure that there are no errors. It's a job that's often given to pilots and engineers between flights. The loadmaster must be aware of the mass of every item taken aboard, and make sure that it's balanced as closely as possible. Poor cargo distribution can cause navigation errors and wasted fuel, and has to be taken very seriously. On ships with ventral underjets the loadmaster must also make sure that cargo and other masses are distributed symmetrically along the length of the ship, as well as around its central axis. This is one of the reasons why the simpler vertically-landing cigar shape is greatly preferred for passenger ships and freighters.

Meanwhile the flight plan must be carefully prepared; ships on routine flights generally have the work done by a ground-based specialist, but exploratory ships and tramp freighters must carry an astrogator capable of planning the next stage of a flight. As noted, it can take several days of painstaking mathematics to work out every detail. Naturally all pilots must be competent navigators, able to check the ship's position and correct errors, but this is much easier than preparing an entire flight plan.

The final hours before takeoff are usually extremely busy, with final checks of equipment and supplies continuing up to the moment of takeoff.

Taking off, and accelerating to escape velocity under full emergency power, test the pilot's and engineer's skill, and the ship itself. The engines and hull are under enormous stress and the ship is most heavily laden with fuel, supplies, etc. If anything goes wrong the effects can range from loss of power or fuel to a catastrophic explosion. Errors in navigation are potentially more serious than at any other time in a flight; a tiny mistake early on can have massive cumulative effects weeks later.

Acceleration is reduced to cruise settings as soon as possible after takeoff, and all available hands must then check the ship for problems; leaks and blast malfunctions are fortunately rare, but cargoes and stores sometimes break loose from their straps under the stress of takeoff, delicate equipment can go wrong, and it's a rare ship that doesn't lose a few lights, cups, and plates.

Once these immediate problems have been handled the next step is to rig the ship for low acceleration. Depending on the design this might involve moving bunks from the "deck" to the wall, and other changes to take advantage of a low-gravity environment. The engineer has to adjust the blast for maximum efficiency, which can take an hour or two. If there are first-time travellers aboard some will probably be feeling very ill at this point, though the nausea usually passes in a day or two. Panic attacks are also possible if there's an undiagnosed claustrophobic aboard, or anyone with an unusual fear of falling.

Once any immediate problems have been handled there's usually a small celebration; aboard Commonwealth ships this is usually the point at which the first rum ration of the voyage is issued, other nationalities have their own customs.

Once the ship is **cruising** life aboard ship is best described as boring, with the low acceleration adding an extra complication to life. It isn't enough to simulate Earth-like conditions, and is easily confused with free fall, but it's still strong enough to cause occasional accidents. Objects left in mid-air slowly accelerate aft, and although nobody is known to have been killed as a result, at least one crewman has broken an arm after falling asleep at the forward end of a large hold. While it would be convenient to design ships so that the "acceleration down" is always towards the deck, that's only possible with ships that will always land stern-first, liners and freighters.

In flight spacefarers wear magnetic shoes (or boots with spacesuits); with training they learn to instinctively keep one foot anchored at all times, and brace themselves to compensate for the barely-perceptible tug of acceleration. Everyday activities such as washing and showering, cooking, eating and drinking are fraught with complications. There is also a long-term medical risk; prolonged low gravity can lead to muscle and bone damage.

The Laws of Space *(continued)*

Barratry is a civil offence, often committed as an adjunct to a criminal act. It generally involves the captain *knowingly* acting against his duty to the owners, and committing an illegal act, in such a way that the owners sustain injury.

Common forms of barratry include condoning smuggling, helping the owners of cargo to commit insurance fraud by "accidentally" damaging it, taking bribes to delay departure so that a competitor of the owner gains an advantage, selling equipment, stores or the ship itself, etc.

The laws governing this offence are complex; the main reason why it is important is that it a factor determining the liability of a ship's owners if the ship is used for criminal purposes.

Marooning is fortunately rare; it's the offence of abandoning crew or passengers in such a manner that there is little chance of rescue. Given conditions in space this is often an automatic death sentence, and unjustifiable marooning is generally treated as murder.

The Customs of Space

As at sea, there are considered to be customs of space travel related to conduct in extreme emergencies. These customs may excuse cannibalism if one of more of the survivors of a wreck dies after food runs out, lotteries for a lethal injection if air is certain to run out before rescue can arrive, etc.

Each case is decided on its own merits; outright murder is never condoned, but the courts recognise that under conditions of great stress mistakes are likely to be made, and often commute sentences in such cases.

The League's courts treat any appeal to these customs with great suspicion, since they are easily abused, and are very wary of setting precedents which condone *unnecessary* criminal acts, especially murder. Since there have been cases in which an emergency has been faked to cover a murder, the courts are wise to be cautious.

Qualifications

Pilots need skill, training, and natural aptitude. Training obviously focuses on piloting, but also includes engineering and navigation, radio operation, etc. It may also include business skills and (in the case of passenger ships) basic etiquette and other 'people skills.'

The senior pilot is often also First Officer or Captain, with responsibility for the safety and security of the ship, contact with officials, etc.

Pilot Qualifications

Fully qualified spaceship pilots need **Pilot 6** or better with at least two points spent on the skill, representing a prolonged training course.

At least one point each must be spent on **Babbage Engine (Astrogator),** on **Morse Code**, on **Scientist (Astronomy)**, and on **Mechanic (Space ship systems)**. If the pilot is also going to prepare flight plans the minimum qualifications are **Babbage Engine (Astrogator) 7** and **Scientist (Astronomy) 7.**

Additional useful skills include **Business, Psychology**, and **First Aid.**

Engineers must be Jacks of all trades, at home repairing an atomic blast, a radio transmitter, an air purifier, a meteorite puncture or a dripping shower. Most time is probably devoted to keeping the atomic blast running efficiently, to keeping it from failing altogether at full power, and to routine maintenance of life support equipment, with real emergencies a comparative rarity.

Training includes nuclear physics, electrical and mechanical engineering, plumbing, chemistry, and more; for example, on exploratory ships the engineer is often the armourer.

Engineer Qualifications

Qualified engineers need **Mechanic (Space ship systems) 7** or better and must spend two or more points on **Scientist (Engineering, Nuclear Physics).** Additional useful skills include **Marksman (gunsmith)** and **First Aid. Scientist (Botany)** is useful for ships with algae farms.

Daily exercise and a regime of calcium-fixing tablets are a necessity. On the largest ships the medical officer has the duty of ensuring that everyone remains fit; on smaller ships this duty usually falls to whichever officer has taken a first aid course most recently. Hypochondria is regrettably common.

The busiest officers are the pilots and the engineer, who must work together to compensate for any variation in the atomic blast. The engineer also needs to keep an eye on the fuel and supplies to make sure that their mass continues to be distributed as evenly as possible around the ship as they are used. Course and speed can also be affected by space dust, meteor impacts, the gravity of nearby asteroids and moons, and dozens of other factors. It's especially important to maintain constant watches within a million miles of any planet, and everywhere in the Asteroid Belt.

Ideally every ship would have three pilots on rotating eight hour watches and at least two engineers; this is practical on the largest liners and freighters on the inner planet routes, but outside the orbit of Mars it's rarely possible since the extra personnel and stores would add too much extra mass. Most ships on outer planet routes make do with one engineer and two pilots alternating eight-hour and four-hour shifts. It's not ideal, especially if a problem arises while the engineer is asleep, and stress related illnesses are common.

The last stage of any flight is **landing**. It's often the time of greatest danger, especially on unexplored territory, but even a routine landing at a spaceport can cause problems, especially with the larger freighters and liners. An error on takeoff is rarely fatal; the smallest miscalculation while landing can be catastrophic. Preparations usually begin at least a day before arrival; as at takeoff, all cargo and stores must be stowed as close as possible to the centre line of the ship, and everything must be secured to prevent accidents. All bunks etc. have to be moved back to their high acceleration positions. The last hour or so of the flight is a tense wait for full-power deceleration to begin, followed by a period of discomfort and (hopefully) a reasonably gentle landing.

Assuming that nothing goes wrong, duties don't end when the ship lands, even in port; the crew is usually busy until it takes off again. The atomic blast can only be serviced or replaced when it is shut down, and many other servicing jobs are much easier under gravity or in an atmosphere. Cargo and passengers must be unloaded, and there are often bureaucratic hurdles to be jumped before a ship can be prepared for its next flight. If fuel, water, or air is loaded it must be checked for contamination and properly stored. It's a never-ending process involving all officers and crew who aren't on leave.

Ship-Building

Spaceships are big, incredibly complicated, and extremely expensive. They're usually built for a specific purpose, and often for a specific route. That isn't surprising; a freighter on a slow run to Jupiter is a very different matter to a passenger ship on the Venus run, a short-range ferry flying between Jupiter's moons, or a League patrol ship combing the asteroids for pirates. Each has its own requirements in equipment, supplies, and fuel. While there are a few general purpose ships, typically freighters whose holds can optionally be used for fuel and supplies instead of cargo, they're the exception rather than the rule. They're probably the ships of most interest to adventurers, and fortunately come onto the market reasonably often – they're expensive to run compared to ships designed for a specific route or mission, so their owners often have to sell them off in a hurry.

Step 1 – Payload

The first step in designing a ship is to calculate the payload; the total tonnage it will carry, excluding atomic blasts but including fuel. Calculations for cargo are simple – a ton of cargo is a ton of cargo, plus the weight of the hold etc. – but crew and passengers need more thought, with total tonnage varying according to the amount of space allocated per person, and more importantly the duration of the flight.

Cramped accommodation, shared cabins, etc.	0.3 tons / person	$500 / person
Individual cabins, moderate comfort	0.6 tons / person	$1200 / person
Luxurious accommodation	1.5 tons / person	$2500 / person
Life support equipment	0.2 tons / person	$150 / person
Algae "farm" food unit	4.5 tons and up[1]	$20000 and up[1]
Supplies / person (includes water, food, air etc.)	0.3 tons / person / wk[2]	$25 / person / wk[2]
Head (shower and lavatory)	0.4 tons	$2800
Galley (small / large)	0.6 tons /1.5 tons[3]	$2500 / $7500[3]
Cargo (hold including mass of cargo)	1.1 tons / ton	$250 / ton
Fuel (hold or tank including mass of fuel)	1.1 tons / ton	$250 / ton
Controls, per pilot	0.5 tons / pilot	$1200 / pilot
Radio (short range, approx 1000 miles)	0.1 tons	$500[4]
Radio (interplanetary range)	1.5 tons	$15000[4]
Meteor warning device	0.1 tons	$1200
Electric "plumb" altimeter	0.1 tons	$1200
Multi-function meteor warning / plumb	0.1 tons	$1800
Air lock	0.5 tons	$2500
Space suit recharge point	0.1 tons	$1100[5]
Fixed weapon (machine gun or flame gun)	0.2 tons / weapon[6]	See below
Turret for weapons	0.5 tons + weapons[6]	$5500

[1]Add .25 tons and $500 per person to be supplied, e.g. a unit to supply 56 people weighs 18.5 tons and costs $48000. If one of these units is fitted the requirement for other supplies is reduced by a third.

[2]Use the total tonnage of supplies to calculate how much capacity is needed to store them, using cargo space at 1.1 tons / $250 per ton of supplies.

[3]$2500 / 0.6 tons buys a minimum galley suitable for e.g. a crew of four or five. $7500 / 1.5 tons buys a galley suitable for a liner, capable of serving a sitting of up to 25 passengers or crew.

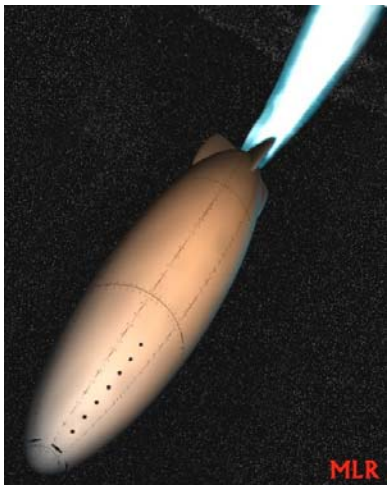
[4]Radio range varies with atmosphere etc. on planets. At interplanetary distances Morse code must be used.

[5]$1100 covers the equipment needed to refill, recharge, and repair up to six spacesuits at a time, but not the spacesuits themselves. Their mass is too low to be considered during the ship design process.

[6]Weapon weights include ammunition and mounts. Turret mass and costs include motors etc. Up to two weapons may be mounted in a turret at 0.2 tons / weapon. Weapon costs are $750 (machine gun), $3000 (flame gun). Prices include a full load of ammunition if needed. Not available (legally) to civilian purchasers.

Example: *Aardkin (The Red Peri)* was designed for the lucrative inner planet routes, Earth-Mars and Earth-Venus. She's equipped to cruise at 0.03g, so most flights will take less than two weeks. She carries 20 tons of cargo, 100 tons of fuel, six crew, and 50 passengers, and is equipped with three heads and a galley that can serve up to 20 people in a single sitting. The control room is set up for two pilots with a short-range radio and meteor warning device. The ship has an air lock and two space suit recharge points:

Cramped accommodation, 46 persons	13.8 tons	$23000
Individual cabins, 8 persons	4.8 tons	$9600
Luxurious accommodation, 2 persons	3.0 tons	$5000
3 heads	1.2 tons	$8400
Large galley	1.5 tons	$7500
20 tons cargo	22.0 tons	$5000
100 tons fuel	110 tons	$25000
Life support equipment for 56 persons	11.2 tons	$8400
Storage for supplies; 56 persons for two weeks	37.0 tons	$8500
Controls for two pilots	1.0 tons	$2400
Short range radio	0.1 tons	$500
Meteor warning device	0.1 tons	$1200
2 space suit recharge points	0.2 tons	$2200
Air lock	0.5 tons	$2500
Totals	206.4 tons	$109940



Life support supplies cost $2,800 per flight. If the *Aardkin* is refitted with an algae farm unit to supply everyone aboard it will weigh 18.5 tons and cost $48000, but the tonnage of the other supplies needed for a two-week journey is reduced from 38 tons to 25.3 tons costing $1,867. On a longer route this would make sense, if the ship always runs at full capacity, but for the Inner Planet runs ordinary supplies and chemical recycling are cheaper and weigh less; the owners decide that the expense isn't justified.

Example: *Golden Flash (Redemption Cairn)* is a racing rocket designed for the Curry Cup race from the Earth, around the Moon, and back to Earth, about half a million miles. Normally this flight would take a day or so, but racing rockets spend most of the flight at full emergency power and can make it in a few hours. For safety reasons they carry supplies for a full week and a short range radio. The pilot wears a space suit throughout the flight. There is no airlock. Meals are pre-packed sandwiches and energy bars, sanitary facilities are basically a bottle and absorbent pads inside the suit and some wet wipes.

Cramped accommodation, one person	0.3 tons	$500
10 tons fuel	11.0 tons	$1250
Life support equipment for one person	0.2 tons	$150
Storage for supplies; one person, one week	0.33 tons	$82.50
Controls for one pilot	0.5 tons	$1200
Short range radio	0.1 tons	$500
Totals	12.43 tons	$4932.50

Step 2 – Engines

The next step is to determine the type of engines fitted, whether they are to be used in the standard vertical hull or a horizontally-landing design with wings and underjets, and the cruising and emergency power expected. Some of these decisions may make it necessary to change prices from Step 1; most notably, adopting a horizontal design adds 25% to the weight of galleys and heads, and 50% to their cost, due to the extra complexity of the plumbing etc. they need.

The basic formula for calculating the total **mass** of the blasts needed for a ship is as follows:

1. Multiply the mass of the payload in tons by 0.05
2. Multiply the result by the maximum emergency power in gravities
3. Add 2.5% for each 0.005g at cruising speed
4. Add 25% if the ship is designed for prolonged horizontal atmospheric flight with wings, underjets etc.
5. For radium blasts subtract 5%; for protactinium blasts (when available) subtract 10%.
6. For racing engines designed to operate on full power for extended periods add 25% to the mass.

To calculate the **cost** of engines:

1. Multiply the total mass of the engines in tons by $5000
2. Multiply the result by 1.5 x the maximum emergency power in gravities
3. Add 5% for each 0.005g at cruising power.
4. Double the cost if the ship is designed for prolonged horizontal atmospheric flight with underjets etc.
5. For radium blasts add 25%; for protactinium blasts add 50% (once commercial production begins)
6. For racing engines designed to operate at emergency power for extended periods add 50%. Note that there is a BIG impact on fuel consumption, reliability, engine life, etc.

Example: *Aardkin* is equipped to cruise at 0.03g with emergency power of 3g, has uranium engines, and takes off and lands vertically without prolonged horizontal flight. Her payload weight is 206.4 tons.

1. Payload = 206.4 tons so basic engine mass = 10.32 tons
2. Emergency power = 3g so engine mass becomes 10.32 x 3 = 30.96 tons
3. Cruising power = 0.03g so engine mass becomes 30.96 + 15% = 35.6 tons

There are no other modifiers, so the final engine mass is 35.6 tons.

1. Engine mass = 71.19 tons so basic engine cost = $178,020
2. Emergency power = 3g so cost is multiplied by 4.5 = $534,060
3. Cruising acceleration is 0.03g so cost rises by 30% = $694,278

There are no other modifiers, so the final engine cost is $694,278
This takes the Aardkin's totals to 242 tons and $804,228

Example: *Golden Flash* is a racing rocket designed for short fast flights. She has a radium engine. She takes off and mostly flies at 3g, and cruises at 0.03g when she isn't racing; her payload is only 12.43 tons.

1. Payload = 12.43 tons so basic engine mass = 0.62 tons
2. Emergency power = 3g so engine mass becomes 0.62 x 3 = 1.86 tons
3. She cruises at 0.03g so engine mass becomes 1.86 + 15% = 2.14 tons
4. There are no modifiers for flight mode
5. The radium engine reduces engine mass by 5% = 2.04 tons.
6. Prolonged acceleration adds 25% engine mass = 2.55 tons

Engine mass = 2.55 tons

1. Engine mass = 2.55 tons so basic engine cost = $12,731
2. Emergency power = 3g so cost becomes $38,193
3. Cruising power = 0.03g so cost becomes $49,651
4. Add 25% for a radium engine = $62,064
5. Add 50% for a racing engine = $93,096

This takes the *Golden Flash's* totals to 14.98 tons and $98,028

As well as the above costs for engine construction, there are ongoing costs for engine maintenance and refurbishment, roughly 0.5% of engine costs per year (excluding labour), DOUBLING for each year without a full service. Without such maintenance the reliability and power output of atomic blasts is slowly impaired, due to (for example) build-up of lead in a uranium engine *[A Martian Odyssey]*, erosion of the exhaust nozzles, etc.

Example: *Aardkin* is serviced regularly every year. It costs $694,278 x 0.5% = $3,471.38 a year.

Example: Due to Claire Avery's financial problems the *Golden* Flash isn't serviced for four years. Her engines cost $93,096 so the first year cost would have been $466, after four years the cost is $3,728

Step 3 – Fuel and Range

The calculations for fuel consumption are relatively simple:

- Fuel per day at cruising power is the cruising acceleration multiplied by 50% of the ship's total mass.
- Fuel per hour at emergency power is emergency acceleration multiplied by 4% of the total mass.
- Multiply the result by 1.2 for uranium engines, by 1.1 for radium engines. Leave it unchanged for protactinium engines.

Most flights begin and end at full emergency power so it's usual to assume at least a quarter of an hour of emergency power at each end of a flight.

Fuel for uranium and radium blasts is relatively cheap, but protactinium blasts will be expensive to run:

- Fuel-grade salt for uranium blasts costs about a dollar a ton on Earth and on Ganymede; it's a by-product of the most common type of power plant, extracted from sea water. It's more expensive on some of the other worlds; $2.50 a ton on Mars, $25.00 a ton on Venus (where it has to be transported from the bright side through the Hotland swamps to the Cool Country colonies), and up to $50 a ton on Io, which has no reserves and must import it from Ganymede.
- Fuel-grade iron ore for radium blasts costs about $5.00 a ton on Earth, $40 a ton on Venus, $20 on Mars, Ganymede, and Titan.
- Fuel-grade copper ore costs $15 / ton on Earth and up to $40 a ton elsewhere. It isn't available on Venus or Mars. In view of its price it is normally reserved for emergency use.
- Fuel costs for protactinium blasts haven't been determined as of 2115; lead and its ores are relatively rare and expensive on Earth, around $50 a ton, and unobtainable on Mars and Venus. It's relatively abundant on Mercury, and a by-product of Titan's gold mines, but to date no large deposits have been found on the moons of Jupiter, although what is known of Europa's geology suggests that it ought to be found there. Pluto probably has good supplies too.

Example: *Aardkin* is equipped to cruise at 0.03g with emergency power of 3g. Her mass is 242 tons. She has uranium blasts.

Cruising fuel consumption is thus 0.03 x 242 x 0.5 x 1.2 tons / day = 4.36 tons / day

Emergency power consumption is 3 x 242 x .04 tons / hour = 34.85 tons / hour

Her longest flight is usually the Mars run; about 12 days at 0.03g when the planets are in conjunction. Assuming a 12 day flight with about a half hour of emergency power at each end gives roughly 12 x 4.36 tons = 52.3 tons + 35 tons = 87.3 tons. *Aardkin's* 100-ton fuel capacity allows for another three days of flight, which extends her range significantly and allows flight for several weeks either side of conjunction. She always flies with a full fuel load, costing $100 on Earth, $250 on Mars, and $2500 on Venus.

Example: *Golden Flash* is equipped to fly from point to point on Earth or race in space at 3g, with cruising speed of 0.03g when she isn't racing. Her mass is 15.0 tons. She has radium blasts.

Cruising fuel consumption is .25 tons / day

Emergency power consumption is 1.98 tons / hour, her tanks are empty after 5.08 hours

Her normal racing flight is the Earth-Moon-Earth circuit; this would be about six hours at constant emergency power, but ships in this class don't carry quite enough fuel for that, so part of the flight must be at cruising power.

The author's web site for *Forgotten Futures XI* includes a spreadsheet template, ships.xls, which speeds these calculations considerably. Small changes in e.g. fuel capacity can sometimes have surprising consequences; for example, reducing the *Golden Flash* to five tons of fuel cuts the duration of full power

by only 36 minutes and reduces the ship's price by more than $40,000 – raising it to 20 tons adds only fourteen minutes and almost doubles the cost of the ship!

Step 4 – Game Data

All ships have BODY and some degree of armour protection. Many also have modifiers for skill rolls such as Pilot, Engineer, etc. Some of the Traits described in the next section can also affect skill rolls,

BODY is calculated as 5 plus the square root of the mass of the ship in tons, rounded UP. Normally there are no other modifiers, but the Sturdy trait below can add BODY.

Armour is 1/10th the BODY of the ship rounded UP. It can also be affected by the Sturdy trait.

The following skill modifiers may also come into play:

- If the ship is designed for prolonged horizontal atmospheric flight with underjets etc. add +1 to Pilot skill during landings and takeoffs, but raise the Difficulty of all Engineering-related skill rolls +1.
- If the ship has a racing engine raise the difficulty of all Engineering and Pilot skill rolls +1.
- If the ship has a Uranium blast reduce the Difficulty of any engineer skill rolls related to the Blast, fuel systems, etc. – this is old, well understood technology, and most of the bugs have long been solved.
- If the ship has an experimental protactinium blast raise the Difficulty of any engineer skill rolls related to the Blast, fuel systems, etc. +2.

Example: *Aardkin's* total mass is 242 tons; the square root is 15.56, rounded up to 16, plus 5 = BODY 21. The ship's armour rating is thus 2.1 (rounded up as 3, or -3 Effect on all attacks). She has a Uranium blast so the Difficulty of all engineering-related skill rolls is reduced -1.

Example: *Golden Flash* has a mass of 15.0 tons; the square root is 3.9, raised to 4, plus 5 = BODY 9. The ship's armour rating is thus 1. She has a racing engine so the Difficulty of Engineering and Pilot-related skill rolls is raised +1.

Step 5 – Traits

The final step in designing a ship is to give it a few traits, qualities which affect its reputation, crew morale, and possibly performance. Most are rated as positive or negative; there must be at least one negative trait for each positive trait. Traits which cancel each other out (e.g. Beautiful with Slovenly, Lucky with Unlucky) should not be used. It's suggested that no more than four or five traits should be allocated to a ship.

Beautiful: The ship has unusually good looks, and most people would consider it to be the most beautiful example of its type. The reaction is generally favourable, but there might be e.g. an assumption that the owners are wealthy and can be overcharged, that the crew are snobs, etc. This is a *Positive* trait, but anything that seriously messes up the ship's looks will turn it into a Laughing-Stock instead.

Comfortable: Someone got things right when the ship was designed and built. She's comfortable, with (for example) unusually roomy cabins, a particularly good galley, especially good soundproofing. This is a *Positive* trait but is often paired with negative traits such as Expensive.

Cramped: Someone tried to fit too much equipment or too many passengers and crew into too small a hull. Cabins have very little elbow room, barely holding the allotted numbers of passengers or crew, corridors are narrow and obstructed. This is common for military and racing ships and ships on the outer planet routes to e.g. Titan. If it's a passenger ship the crew will experience constant complaints. A *Negative* trait.

Cranky: The ship is just a little temperamental in some respect; e.g. the atomic blast only switches to cruising power if the engineer hits exactly the right spot with a hammer, there's an odd rattle in the life

support system that nobody seems to be able to get rid of, etc. This should not represent a life-threatening problem, it's just a quirk, but is still a *Negative* trait. Note that this trait can be combined with Reliable, to represent a ship that performs well in most respects but has a couple of odd quirks.

Expensive: The ship costs a lot to run, with (for example) unusually high life support costs, engines that are no longer made and need costly spares, especially luxurious cabins. A *Negative* trait; often paired with e.g. Luxurious. The referee should determine which aspect of the ship is especially costly.

Famous: The ship is well known; possibly it broke a speed record or was the first to land on a particular asteroid or moon, possibly it had a famous captain or was involved in some historical incident. As a result most people know the ship's name and respond to it reasonably well, which might affect e.g. the fare that's charged for a cabin, the willingness of port authorities to cooperate with its officers, etc. This is a *Positive* trait – the down side is that any negative incident that affects the ship's reputation will immediately make it Notorious or a Laughing-Stock instead.

Haunted: There's a story (which may be true) that the ship is haunted. This might be the ghost of a former captain, someone who was killed when it was built, or the random victim of some space-going accident such as a meteor strike. If true, psychically gifted visitors to the ship will swear that they've seen something supernatural. This can be *Positive* (the ghost is helpful), *Negative* (the ghost is unhelpful or dangerous), or *Neutral* (there is no ghost / it's not interested in interacting with anyone aboard) as the referee prefers. See FF IV and FF VIII for more on ghosts.

Laughing-Stock: Some incident has made the ship's name into a joke, and one that her crew hear all too often. She isn't Notorious as such; the reaction is affectionate rather than hostile. Nevertheless it's a *Negative* trait.

Lively: The ship handles unusually well and is very responsive to its controls, +1 to all Piloting skill rolls. The down side is that *all* rolls must be made, even those that would normally be automatic successes, since errors have an immediate effect. This is a *Positive* trait. It cannot be combined with Stable.

Lucky: For some reason things usually go well aboard this ship; pilot errors cancel out, there's usually more fuel left than expected, and accidents have minimal consequences. To simulate this, players should re-roll any failed roll which affects the ship as a whole, and use the more favourable of the two results. This counts as TWO *Positive* traits, and cannot be paired with Unlucky.

Luxurious: Every detail of the ship (or at least the parts used by passengers) is designed for maximum ostentatious comfort, the best possible appearance, the best food, etc., regardless of impact on the ship's total mass, handling, etc. This is counted as a *Positive* trait; however, the movements of luxurious ships invariably attract a lot of attention, from the press, pirates, and anyone else likely to take an interest, which may lead to problems if the adventurers are trying to be inconspicuous. Luxurious ships must have the Expensive trait too.

New: The ship is fresh out of the yards, with state-of-the-art atomic blast, brand new air purifiers, etc. etc. This is a *Positive* trait; the snag, of course, is that everything is new and untested. If there are any problems with a ship or its components they invariably turn up during the first few flights.

Noisy: For some reason the ship makes more noise than usual. On a short flight it's a nuisance; on a long flight it may be necessary to wear hearing protection, especially in the engine compartments, and use ear plugs to ensure a good night's sleep. This is optionally a sign of impending equipment failure; on the other hand, it may be something that the right engineer can easily fix. This is a *Negative* trait.

Notorious: Everyone's heard of the ship, and not in a good way. Something nasty happened aboard, or some crime was committed by passengers or the crew; maybe there was a mutiny, suicide or murder, maybe the ship ignored a distress signal and left others to die. There are many possibilities. Changing the ship's name isn't enough to get rid of the problem – somehow the truth always gets out. The only way to get rid of the stain is by some unusual act of heroism. Always a *Negative* trait.

Old: The ship is reaching the end of its service life, and may be due (or overdue) for expensive repairs and servicing. Performance definitely won't be new or state of the art. This is generally considered a *Negative* trait; on the other hand anything that was likely to go seriously wrong has probably already done so. Old ships may be Beautiful and/or Reliable, but are often Cranky.

Reliable: The ship performs well; not flashily so, but there are few engineering problems and mostly they are easily solved. To simulate this reduce the Difficulty of engineering rolls for most equipment problems; this does not apply to e.g. repairing damage from meteor impacts or a crash landing. This is a *Positive* trait; note that it may still be combined with Cranky, representing a ship that performs well in most respects but still has one or two quirks.

Slovenly: The ship has a reputation for poor housekeeping, slack discipline, strange little animals hiding in the cargo space, etc. This is a *Negative* trait most common in freighters.

Smelly: Something is wrong with the life support equipment and nobody can find the cause; it isn't bad enough to be life-threatening (although the engineer needs to make sure that things don't get any worse), but it's annoying on short flights. On long flights everyone eventually gets used to the smell, and will be surprised if anyone mentions it. Another *Negative* trait most common in freighters.

Stable: The ship is unusually tolerant of things that would normally cause minor course changes; movement of mass around the ship, fluctuations in drive power, etc. Pilots will need to make routine course adjustments less often, and the Difficulty of routine manoeuvres is reduced -1. However, stability comes at the price of poor handling if an emergency course change is needed, with Difficulty raised +1. This is nevertheless a *Positive* trait. It cannot be combined with Lively.

Sturdy: The ship was built unusually strongly; add either 5 or 10 BODY, but also 5% or 10% total mass and 5% or 10% fuel consumption, and raises the armour protection of the hull +1 or +2. Other qualities are not affected. A *Neutral* quality.

Ugly: Something about the ship is unusually ugly. This may be the proportions or shape of the hull, an unfortunate combination of paint colours in its national and company insignia, or anything else that seems appropriate. A *Negative* trait, most common in ships designed for industrial applications such as mining ships, which cannot be combined with Beautiful.

Unlucky: Things tend to go badly aboard this ship; anything that can go wrong will do so, usually at the worst possible moment. If she lands on level ground it will turn out to be the only quicksand for miles around, if there is contraband aboard the customs inspectors will find it, if someone drops a gun it will fire. This doesn't usually change the difficulty or result of skill rolls, unless the referee is feeling unusually sadistic, but any failed roll will have the worst possible consequences. This counts as TWO *Negative* traits, and cannot be combined with Lucky.

Referees should feel free to invent more traits according to the needs of adventures, and to allow or ban traits invented by players.

Example: *Aardkin* is Comfortable (she's a well-regarded liner) and Reliable (she's flown the Mars and Venus routes for several years without any engineering problems but Unlucky (she's attacked by pirates). The Reliable trait reduces the Difficulty of engineering skill rolls -1, for a total -2 Difficulty modifier

Example: *Golden Flash* is Beautiful (one of the classic small racing ships) and Famous (the first Curry Cup winner to be piloted by a woman) but Cramped (the down-side of all racing ships) and Noisy (she has a big loud racing engine and most of the sound absorbent materials used in larger ships have been omitted to save weight.

The final details that should be added to a ship record are its ownership, role, history, etc. as in the examples that follow. The *Red Peri* is NOT described; the referee should feel free to "fudge" its performance beyond the limits of these rules.

Aardkin ***(The Red Peri):*** Large Dutch passenger/ freighter rocket on the Inner Planet routes, best known as one of the victims of the pirate *Red Peri*.
242 tons, $804,228.
40 passengers (and 6 crew) in cramped accommodation, 8 individual cabins, 2 luxury cabins, 3 heads, large galley, life support and supplies for maximum 2 weeks, Life support supply cost $2,800 per flight. 20 tons cargo.
Two pilots, short-range radio, meteor warning device, 2 spacesuit recharge points, air lock
Uranium engines, Cruise 0.03g, Emergency power 3g, 100 tons fuel (15 days at cruising power)
Engine maintenance cost $3,472 P/A.
BODY 21, Hull armour 3. Comfortable, Reliable, Unlucky. -2 Difficulty Engineering skill rolls.

Golden Flash ***(Redemption Cairn):*** Single-seater racing rocket, best known as the first ship captained by a woman to win the Curry Cup race around the Moon.
15.0 tons, $98,028
1 crew in cramped accommodation, life support and supplies for 1 week, life support supply cost $25.
One pilot, short-range radio.
Radium racing engine, Cruise 0.03g, Emergency power 3g, 10 tons fuel (5 hours at full thrust, 40 days cruise)
Engine maintenance cost $466 P/A.
BODY 9, Hull armour 1, Beautiful, Famous, Cramped, Noisy. +1 Difficulty Pilot and Engineering skill rolls.

Christiaan Huygens: Planetary Lines passenger / freighter rocket on the Outer Planet route serving the moons of Jupiter and Titan, capable of the Earth-Titan run in a single stage.
867 tons, $2,008,321
15 passengers (and 5 crew) in cramped accommodation, 3 passengers (and 2 officers) in individual cabins, 2 heads, large galley, life support and supplies for maximum 10 weeks (supplemented by algae farm), life support supply cost $6,500 per flight. 20 tons cargo.
Two pilots, short-range radio, meteor warning device, air lock, 2 spacesuit recharge points.
Radium engine, Cruise 0.015g, Emergency power 2.5g, 600 tons fuel (84 days at cruising power),
Engine maintenance cost $8,819 P/A.
BODY 35, Hull armour 4, Cramped, Reliable, -1 Difficulty routine Engineering skill rolls.

Hera and **Minos** ***(Redemption Cairn):*** Elderly Planetary Lines freighters designed for the Earth-Jupiter and Jupiter-Saturn routes, used for the Gunderson expedition to Europa and the follow-up expedition.
232 tons, $484,295
4 cramped accommodation, 4 individual cabins, life support and supplies for 8 weeks (supplemented by algae farm), head, small galley, life support supply cost $1,600 per flight. 10 tons cargo.
Two pilots, short-range radio, meteor warning / electric plumb, air lock, 1 spacesuit recharge point.
Uranium engine, cruise 0.015g, Emergency power 2.5g, 150 tons fuel (72 days at cruising power)
Engine maintenance cost $1,976 P/A
BODY 21, Hull armour 3, Comfortable, Old, -1 Difficulty routine Engineering skill rolls.

HMSS Endeavour: One of the British ships assigned to the League of Nations Patrol, primarily a police craft but used for exploration, diplomacy, etc. Capable of Earth-Jupiter, Jupiter-Saturn, etc.
301.27 tons, $1,352,641
6 cramped accommodation, life support and supplies for 5 weeks, 1 head, small galley, life support supply cost $750 per flight. 10 tons cargo.
Two pilots, long-range radio, meteor warning / electric plumb, air lock, 1 spacesuit recharge point
Radium engine, horizontal landing on underjets, cruise 0.03g, emergency power 3g, 200 tons fuel (40 days at cruising power).
Engine maintenance cost $6,243 P/A
4 machine guns (fixed mount firing forward), 2 turret-mounted flame guns (forward arc)
BODY 23, Hull armour 3, Cramped, Lively, -2 Difficulty Pilot skill rolls, +1 Difficulty Engineering skill rolls.

Accessorising

Spaceships are important, but their occupants need many other items of equipment, for use during or after the journey, from space suits and thermoskins to vehicles, tents, cameras, and tools. What follows can't hope to be an all-inclusive list, but it hopefully touches most of the main bases.

Vehicles

Auxiliary Rocket: The first expedition to Mars carried two auxiliary rockets, small craft designed for survey work. These craft were suitable for atmospheric flight only, and were designed to carry two passengers with minimal comfort. These craft proved useful, but the small atomic blasts were unreliable. Later exploratory ships were built for greater atmospheric range, as it was realised that the fuel needed to carry such a heavy craft was more useful than the craft itself. Auxiliary rockets are now almost forgotten, but small winged rockets with similar specifications are still used for transport on some of the colony moons such as Io and Titan.

Two-seat winged rocket for atmospheric flight.
3.7 tons, $5,689
2 crew in cramped accommodation, life support and supplies for 1 week, life support supply cost $50.
One pilot, short-range radio, 3 cameras.
Uranium racing engine, Cruise 0.01g, Emergency power 1g, 1 ton fuel (5.44 hours at full thrust, approx. 15 hours in normal flight under Mars gravity), maximum speed around 250 MPH.
Engine maintenance cost $12 P/A.
BODY 7, Hull armour 1, Agile, Cramped, Noisy. -1 Difficulty Piloting, +2 Difficulty Engineering skill rolls.

Gyro: These small vehicles are essentially winged helicopters with the rotor blades shrouded in their wings. They are most suited to worlds with comparatively dense atmospheres such as Earth and Venus. They run on small uranium-fuelled power packs, and have a range of several hundred miles on a few pounds of salt. The models sold for off-world use are designed for "easy" assembly from a crate-full of components. In practice this takes an engineer several hours and a lot of swearing.

2-seater with ¼-ton cargo capacity – $500 and up (Earth price) – 120 MPH – BODY 6, mass 0.7 tons*
2-seater with 2-ton cargo capacity – $800 and up (Earth price) – 90 MPH – BODY 8, mass 1.2 tons*
4-seater with ½-ton cargo capacity – $1200 and up (Earth price) – 100 MPH – BODY 8, mass 1.0 ton*
They are designed to be easy to fly, -1 Difficulty to all Pilot rolls. *Excludes passengers & cargo

Ground Car: Provided that the terrain isn't too rugged, soft, or overgrown, there's a lot to be said for a ground car. Off-world models are usually four-wheel drive, made of lightweight alloys, with uranium power packs and minimal comforts. They're mostly used in colonial cities, but occasionally encountered elsewhere. Some examples are shown below; naturally there are larger and faster variants. They are usually shipped with the wheels, windscreen, etc. removed to minimise the size of the crate. Assembly takes an hour or two but doesn't need any special skills; it's no harder than changing a tyre.

Various options are available, all adding cost and weight. These include amphibious capability (extra-large tyres, an auxiliary propeller, flotation tanks and waterproofing), armour, weapons etc.

2-seater with ¼-ton cargo capacity – $300 and up (Earth price) – 60 MPH – BODY 6, mass 0.7 tons*
2-seater with 2-ton cargo capacity – $350 and up (Earth price) – 50 MPH – BODY 6, mass 1.0 ton*
4-seater with ½-ton cargo capacity – $450 and up (Earth price) – 60 MPH – BODY 7, mass 1.0 ton*
*Excludes passengers & cargo
For amphibious models add 10% to mass and 20% to cost and reduce speed by 10 MPH
For an armoured shell add 5% mass and 10% cost and reduce speed by 5 MPH per point of armour, e.g. 3 armour adds 15% mass, 30% cost, and reduces speed by 15 MPH.
For weapons see prices etc. in the next chapter.

Protective Clothing

Testing a hard suit for extreme cold on Titan - *Smithsonian 2088*

Space suit: The iconic protective garment is a space suit, but most people never wear one unless they venture onto an airless moon or need to make repairs outside a ship's hull. "Soft" suits protect against vacuum, moderate radioactivity, and moderate heat and cold – typically -50ºC to 150ºC – and incorporate magnetic boots, a short-range radio, sockets to allow a cable to be used for private conversations, and an 8-hour air supply, with chemical absorption of carbon dioxide and other contaminants such as ammonia and water vapour. An absorbent pad provides basic sanitary facilities, and a nozzle in the helmet, controlled by an external valve, allows the wearer to drink water, an energy drink, or a stimulant (usually strong caffeine solution). The helmet also mounts a light and a microphone and speaker to allow the wearer to talk in atmosphere. These suits are made in several sizes, and usually there is an approximate fit available for anyone who needs one, but to avoid discomfort suits need to be tailored precisely to the wearer, at extra cost. The main materials used are woven glass fibre with silicone rubber sealant for the suit itself, an aluminium helmet with a clear Sillicellu® visor, and hard silicone rubber with magnetic inserts for the boots. The lining is absorbent rubber and nylon. It offers limited armour protection, but the silicone rubber is self-sealing for small punctures including small-calibre bullets.

For more extreme conditions a hard suit may be preferred. This has jointed aluminium armour and layers of insulation, extra heating or cooling systems, extra radiation screening, pincers instead of gloves, etc. according to the needs of the purchaser. Each extra system adds mass that must be carried by the wearer; on low gravity moons this isn't a problem, although the added mass can hamper movement, but on worlds such as Pluto, whose gravity exceeds that of Earth, the extra mass can cause fatigue and limits endurance.

All space suits need occasional recharge and repair. The standard recharge centre built into most ships can refill up to six suits at a time, but more can be recharged by doing it in shifts. Complete recharging and replenishment of the air recycling system takes about twenty minutes; much more time is required if repairs are needed, of course.

"Soft" space suit – $600 (Earth price) – 50 lb suit, 0.1 tons suit plus recharging equipment, supplies, stores, etc. BODY 5, Armour 1. Add $50 for a suit tailored to a perfect fit.

"Hard" space suit – $1100 (Earth price) – 80 lb suit, 0.1 tons suit plus recharging equipment, supplies, stores, etc. BODY 7, Armour 3. Add $120 for a suit tailored to a perfect fit.

- Extra heating system for above, good down to absolute zero; add 20lb, $250
- Extra cooling system for above, good up to 350°C – add 25lb, $200
- Extra cooling system for above, good up to 500°C – add 50lb, $400, requires umbilical connection to cooling plant aboard ship, mass 100lb
- Radiation screening for above, adequate for all routine atomic blast work – add 25lb, $75
- Steel armour for above, raises armour to 5 – adds 50lb, $200.
- Waterproofing and pressure-resistant modification for underwater work – adds 30lb, $200

Example: A hard suit modified for a perfect fit, with radiation screening and heating to absolute zero, would cost $2100+$120+$100+$350 = $2,670 and would mass 80+20+25lb = 125lb

Space suit liner – $10 – negligible mass. Soft long underwear with replaceable absorbent pads, $5 for 24 pads.

Transkin™ oversuit & filter mask: Essential for anyone venturing into the swamps of Venus, a Transkin™ oversuit is claimed to offer perfect protection against all spores, fungi, etc.; they are also widely used in e.g. the chemical industry, since the material is good protection against most acids and alkalis. The material resembles grey opaque rubber, and covers all of the body. The material forms a hood around the head, with the face plate and filter mask attached by a quick-release locking ring. Facilities inside the suit include a water pouch and pockets for spare filters, Thermide™ tablets, etc. The standard package for Venus also includes a water bottle and filter, a Transkin™ back-pack for supplies, and mud shoes.

Transkin™ has one serious flaw; although it's tough it isn't self-sealing, punctures etc. must be repaired with a patch kit. Of course even the tiniest puncture will let in enough spores to kill the wearer of a suit in minutes, so that's rarely a problem in itself.

Transkin™ is a good insulator, but under Venusian conditions it tends to keep heat in so that the wearer is usually uncomfortably warm and extremely sweaty. Most wearers wear t-shirts and shorts under the suits, to prevent chafing, anything more will soon be a soggy uncomfortable mess.

Transkin™ Oversuit – $85 – 25lb. Includes suit, face plate, filter mask, repair kit, back pack, 200 Thermide™ tablets, 1 pack 50 filter inserts, water flask and mesh screen, mud shoes. BODY 5, reduces Effect of blows etc. (but not puncture wounds) -1. Walking in mud shoes requires an Athlete or BODY roll against Difficulty 4; after some experience success is automatic.
Replacement filter inserts – $5 pack 50 – mass negligible.
Thermide tablets – $7.50 pack 200 – mass negligible

Cold-Weather Clothing: Since the first expedition to Mars there have been many attempts to perfect cold weather clothing, but the essentials still remain much the same as they have always been; heavily-insulated parkas, boots, and trousers, with face masks and Sillicellu® visors. Modern synthetic sponge "rubber" insulators are efficient enough that the main problem for wearers is often the need to get rid of the moisture from the wearer's sweat, which can reduce the effectiveness of the insulation. On Mars insulated clothing and a Thermo-skin sleeping bag will handle all conditions that visitors are likely to encounter. On Titan similar clothing is used, but thicker insulation and electrical heating are needed due to the constant winds.

On Ganymede this clothing is combined with an electrically-heated "vacuum suit," an undersuit resembling a rubber diving suit; given conditions on this moon it's almost impossible to avoid immersion in icy water, which ruins normal insulation. The drawbacks are cost and heaviness, since the "vacuum suit" actually consists of two waterproof layers separated by a grid of electrically-heated wires, with a radium power pack, all built strongly to maximise ruggedness.

For more extreme environments space suits are probably the best answer.

Basic cold weather gear – $55 – 20lb. BODY 2, Includes insulated parka, trousers, and boots, fur hood, face mask, Sillicellu® visor. Armour 2 versus blows etc., 1 versus knives etc. Add $25 and 5lb for Titan.

Ganymede "vacuum" suit – $100 – 45lb. BODY 3, undersuit BODY 2. Includes insulated heated waterproof undersuit, Sillicellu® visor, radium power pack, trousers, parka and boots. Armour 2 versus blows etc., 1 versus knives etc. Damage to the undersuit may cut off the power to the heating system.

Magnetic Footwear: Made in a range of styles, from industrial work boots to high fashion, magnetic footwear performs the simple but essential job of (literally) keeping its wearers grounded under conditions of zero or near-zero gravity. There are dozens of different versions, all designed so that they stick to a steel surface with sufficient force to prevent accidental release, while coming away easily as

the wearer walks. The method is actually surprisingly simple; each shoe contains a strong magnet near the heel, and a weaker magnet under the ball of the foot. The example illustrated has a ferrite magnet ring embedded in the leather sole (part of the covering has been removed for clarity) with magnetic rubber (a mixture of synthetic rubber and a barium ferrite compound) in the middle of the ferrite ring and under the ball of the foot. As the heel comes into contact with a steel surface the relatively weak magnetic rubber takes effect first, pulling the foot close enough for the stronger ferrite magnet to add more force. The magnetic rubber under the ball of the foot adds more attraction. If the wearer walks forward the natural movement of the foot and ankle lifts the ferrite magnet far enough away that it's easy to pull the heel free, while retaining some anchorage via the magnetic rubber under the ball. This isn't quite as easy as walking under gravity – care must be taken to avoid pulling both shoes free simultaneously – but it works well enough to give most wearers an impression that they are under gravity, which is psychologically useful.

Magnetic Shoes & Boots – $5 to $100+ – BODY 1, mass negligible. The price depends mainly on fashion, in general work shoes and boots are cheap, fashion shoes can be very expensive, especially if they are aimed at the wealthy space yachting set. Capabilities for e.g. protection are the same as for any other shoe; for example, work boots will protect the feet against impact, acid, etc., fashion shoes usually don't offer any protection at all. Most space suits incorporate magnetic boots.

Accommodation: Explorers, traders, and other travellers often need housing. While a tent (5lb $20) or a sleeping bag (3lb $10) may be all that's needed in some locations, such as the cooler areas of Venus and most parts of Mars, more care is needed when there are adverse conditions, as in the Venus Hotlands, the frozen wastes of Titan, etc.

Prefabricated shelters are generally made of aluminium alloys, due to their lightness, but there are disadvantages; strong chemicals and impacts can damage or destroy them, and they are easily damaged by weapons and other attacks. Where possible stronger materials are preferred; on Io native woods are used to build log cabins, on Ganymede concrete domes based on native technology are used by many traders, the main cities of Titan are dug into the rock, the pirate Red Peri used a cave lair, and so forth.

Venus Hotland Cabin - $750 and up, mass 0.5 tons and up, BODY 5, Armour 2, consists of one or more rooms with a filtered air supply, air lock, anti-spore spray, basic cooking facilities, a bunk and other furnishings, a radium power supply, etc. Add $300 and 0.3 tons per additional room. Note that the price is for delivery to Venus, but does not include transportation to the final location or foundations; if the cabin is undermined by mud spouts etc. it will probably be lost. Double the price and mass if foundations are needed.

Titan Igloo - $1500 and up, mass 0.4 tons and up, BODY 4, Armour 2, consists of one rooms with an air lock, basic cooking facilities, radium power supply and heater, a bunk and other furnishings etc. Add $1000 per additional occupant. Note that the price includes transportation to Titan but not to its final location.

Gadgets and Gizmos

Telescope (hand-held monocular design)	10lb, $50	Binoculars with compass and rangefinder	5lb $75
12" Astronomical telescope	50lb, $200	Field microscope for biologist	10lb, $200
35mm camera with fixed standard lens	1lb, $70	35mm camera with three lenses	8lb, $250
16mm cine camera	15lb, $150	Pilot's precision chronometric watch	4oz, $150

Radium battery	1lb, $25 to 10lb, $200 depending on capacity
Fluorolux lantern	5lb, $30 including radium battery
Hexylamine (Illegal)	Negligible mass, $1 per dose on Earth, $5-$10 elsewhere.

Inferno burst. The tiny diamond, giving up all its energy in one terrific blast, shot a jagged stream of fire that filled the canyon from wall to wall and vomited out beyond to cut a fan of fire through the bleeding-grass of the slope.

The Mad Moon

Load Up on Guns (Friends Optional)

SPACE is big and the natives aren't always friendly. There are times when a man (or woman, or Martian) has to do what a man (or woman, or Martian) has to do, and it pays to have the best possible weapon for the job.

The most reliable hand weapons available are still old-style automatic pistols and rifles. The most powerful (but decidedly *unreliable)* are flame guns, which initiate a partial carbon-cycle fusion reaction in an industrial diamond, converting some of its matter into energy and discharging a huge gout of super-hot plasma flame.

There are larger military versions of both of these weapons, as well as more specialised weapons such as blasters (nuclear grenades), special ammunition for use aboard ships, Boland explosive bullets, etc.

Mauser concept model for an "improved" flame pistol, 2095. The prototype exploded and the project was abandoned.

Leroy wanted to dissect it with a Boland explosive bullet, but I thought that anything that had lived for ten million years was entitled to the respect due to old age, so I talked him out of it.

Valley of Dreams

.45 AUTOMATIC ($75-$125)
Huge handgun; 2 shots/rd, 8 shots per clip
Normal ammo; Effect 9, A:I, B:I, C:C/K ($3 per 100)
Boland bullets; Effect 7 plus explosion, burst radius 4ft, Effect 12, A: F, B:I, C:C/K ($1 per 10)
Fragmentation bullets: Effect 6, A:F, B:I, C:C/K – will not penetrate spaceship hulls ($4 per 100)

.38 AUTOMATIC ($60-$100)
Large handgun; 2 shots/rd, 10 shots per clip.
Normal ammo; Effect 7, A:I, B:I, C:C/K ($2.50 per 100)
Boland bullets; Effect 5 plus explosion, burst radius 4ft, Effect 8, A: F, B:I, C:C/K ($1 per 10)
Fragmentation bullets: Effect 5, A:F, B:I, C:C/K– will not penetrate spaceship hulls ($3.50 per 100)

.357 RIFLE ($125-$200)
Large rifle; 1 shot/rd, 5 shots per clip.
Normal ammo; Effect 10, A:I, B:I, C:C/K ($4 per 100)
Boland bullets; Effect 9 plus explosion, burst radius 4ft, Effect 12, A: F, B:I, C:C/K ($4 per 10)

40MM MACHINE CANNON ($450 / $750 WITH FITTINGS FOR SPACECRAFT USE)
Tripod or vehicle-mounted belt-fed machine gun; 5 shots/rd, multiple targets at -2, 400 shots per belt. Single shots may be fired.
Normal ammo; Effect 10, A:I, B:I, C:C/K ($25 / belt 400)
Boland bullets; Effect 9 plus explosion, burst radius 6ft, Effect 14, A:F, B:I, C:C/K ($100 / belt 400)
Spaceship-mounted versions incorporate an airlock so that air doesn't leak out of the barrel.

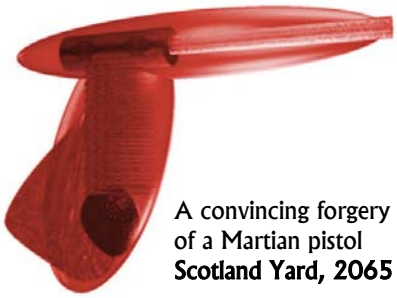
"…that crystal weapon of Tweel's was an interesting device… It fired a little glass splinter, poisoned, I suppose, and I guess it held at least a hundred of 'em to a load. The propellant was steam – just plain steam!... …You could see the water through the transparent handle and about a gill of another liquid, thick and yellowish. When Tweel squeezed the handle – there was no trigger – a drop of water and a drop of the yellow stuff squirted into the firing chamber, and the water vaporized – like that…

A Martian Odyssey

MARTIAN PISTOL ($1000 AND UP)

Small handgun; 1 shot/rd, 128 shots.
Dart; Effect 4, A:F, B:I, C:C/K*
*Ammunition is coated with a chemical harmful to Martian life, adding Effect 4+1/round, but harmless to humans.

The gun must be hand-reloaded with darts and chemical propellant once the ammunition is exhausted, which takes several minutes.



A convincing forgery of a Martian pistol
Scotland Yard, 2065

These weapons are mostly used by Martians, but there are a few in human hands; they sell at high prices as collector's items, not working weapons, and there is a brisk trade in fakes. Ammunition is virtually unobtainable off Mars. The grip is sized for Martian hands, not human, and they are difficult for humans to use, -1 to Marksmanship skill at all ranges. One of the most common errors in forgeries is sizing the grip closer to the shape and size of a human hand.

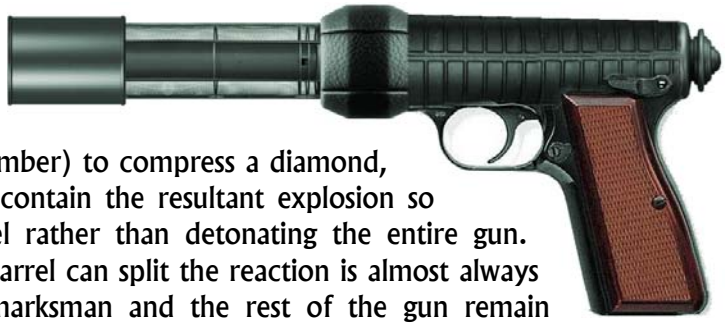
And as for the flame pistol, that was like using a Big Bertha to swat a fly. Its vast belch of fire would certainly incinerate all the slinkers in its immediate path, along with grass, trees, and loonies, but that again would make but little impress on the surviving hordes, and it meant laboriously recharging the pistol with another black diamond and another barrel.

The Mad Moon

FLAME PISTOL ($150-$200)

Heat Ray; Range 300ft radius 20ft, Effect 30 A:I, B:C/K, C:K
Fires 1 shot per 3 rounds; Ammunition industrial diamonds, value $10
Barrel (cost $5) shatters on 10-11; changing barrels takes 40 minutes.
Chamber bursts on 12 – not repairable.

Ruger *Vulcan* 2093



Use in confined spaces is **not** recommended!
Illegal in most "civilised" areas, cities, etc.

Flame pistols use powerful electromagnets (in the barrel) and a small radium source (in the chamber) to compress a diamond, ignite a momentary carbon-fusion reaction, and contain the resultant explosion so that the energy leaves via the end of the barrel rather than detonating the entire gun. They're designed to fail "safe"; by the time the barrel can split the reaction is almost always over, so that the barrel is destroyed but the marksman and the rest of the gun remain unscathed. Occasionally the reaction flashes back down the barrel to the radium chamber; the whole gun can be destroyed, although this again usually happens *after* the shot has been fired.

Hand-held flame pistols are a moderately successful kludge, a spin-off of the military flame cannon (below); to make them light enough to carry most of the safety mechanisms of the flame cannon are omitted, hence the increased risk of barrel bursts etc. One consequence is that swapping the barrel is very slow; about 40 minutes, compared to a few seconds for the military model, which has an elaborate system of motorised clamps and contacts to align the barrel and connect it.

There are several models, with identical statistics; barrels cannot be swapped between models.

FLAME CANNON ($1700 / $3000 WITH FITTINGS FOR SPACECRAFT USE)

Heat Ray; Range 300ft radius 20ft, Effect 30 A:I, B:C/K, C:K

Fires 1 shot per 2 rounds; ammunition industrial diamonds value $10

Barrel (cost $12) shatters on 11; since the barrels are changed after each shot this does not delay the next shot. Chamber bursts on 12 – not repairable.

The military version of the flame pistol is the flame cannon, a belt fed weapon. Each belt segment contains a pre-loaded barrel (inside an airtight outer barrel casing in the ship-mounted version). As the barrel is brought up to the gun an automatic clamping system fixes it in place and connects the barrel electromagnets. The cycle from one shot to the next takes two rounds, but these weapons are often mounted in pairs so that one shot can be fired every round. After the belt (typically 30 barrels) has been used each barrel must be laboriously reloaded with a new diamond. If a barrel shatters it must be removed from the belt and replaced during reloading – this takes about 10 minutes. If the chamber bursts the gun is not repairable. This is by any standard a clumsy weapon, weighing about 300lb.

Spaceship-mounted versions are designed so that the barrel aperture automatically seals shut as the barrels are changed and if the chamber bursts, to avoid depressurising the ship. It is not *believed* that this mechanism has ever operated prematurely, causing the entire gun to explode inside the ship.

There are several models, with identical statistics; barrels cannot be swapped between models.

Note: This weapon is not canon for the setting, but its existence as the source and more reliable version of the flame gun seems a plausible way to account for the limitations of the hand-held version.

…It seemed to me that the whole mountain lifted. Vast masses of crumbling rock hurtled toward the black sky. Bits of stone, whistling like bullets and incandescent like meteors, shot past us, and the very ground we clung to heaved like the deck of a rolling rocket.

Redemption Cairn

BLASTER ($250 FOR LEGAL PURCHASER, MUCH MORE ON BLACK MARKET)

Explosion; Radius 30ft, Effect 25+2D6, A:I, B:C/K, C:K

Blasters are atomic grenades equivalent to a few *tons* of conventional explosives, consisting of a radium source and a chamber full of iron salts. When the pin is pulled a lead shutter opens and the salt is irradiated and converted to energy. This continues until the casing is shattered, releasing the blast. They can be thrown, but not far enough to avoid injury under Earth gravity, or used with a timer.

The reaction typically takes 2-3 rounds, during which a faint whistling can be heard, superheated gas leaking out of the pin aperture. At the end of this time the grenade explodes. It's just possible to put the pin back in and close the shutter, but anyone attempting this is likely to be badly burned since the casing heats to several hundred degrees before it bursts. Availability is theoretically limited to the military services and licensed demolition contractors, but they can be found on the black market.

STUNNER ($350)

Sonic pulse; Radius 3ft, Maximum Range 20ft, Effect 8, A:B, B:KO+B, C:KO/KO+I

This weapon uses modulated sound to "overload" the target's nervous system and cause unconsciousness. It is useless in a vacuum, but devastating in the confined corridors of a spaceship. There is a slight risk of injury; stun guns can cause concussion (or epileptic fits at the discretion of the referee). The standard designs are only effective against humans. A radium battery gives hundreds of shots.

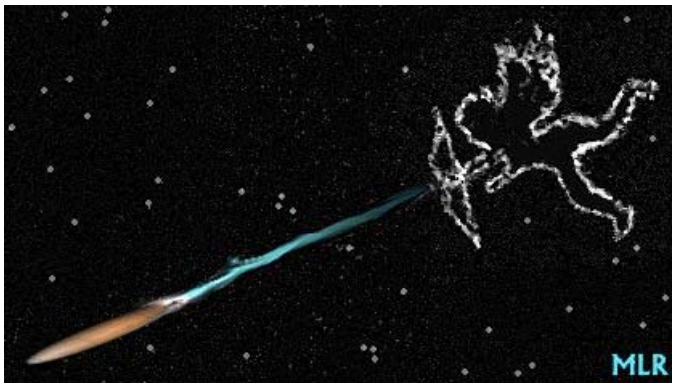
Note: This weapon is not canon for the setting but seems plausible given the other technology described.

Colt *Pacifier* Stun Gun, 2100

… Suddenly he pulled her into his arms. "I'm not going to quarrel about whose fault it was," he said. "But we'll settle one thing immediately. We're going to Erotia, and that's where we'll be married, in a good American church if they've put one up yet, or by a good American justice if they haven't. There's no more talk of Madman's Pass and crossing the Mountains of Eternity. Is that clear?"

Parasite Planet

Love and Rockets



ROMANCE seems to bloom easily in space. This may in part be the result of the scarcity of single women; relatively few venture into space, about one for every twenty single men, and those who do often find that they experience a surfeit of admirers. This isn't surprising, of course, but it occurs so often that it has become a cliché of romantic fiction.

The Eugenics Institute of Chicago's 2093 study[1] suggested that there is a measurable increase in intelligence in the children of off-world colonists, attributed to selection by the parents (especially the mothers) of second-generation colonists. It argues that women venture into space because they subconsciously seek intelligent husbands. Most other studies suggest a much simpler causal relationship; everyone going into space is to some extent selected for intelligence by (for example) passing tests to qualify as space crew, nurses, etc., and in many cases by surviving on colony worlds where those of lower intelligence would be more likely to die for one reason or another. For example, about 10% of "new chums" on Venus die in their first year, usually as a result of forgetting one or another step in keeping themselves fungus-free in the Hotlands. The survivors are likely to be of slightly higher intelligence, or at least more capable of following the appropriate instructions, than those who die.

Whether or not there is any true link between marriage and intelligence, it's estimated that about 65% of single women who take up space-faring careers marry within five years, and that more often than not their husbands are colonists, miners, space-crew, or others whose career takes them into space.

Even the most cursory examination of the current crop of romantic literature suggests a few common themes and character stereotypes that crop up again and again, to such an extent that the same author may reuse them several times.

For example, in dozens of novels, stories, and video dramas the hero (often in fact an anti-hero who gradually becomes heroic as love blooms) is a trader, trapper, or other loner who rescues a beautiful heiress from certain doom in e.g. the swamps of Venus, the jungles of Io, etc., reluctantly agrees to help her return to civilisation, and gradually falls in love with her as the journey progresses. In such stories the gradual flowering of love is generally contrasted with the brutality of nature. Exploration is another popular theme, of course, with romance flowering as the characters explore strange new worlds, meet new life and new civilisations, and all too often end up destroying large swathes of both with flame guns, blasters, and other weapons.

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[1] *Intelligence-Biased Selective Breeding on Venus, Io and Ganymede*; K.R. Thwaite and D.D. Buskin, EIC Press 2086

A full list of the plots and tropes found in these novels would be wearisome; a few more examples will suffice:

Woke Up on Venus

The Hero and Heroine wake to discover that they have somehow been transported to an isolated area of another world (typically the Venusian Hotlands, sometimes the ice mountains of Titan or the jungles of Io), with no memory of having met before or travelled there, then learn that in the "lost" days they have apparently married, aboard ship or in a frontier town.

According to the needs of the story this may be the result of too much booze, a fiendish plot of some sort (likely if one or both are rich), or an unusual colonisation scheme. Naturally true love eventually triumphs, even if it is learned that one or another of the characters was in on the plot from the start.

The Pirate Queen

The original version of this hoary plot (which dates back to the days of sail and possibly even rowing galleys) has a rich bored heroine abducted by a particularly gallant pirate captain, and held under reasonably comfortable conditions pending her ransom. Needless to say his behaviour is impeccably correct, although she is completely at his mercy, and he actually protects him from less respectful underlings.

Gradually her hatred of him turns to love as she realises that her life is much more interesting since her abduction, she eventually confesses her love to him. Their romance continues until the ransom is paid and they are forced to part. But her old life no longer has any appeal to the heiress, and eventually she "escapes" and finds her way back to the pirates, and to a resumption of their interrupted affair.

***Privateers of Pluto* (RKO 2094).**
The hero pledges allegiance to the pirate queen, knowing that he must betray her.

As soon as it was known that the pirate *Red Peri* was a woman, it was inevitable that the older pirate trope would have competition. The most popular current versions "borrow" liberally from the tales of this enigmatic figure, attributing her motives to love or a broken heart. Unusually for romantic fiction, the viewpoint character is often male, a captive who admires the pirate queen even as he seeks to escape or capture her. For legal reasons the real Red Peri's alleged motivations are rarely mentioned in fiction; the Queen's behaviour is generally attributed to revenge for abuse, infidelity, or other crimes against the Queen or her family.

Crewman "Bob" – *Adapted from a suggestion by Mavis Cruet*

The bluff no-nonsense hard-hitting Captain of a freighter cares for no-one… until he slowly starts to recognise an odd trickle of affection for one of the new crewmen appointed by the shipping line; new crewmen who otherwise seem to take their orders from the company, not the Captain, and seem to have their own agenda which may have more to do with profit margins and inflated insurance values than the safety of the ship.

When the Captain confides in the only "man" he thinks he can trust, he learns that "he" is in fact a woman, whose father was the captain of another ship owned by the company, now lost in the deeps of space. Together they must work to overcome the company; inevitably, as they do so, they fall in love.

The Princess Bribe
A Russian Princess (in some stories she's British or from one of the smaller states that still has royalty) decides that she has had enough of the decadence of Earth and wishes to experience the adventurous life as a pioneer. The hero is hired to make life unpleasant for her, but harmlessly so, with the goal of persuading her to return to Earth and resume her royal duties. Of course things aren't that easy, especially when love blooms, and eventually both are on the run from Imperial agents who want to return the Princess to the Motherland, and get rid of the hero permanently.

The Venusian Queen – *Adapted from a suggestion by John Reiher*
In the swamps of Venus, a missionary and his beautiful daughter are ministering to the "heathen savages." But armed conflict has broken out between two of the largest tribes and their mission is in the middle of it. The hero and his friends run a swamp boat which normally delivers supplies to traders and other humans in the area; as the war escalates they're asked to evacuate civilians from the area. But naturally the headstrong girl has other ideas…

Mighty Joe Yurgguh – *Adapted from a suggestion by John Reiher*
A young girl colonist on Mars wants a pet, and is given a small animal by some Martian friends, but doesn't quite understand what they tell her about its habits etc. Inevitably it grows into a massively large and surprisingly intelligent creature that is nevertheless gentle under the ministrations of the young woman. A handsome entrepreneur convinces her to bring Joe back to the earth to star in a night club act, but Joe becomes bored then jealous as love blossoms between girl and entrepreneur. Problems ensue when Joe decides that it wants to go back to Mars, and isn't willing to take 'no' for an answer or return alone.

On Location
Since many readers of romantic novels are also movie fans, it isn't surprising that stories with a movie industry background are popular. In such novels the heroine is either a famous actress or (depending on the target audience) her secretary / costume designer / makeup artist, with a glamorous cast of actors, directors, etc. vying for her affections en route to film on Mars, Venus, or one of the moons of Jupiter. Sometimes that's all that there is to the plot, and the story ends with the heroine and her newfound love continuing to work in the industry – a common variant has the heroine as the understudy to an actress who succumbs to some alien disease during the voyage, with the understudy going on to become a star – but usually the heroine finds love with a rugged spaceman, miner, explorer, etc., and the story ends with her leaving the profession to become a pioneer.

…Together They Fight Aliens
Inspired largely by the careers of famous explorers Ham and Patricia Hammond, and possibly by earlier sources such as the "Thin Man" movies of the 20th century, this variant on the traditional "oddly mismatched couple / opposites attract" love story is a romantic comedy in which the hero and heroine are already married but have contrasting personalities and constantly bicker. Usually their arguments disguise their love. In many examples the couple are forced to pretend that they are not married so that one can (for example) infiltrate a pirate operation, a hexylamine smuggling gang, etc. while the other pretends to be unattached and runs into romantic complications. Often the plot throws in misunderstandings such as apparently compromising situations which may briefly lead to estrangement, but this particular plot variant never leads to divorce; instead all problems are eventually resolved, and the natural status quo of the marriage is restored. Often such restoration occurs over the bodies of a few dozen pirates or several hundred aliens, but that's romance…

Running Romantic Adventures

Forgotten Futures already includes suggestions on melodramatic role playing (in *Forgotten Futures VI* and as the *Adding Melodrama* appendix of the most recent versions of the rules) which involve running characters as though they are members of a troupe of actors, with asides to the audience, songs, soliloquies, etc. These rules are readily adapted to romance and to romantic comedy, by toning down the melodrama a little and concentrating more on the emotional side of things. It should be remembered that Weinbaum's heroines are far more self-reliant than those of Victorian melodrama.

The secret of success in this type of adventure is not to overdo the romance; there needs to be a substantial plot too, and one that gives everyone something to do. One of the adventures includes pre-defined characters with some romantic possibilities, but the adventure revolves around an unexplained death that may be a murder mystery.

It's notable that there are actually very few Villains in Weinbaum's Planetary stories – in most of them nature and alien life forms are the enemy:

Peri Maclane *(The Red Peri)* is an Anti-Heroine rather than a true Villain, and most of her pirate gang are devoted to her, rather than being Villains in their own right. The nearest thing to a large villainous organisation in her story is the Interplanetary Corporation, which seems to be prepared to go to almost any lengths to protect its near-monopoly on space flight and spaceship technology.

Kratska *(Redemption Cairn)* is an out and out villain with no redeeming features – he's a hexylamine addict and probably an agent for Interplanetary, though this is never stated explicitly. He commits multiple murders, he's cruel to animals, tries to abduct the heroine, and appears to be a Master of Disguise. Naturally he comes to a sticky end.

Kirt Scaler *(Tidal Moon)* is an Antihero rather than a true Villain. Admittedly he tries to steal the Hero's girl and commit industrial espionage, but nobody really gets hurt. It's easy to imagine the Hero and Scaler meeting in a bar on Io a few years down the line and settling their differences amicably.

Most of the melodramatic Traits included in the rules are suitable for use in this setting. It's pointless to list all of them here, but some particularly useful examples follow:

Amnesiac: see *Woke Up on Venus,* above.

Disguised nobility: Members of noble and royal families are often discouraged from working in space, and may be forced to resort to disguises to escape their family obligations.

Doomed: An interesting way to bring the Romantic Interest into the plot. There may be a cure, but it requires exposure to a Mound-Builder crystal, exotic plants only found in the Jungles of Io or the Hotlands of Venus, etc. etc.

Extraordinary wealth: Essential for anyone who owns a spaceship without crippling financial problems, may also be true of occasional miners, traders, etc.

Femme Fatale: Very common, especially amongst female pirates and other aggressive female leads.

Foreign: All aliens count as "foreign," albeit definitely not romantic interest for humans.

Heiress: Lost / shipwrecked / marooned / disguised heiresses are a staple of the genre.

Insane: Uncommon in this era, but several diseases on alien worlds can cause delirium or insanity, as can drugs such as Hex. Then there's mind control from dream-beasts and the intelligent plants of the Venusian dark-side. Fortunately most of these conditions are short-lived, but they're ample reason for a character to be insane for the duration of an adventure.

Loner: Common amongst prospectors, traders, etc.

Mortgage: Anyone who owns a ship and isn't ridiculously rich probably has money problems, which may eventually amount to a crushing burden, especially if unscrupulous creditors demand prompt repayment or other favours.

Master of Disguise: Common amongst incognito pirates etc., or famous explorers seeking a little peace and quiet.

Long Lost Heir: Several early colonial attempts failed, e.g. on Venus – maybe a few children were rescued from one of them, and nobody now realises that one of them is heir to a vast fortune.

Reborn: Members of an alien race are convinced that one of the adventurers is an important historical figure reborn, and want him or her to take up the mantle of their predecessor – or want to seek revenge for the predecessor's misdeeds!

Secret, Notorious: Common amongst spacemen with a shady past, e.g. they survived a disaster by taking someone's oxygen; circumstances may have made other choices impossible, in which case the subject may suffer pangs of conscience, and it's a bit embarrassing to be known as "the pilot who ate the chief engineer's leg" etc. Important romantic secrets might be "Secretly engaged", "Divorced", etc.

Sense of Duty: Very common amongst spaceship officers, especially in military service.

Transvestism: See *Crewman "Bob,"* above.

Uncanny Powers: Fairly common amongst the more melodramatic villains, but usually as the result of scientific research; "After years of study I have duplicated the powers of the dream-beasts of Mars. Look into my eyes *and love me…"*

Wanted: Very common amongst space pirates, shady colonials, etc. Since piracy carries the death penalty the phrase may be "Wanted, Dead or Alive."

Some new Traits especially appropriate to this genre:

Addict: The character (Antihero or Villain) is addicted to Hexylamine or some other drug. The Love of a Good Woman may help an Antihero shake the habit. Villains are more likely to come to a sticky end.

Bickering: A common trait of married couples. See *…Together They Fight Aliens*, above.

Girl in Every Port: Most common amongst spacecrew. The Hero (or more commonly an Antihero) has girlfriends wherever he goes. Naturally they will fall by the wayside when he encounters True Love.

Legally Dead: With flights sometimes taking months, and many possible reasons for delay, ships are occasionally incorrectly reported as lost. After all hope seems to be gone the crew must be declared legally dead. This can be a problem, especially if a husband or wife decides to remarry before the mistake is rectified… The "lost" spouse may be desperate to be reunited with the lost love, or might prove to be the villain of the story, willing to wreck true romance to resume an unhappy relationship.

Scarlet Woman: A female character, widely known for her promiscuity, at least in her local community. Maybe this leads to resentment or anger, maybe it's just accepted as the way things are, especially if the Scarlet Woman isn't a threat to marriages; e.g. the only single woman in an isolated mining colony who is "liberal" with her affections but isn't interested in married men. For a more romantic plot it's possible that the reputation is entirely without foundation, gossip spread by someone who is jealous of the heroine's beauty.

Selflessly Devoted: The character loves someone and regards his or her happiness as paramount, even if it means personal risk. See e.g. Diane Vick *(Flight on Titan)* who accompanies her husband to the desolate ice moon at great risk to her own life.

Unfaithful: Most common amongst villains, but occasionally amongst romantic Heroes – with the latter the plot must involve realisation of the mistake and remorse as the character tries to make things right with his or her spouse.

Wandering Eyes / Hands: Most common for male characters who have yet to be Redeemed by the Love of a Good Woman, these traits are exactly what they sound like. If the subject of the trait ever actually encounters said Good Woman the most likely result is a slapped face, a broken nose (Weinbaum's heroines are reasonably good at looking after themselves), or in extreme cases severe damages to sensitive parts of the anatomy, up to and including bullet wounds.



"What the devil!" gulped Keene. He twisted his head within his immovable helmet, peering through the rear visor glasses. Five—no, six figures in blue metal space suits were ranged behind him; they must have approached in the inaudibility of a vacuum while he had been scouring his suit free of the crystals. For a moment he had an eerie sensation of wonder, fearful that he faced some grotesque denizens of the mysterious black planet, but a glance revealed that the forms were human. So were the faces dim in the dusk behind the visors; so had been the voice he had heard.

Keene hesitated. "Listen," he said. "We're not interfering with you. All we want is some tungsten in order to fix our—"

"Move!" snapped the voice, whose tones travelled through the weapon hard against Keene's back. "And remember that I'm two thirds inclined to kill you anyway. Now move!"

The Red Peri

Have Spacesuit, Will Travel

THIS section contains adventures for this setting and is written primarily for referees; if you will be playing a character in these scenarios you are advised not to read past this introduction. Knowledge of things to come won't give you any advantages; it just spoils the fun if you know what the referee plans to throw at you.

There are three full-length adventures, plus some short outlines. All were written for three to six player characters, but in a pinch can probably be run for larger or smaller groups. There are detailed statistics for six characters below, used by the author for demonstration games.

- ***Grand Tour*** is a framing story for the sample characters; it isn't a complete adventure in itself, but provides a rationale for a diverse group of adventurers to be travelling together, and a suitable ship, and includes seven scenario outlines. With one exception the other adventures can easily be fitted into this framing story.
- In ***With a Pinch of Salt*** there are problems with the mobile factory that supplies much of Venus with the salt that's essential for its atomic power plants. Fortunately some visiting spacefarers have the skills and transport needed to get to the factory and resolve the problem.
- ***A Ceres of Unfortunate Events*** takes the adventurers to the Asteroid Belt, and gives them the opportunity to explore the interior of the largest asteroid by submarine.
- ***Earth Girls Aren't Easy*** visits Titan, where the father of the Heroine has died under mysterious circumstances. It's a melodramatic adventure that comes with some appropriately melodramatic characters.

Before running these adventures you will need to print out maps and other handouts, and may wish to purchase or build models and other props, such as the ships, factories, submarines etc. that appear in the

adventures – PDF plans scaled for 25mm/28mm figures can be downloaded from the author's web site. Additional props might include models, vehicles, etc. It's worth mentioning here that models sold as ornaments or toys are usually much cheaper than those sold specifically for gaming purposes.

Miniatures

There are no miniatures specifically designed for this game setting, and many of the SF ranges seem to be focussed almost exclusively on heavily armoured figures with ridiculously spiky shoulder pads. Figures sold for "pulp SF" campaigns are a better bet. Most are comparatively expensive and poorly distributed, but one cheap source is readily available; collectible plastic figures for the *Star Wars™ Miniatures* game from Wizards of the Coast. The humans in this range are depicted in costumes that seem to be based on SF illustrations of the 1930s to 1950s. There are hundreds of designs, all supplied ready-painted. Most carry weapons, but they aren't as heavily armed and over-armoured as most of the other SF ranges. While there are no space-suited figures, several of the designs resemble space suits and can be modified very easily; for example, by replacing the head with a spherical bead painted to resemble a helmet.

For information on this system see http://www.wizards.com/default.asp?x=starwars

Wizards of the Coast sell these figures in packs that have been randomised for game use, which usually contain some "personality" and alien figures that are unsuitable for this setting, but there are many third-party vendors selling them on an individual basis, and "common" figures are often very cheap. I purchased most of those I use from an American vendor, *Auggies Games*, and can recommend their service to overseas customers. See http://store02.prostores.com/servlet/auggiesgames/StoreFront

For metal figures I particularly recommend models sold by *Ground Zero Games*, especially their Station and Ship Crew range. Their catalogue (and some free war games) can be downloaded from their web site, http://www.groundzerogames.net – note that their ranges include some figures intended for anime games and other models aimed at an adult market, which may not be considered safe for work, children, etc.

Sample Characters

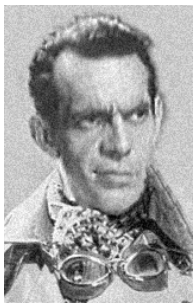
Most of these adventures were demonstrated at conventions using the crew and passengers of the spaceship *Endeavour,* one of the British-built contributions to the League of Nations fleet. The rationale for the mission, explained in more detail in the ***Grand Tour*** briefing below, is that the League is experimenting with mixed military/civilian crews and trying to develop automated spaceship controls. First it's necessary to study the current systems under operational conditions during a prolonged flight.

The League personnel are Commander Hubert 'Huntley' Palmer (Captain), Lieutenant Hiram Jones (Engineer), and Professor Milton Morton, who is developing the new control systems. The League has agreed to let famous explorers 'Ham' and Patricia Hammond take part in the cruise, since it will be visiting several sites of interests to science. They are aboard as acting second lieutenants; they are subject to the chain of command but only for the specific purposes of their duty station – for example, Ham Hammond is aboard as a pilot, the captain can order a specific course but can't order him to shave, wear uniform, etc.

'Ham' will be co-pilot for the flight; Patricia is on the ship's books as science officer and will also act as physician, although she doesn't have formal medical qualifications. The last person aboard is Otto Gerber, a League of Nations diplomat on confidential business.

If fewer than six characters are needed some can be omitted or run as NPCs.

The equipment on board includes spacesuits, Transkin™ oversuits and filter masks, and cold weather gear for everyone. Several characters are shown as owning weapons; with a couple of exceptions all are stored in the ship's arms locker in flight. Most weapons are standard models, as in the rules or above; details should be added to the information given to players. The locker also contains four .357 rifles, with ammunition, belonging to the ship, and six blasters (nuclear grenades).



Commander [Hubert] 'Huntley' Palmer (RNVR, League of Nations Patrol)

BODY 5, MIND 5, SOUL 3 QUOTE: *"Hold her steady at eighty percent power…"*
ATHLETE (SWIMMING) 6, BABBAGE ENGINE (NAVIGATOR) 6, BRAWLING 6, BUSINESS (ADMINISTRATION) 6, LINGUIST (GERMAN, HINDI, RUSSIAN) 6 (MARTIAN) 1, MARKSMAN 6, MECHANIC 6, MELEE WEAPON 7, MILITARY ARMS 7, MORSE CODE 6, PILOT (SPACESHIP, SUBMARINE) 8, SCIENTIST (ASTRONOMY) 6, STEALTH 3

You're British and have served with the Royal Navy then the Patrol all of your adult life. Currently you command *Endeavour*, and can't easily think of anything you'd rather do, although this cruise is unusual. Normally she has a crew of four Patrol officers; this time around the Patrol is conducting a public relations exercise and you're carrying one engineer, Hiram Jones, and four civilians – "Ham" Hammond, an explorer and journalist, and his wife Patricia, a biologist who will act as the ship's physician; Professor Milton Morton, a scientist who is trying to develop some sort of robot pilot for spaceships, and has rigged chart recorders and other instruments all over the ship; and Otto Gerber, a League diplomat who is meeting officials on the worlds you visit to discuss the illegal drugs trade.

You're not sure how you will handle any emergencies that come up, but you'll try to do your best. Fortunately Jones is tough and competent, well up to coping with most problems, while Ham Hammond is a pilot and can relieve you at the controls if necessary, and he and his wife are pleasant company. You're still making up your mind about Gerber; he seems competent but tends to keep to his cabin, apart from an occasional poker game, and you have no real information on his mission except that it involves suppression of the narcotics trade. As for Morton, you're counting the days until you can get rid of him; he's a real nuisance, and his carelessness has already caused a few minor accidents; he seems to have no idea how to install equipment safely.

While your real name is Hubert, most of your British friends call you 'Huntley,' after *Huntley & Palmer* biscuits. You've long since given up trying to get people to call you by your real name.

.38 automatic, 4 clips fragmentation bullets – kept in your safe
Stun Gun – kept in your cabin

Lieutenant Byron Jones (Engineer)

BODY 5, MIND 6, SOUL 4 QUOTE: *"You lost WHAT down the drain?"*
ATHLETE (BASEBALL, BASKETBALL) 6, BRAWLING 8, MARKSMAN 7, MECHANIC 8, MELEE WEAPON 7, MILITARY ARMS 7, MORSE CODE 7, SCIENTIST (ENGINEERING) 8, STEALTH 4

You are a competent American engineer who currently finds himself aboard a British-built ship trying to cope with a mad scientist and a bunch of civilians who have been foisted onto the Commander by the Patrol. You get on reasonably well with Commander Palmer, despite a little initial awkwardness caused by your race; he comes from the British Empire, of course, where that sort of thing is still important. Now that he's used to you there don't seem to be any problems. As for the civilians, Ham Hammond and his wife are good people, and the German diplomat keeps out from underfoot; he's on some sort of law enforcement mission, something to do with narcotics. But Milton Morton is an idiot, who keeps getting in the way when you're trying to work. He has some damn-fool idea that it might be possible to automate piloting and the routine work of controlling the engines of a ship, and there are weird gizmos all over the ship, recording everything you and the Commander do as you operate the ship – on the rare occasions that they work.

Your current aim in life is to get through this cruise without throwing Morton out of the air lock, and fleece him for as much as you can in your "friendly" poker games. Not that you cheat – you're just a MUCH better player than he is!

Stun Gun – kept in your cabin
Skeet Gun (Medium pump action shotgun), 50 cartridges – kept in ship's arm's locker.

Hamilton 'Ham' Hammond (American Explorer / Journalist)

BODY 6, MIND 4, SOUL 3 QUOTE: *"There I was, hanging over the pit…"*
ARTIST (PHOTOJOURNALIST, ZERO GRAVITY CHEF) 6, ATHLETE (RUNNING, CLIMBING) 8, BRAWLING 8, LINGUIST (GERMAN, FRENCH) 5 (VENUSIAN) 1, MARKSMAN 6, MELEE WEAPON 7, MORSE CODE 5, PILOT (SPACESHIP) 6, SCIENCE (ENGINEER) 5, STEALTH 5

Born on Earth, you've spent your adult life knocking around the Solar System, initially as a *Xixtchil* trader on Venus, where you met your wife Patricia, and later began to work with her as an explorer for the Smithsonian Institute. Your credits include the discovery of intelligent life on the Dark Side of Venus and the second expedition to Uranus. You think of yourself as a man of action rather than a scientist, although you have participated in numerous discoveries. You have a knack for writing popular accounts of your work, with several books and numerous articles to your credit.

You think that Patricia takes too many risks in the field, and tend to be a little over-protective occasionally. You've saved her life several times, which does lend a little weight to this opinion… but she's saved your life almost as often.

Currently, following a second honeymoon on Earth, you're working your passage as co-pilot aboard the League of Nations Patrol Ship *Endeavour;* you're writing a series of articles about the work of the Patrol for *National Geographic*, while Patricia studies the plants and animals of the worlds you visit. Of the others aboard, Commander Palmer seems to be very competent, as does the engineer, Hiram Jones. Otto Gerber is a diplomat who keeps a little distance from others, but plays a mean game of poker. And Milton Morton is an obsessive geek who thinks that science is an acceptable substitute for common sense.

Large Knife – worn on belt
Flame Pistol, 4 barrels, 20 rounds – kept in ship's arm's locker.
.45 automatic, 4 clips normal ammo, 4 clips Boland explosive bullets. – kept in ship's arm's locker.

Patricia Hammond (nee Burlingame; Venus-born Biologist / Explorer)

BODY 4, MIND 5, SOUL 4 QUOTE: *"It could be some sort of bryophyte…"*
ATHLETE (RUNNING) 5, BRAWLING 6, FIRST AID 7, LINGUIST (FRENCH, DUTCH) 7 (VENUSIAN) 2, MARKSMAN 7, MELEE WEAPON 5, SCIENCE (BOTANIST) 7, STEALTH 4

The first child born on Venus, you met and fell in love with "Ham" Hammond at the end of the 21st century, and have been married to him for fifteen years. You are a passionate botanist, ready to take almost any risk in the service of Science. Ham tends to be over-protective, although you have to admit that you've occasionally given him cause for worry. You've saved his life as often as he's saved yours, so he has no real reason to complain!

Your credits as explorers include the discovery of intelligent life on the Dark Side of Venus and several plant and animal species on the second expedition to Uranus. You're interested in the (widely accepted) theory that Martian explorers spread several species around the solar system circa 13000 BC, and hope to find more proof. Following a second honeymoon on Earth you're both signed on to the League of Nations Patrol Ship *Endeavour;* you're studying the biology of the worlds you visit, while Ham working as co-pilot and writing a series of articles about the work of the Patrol for *National Geographic*. Of the others aboard, Commander Palmer seems competent but you have a feeling that he'd be happier with a normal crew. You get the same feeling from the engineer, Hiram Jones. Otto Gerber seems pleasant enough but very reserved about his work. And Milton Morton is an obsessive tinkerer, an accident waiting to happen.

Flame Pistol, 5 barrels, 15 rounds – kept in ship's arm's locker.
.38 automatic, 4 clips normal bullets – kept in ship's arm's locker.
Net Gun, 10 rounds, propels a 20ft diameter net, Body 4, Effect 6, up to 50ft.– kept in your cabin.
Biology field kit – portable microscope, specimen tubes etc. Laboratory equipment in cabin.
First aid kit

Professor Milton Morton (eccentric scientist)

BODY 3, MIND 6, SOUL 2 QUOTE: *"They all laughed at me at MIT…"*
BABBAGE ENGINE (ROBOTICS) 7, BRAWLING 3, MARKSMAN 5, MECHANIC 8, MELEE WEAPON 4, SCIENTIST (ROBOTICS, ATOMIC PHYSICS) 8, STEALTH 2

A misunderstood genius, you aim to design robotic control equipment that will do the routine work of space travel; it's ludicrous that ships need constant course corrections and "tweaking" by the pilots and engineer. There must be a better way. You have persuaded the Patrol to let you monitor this cruise, analyze all operations, and use the results to create a suite of automated controls.

You're making progress, but people seem to be going out of their way to complain. Of course your equipment is bulky! Of course there are a few cables! Only fools would trip over them as often as they do. You've complained to Palmer, but he doesn't seem to be interested in the advancement of science. As for Jones, the so-called engineer, you suspect that he's sabotaging your experiments, though you've yet to catch him in the act. Of the others aboard, Hammond seems to side with Jones and Palmer, while his wife has no real understanding of science – admittedly she's a botanist, but you don't consider that to be a *real* science – and Gerber is a mystery; you have no idea what he thinks of your project. The main contact you've had with him is at the poker table – it's a stupid game, too dependent on chance, but everyone seems to expect you to play. So far you've lost $212, mostly to Jones and Gerber.

Electromagnetic gun: Large handgun; 1 shot/rd (or burst of all remaining ammunition), 20 shots
Effect 9, A:I, B:I, C:C/K
You've invented an electromagnetic rail gun firing steel darts, single shots or a burst which empties the magazine in an instant; you're still working on that. You haven't told anyone that it's a weapon; it looks more like a test instrument. It isn't rated as safe for use aboard ship.

Doctor Otto Gerber (League of Nations diplomat and lawyer)

BODY 5, MIND 6, SOUL 3 QUOTE: *"You might think that, but I couldn't comment…"*
ACTOR (ORATORY) 7, ATHLETE (GOLF, SWIMMING) 6, BRAWLING 6, LINGUIST (ENGLISH, GERMAN, ITALIAN, CANTONESE) 8 (MARTIAN) 1, MARKSMAN 9, MELEE WEAPON (SWORD) 7, PILOT (GYRO & LIGHT AIRCRAFT) 6, SCHOLAR (LAW, GOVERNMENT, ETC.) 8, STEALTH 3

A hard-working bureaucrat currently assigned to the League of Nations Economic Committee. The Committee plans anti-trust moves against the giant Interplanetary Corporation, the largest space line. You are gathering evidence on the line's activities in space and on the colony worlds. This involves talks with colonial administrators and law enforcement officials, and must be done very quietly, since Interplanetary are ruthless. To avoid attracting their attention you are travelling aboard the *Endeavour*, a League patrol ship. To cover your activities you are supposed to be discussing extradition, piracy and the narcotics problem; several off-world plants have narcotic effects, and small quantities have begun to appear on the black market on Earth. It's trivial compared to "traditional" drugs such as cocaine and heroin and modern synthetics, but enough of a problem to be convincing.

As part of your cover the ship is carrying three other civilians; "Ham" and Patricia Hammond, the well-known explorers, and Milton Morton, a scientist who thinks that it may be possible to automate space ships but seems to be a bit of a fool. You haven't told them about your mission or its cover; as far as they're concerned you're travelling for "talks with local law enforcement organizations" without additional details. Commander Palmer and Lieutenant Jones have been given the narcotics cover story.

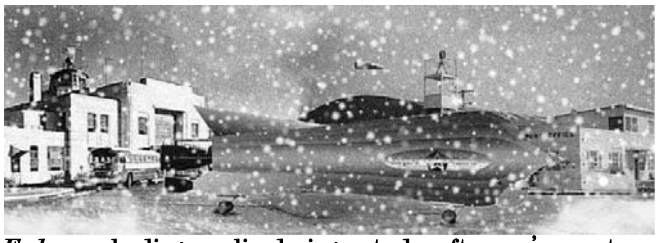
While you won't go out of your way to hurt anyone, you are prepared for trouble; Interplanetary has fingers in a lot of pies, and its directors must suspect that the League may be planning moves against it.

.32 automatic, 2 clips bullets (standard ammunition) – kept in ship's arm's locker.
Sword stick – kept in cabin or carried.

All the News That's Fit to Print

The New York Times

Late City Edition
Closing Stock Prices



Endeavour loading supplies during yesterday afternoon's snowstorm.

Spaceship Automation Anger as HMSS *Endeavour* Departs for Venus and Outer Planets.

By Tanya Clarke

HMSS *Endeavour,* one of the British spaceships assigned to the League of Nations Patrol, will lift from Young's Field, Long Island, at 3.35 A.M. tomorrow, bound for Venoble, Venus.

The flight is the first leg of a multi-planet expedition, whose aims include scientific research, tests on methods of automating spaceship power and control systems, piracy suppression, etc. The launch should be visible from most parts of the New York Metropolitan area and New Jersey.

Commander Palmer

The captain of the ship, Commander Hubert Palmer, stated that the night launch was essential to conserve fuel: 'We're heavily loaded, and Venus isn't in the best position for a direct flight. Launching then gives us an extra boost from the Moon's gravity. From Venus onward we'll be well positioned to save on fuel and supplies in later stages.'

Lieutenant Hiram Jones, a native of this city and Endeavour's chief engineer, said 'We're looking forward to takeoff, and to getting to know each other en route. I've already briefly met the scientific team and Professor Morton, the engineer who is working on the control systems, and I expect this to be a memorable flight.'

Two key crew positions will be taken by civilian scientists; Hamilton 'Ham' Hammond, the noted explorer and journalist, will be co-pilot, and is covering the flight for *National Geographic;* his wife, noted botanist Patricia Hammond (nee Burlingame), famed as the first woman born on Venus and as the discoverer of many new species on Venus and Uranus, will be the expedition's science officer and physician. Both said that they were looking forward to the flight, and to returning to Venus where they first met.

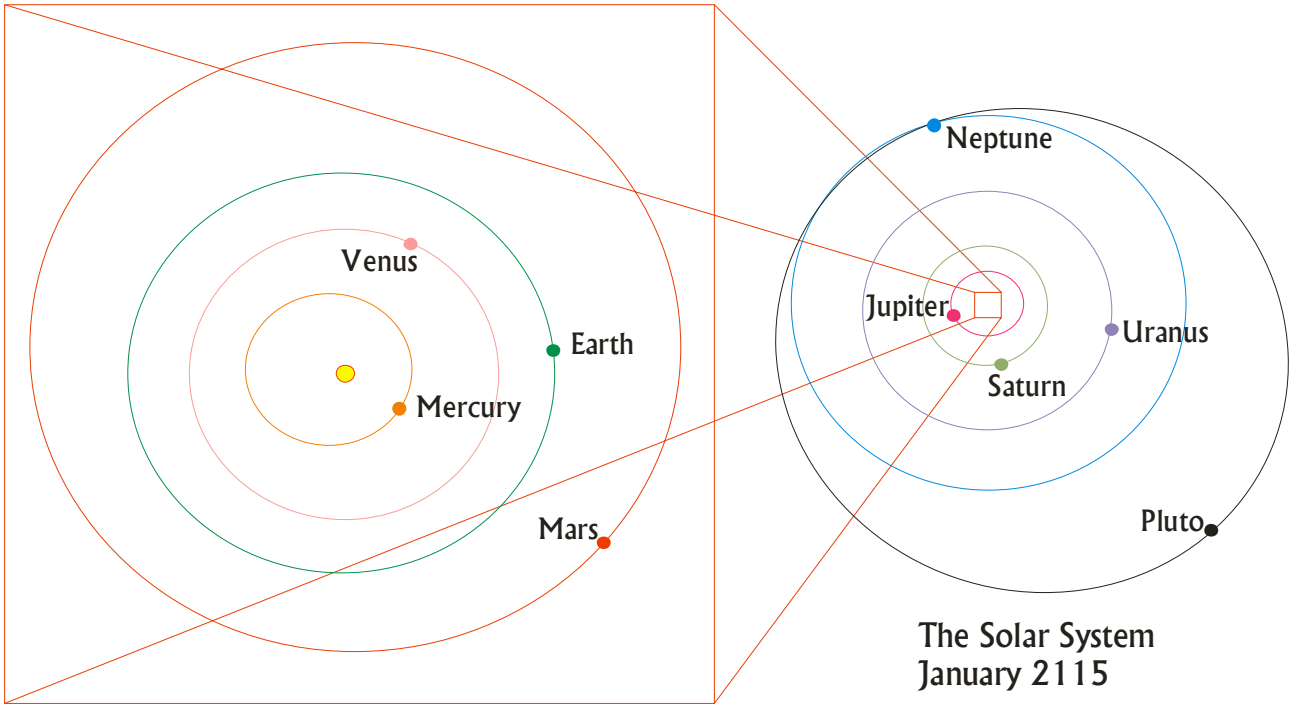
Doctor Otto Gerber, the League attorney and prosecutor who recently secured the conviction of the space pirate Alfredo Sanchez, is accompanying the mission as supernumerary, and for 'talks with local law enforcement organizations on subjects of mutual interest;' improved co-operation on tracking fugitives, the trade in illegal drugs, piracy, etc.

The Space Pilot's Association and the Union of Spaceship Engineers have again expressed concern about attempts to develop automated control systems. Donald Cunigghiuni, representing the SPA/USE Local 32, said 'This is the sort of crazy stunt that management keeps pulling. Ships are already flying undermanned; there should be more pilots and engineers, not less. In the last five years three crashes have been caused by pilot exhaustion, if they try to put (deleted) machines in the cockpit it'll just get worst. The League must be nuts to have anything to do with it, they should know better.'

Interviewed at his hotel, Professor Milton Morton, the engineer who is developing the new control systems, stated 'The purpose of these experiments is to help pilots and engineers, not replace them. There will still be a role for them, especially during takeoffs and landings. The aim of this project is to relieve them of some of the pressure that drives so many to early retirement.' He declined to comment on the union reaction.

The New York Spaceport Authority has stated that ships will not be allowed to takeoff and land under automatic control until the system is proven to be '110% reliable.'

***New York Times*, January 2115**



The diagrams show the Solar System at the beginning of January 2115. Planets orbit counter-clockwise.
See page 45 for positions of the major asteroids at this time; all are on the opposite side of the Sun to Jupiter.

Grand Tour

THIS isn't a complete adventure; it's a framing narrative that puts a group of characters aboard a League patrol ship, with reasons to visit a variety of worlds, and sets up several possible sources of conflict and adventure seeds.

For convenience only one ship and set of characters is considered; HMSS *Endeavour* and the pre-generated characters above. There's nothing to stop referees from using the basic idea with a different ship and/or set of characters; for example, one of the freighters described at the end of the spaceship design section. Any of the mission components can be varied to suit the ship or group of adventurers.

Endeavour's mission is mostly as described in the newspaper article. There are several goals for any Patrol cruise:

1. Keep the Peace. The League and the Patrol exist primarily to prevent war. This might mean, for example, intervening in a dispute between two colonies, between colonists and natives, etc. Any suspicion of preparations for war must be investigated and if possible dealt with.
2. Carry out the secondary duties of the Patrol; piracy suppression, rescue, etc.
3. Visit the colonies en route, carrying urgent deliveries such as medical supplies that can't wait for slow freighters, or any special equipment needed for *Endeavour's* on-planet missions. If there's cargo capacity to spare, and no other ships are going the right way, League ships may also carry personal mail, small items of cargo, etc. However, it's League policy not to compete with civilian carriers for anything other than the most urgent goods.
4. "Show the flag." Remind the colonials that the League exists and is a force to be reckoned with, and keep its image as positive as possible. This might involve clearing some ground with the ship's

flame cannon, helping local law enforcement catch a fugitive, or even throwing a children's party at an isolated outpost's school. The phrase "Can we help?" should become second nature.

5. Keep the colonies updated on the news from Earth. Interplanetary radio is too slow for much more than headlines, so most League ships carry packs containing a few months of the major newspapers, periodicals, and books on microfilm, plus music recordings and 8mm versions of the latest movies, for delivery to libraries. It's a free service sponsored by the League, aimed at keeping the colonies in touch with Earth's culture.

Additionally, this flight has several unusual features:

6. Doctor Gerber's mission is expected to take several days at each colony visited. He's mostly fact-finding, collecting information about the activities of the Interplanetary Corporation. This is supposed to be a closely guarded secret, discussed only by Gerber and various law enforcement agencies, but the cover story (that he is discussing piracy and the drugs trade) has already leaked.
7. Professor Morton's experiments will eventually lead to some practical tests. Sooner or later he's probably going to want to put some of his ideas into practice and automate some of the ship's controls. How well he succeeds is left to the discretion of the referee. Engineering work is usually a lot easier under gravity, so this might call for a few days on the ground.
8. 'Ham' and Patricia Hammond have been promised time for Patricia's scientific work, for 'Ham' to meet colonists and natives, and take in local colour for his articles, etc. Because of this, and because of Gerber's mission, there are a few days of slack time between the stages of the flight, over and above the time needed to refuel, re-supply, and take normal shore leave.

While the newspaper story gives the first port of call as Venus, there's no need to start with an adventure set there – just tell the players that the first landing was uneventful, and they're now going somewhere else! You can always return there later.

Don't worry too much about distances, the position of planets, etc., unless your players seem to want to give a lot of thought to planning every stage. *Endeavour* has the range, life support, etc. to go anywhere in the Inner Solar System, even when planets are at opposition, it just takes longer. Journeys to the Asteroids and the Outer System need more thought, of course.

HMSS *Endeavour*

Commissioned by the British Government, *Endeavour* is one of the ships used by the League of Nations Patrol. The legalities are complex; essentially the Patrol hires the ship and its captain from the British government for an annual payment of a guinea (about three dollars). Britain pays all operating expenses, but with two important exceptions has no say in her operation, except by voting in the League's Parliament. The exceptions are firstly that she must be commanded by a British or Commonwealth national, and secondly that she will not be used in operations against the British Commonwealth or its colonies. There are similar leasing arrangements for ships built by the Russian Empire, America, etc.

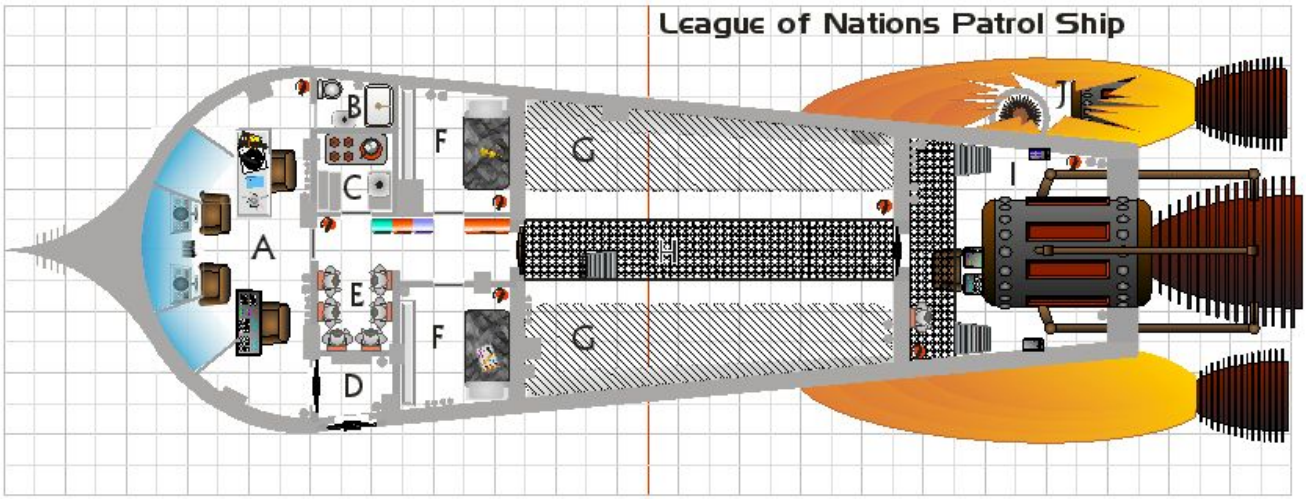
Fully fuelled, *Endeavour* has only ten tons of cargo space, but more capacity can be added at the expense of range, by taking on a partial fuel load, e.g.

200 tons fuel, 40 days at cruising power, 10 tons cargo
150 tons fuel, 30 days at cruising power, 60 tons cargo
100 tons fuel, 20 days, 110 tons cargo etc.

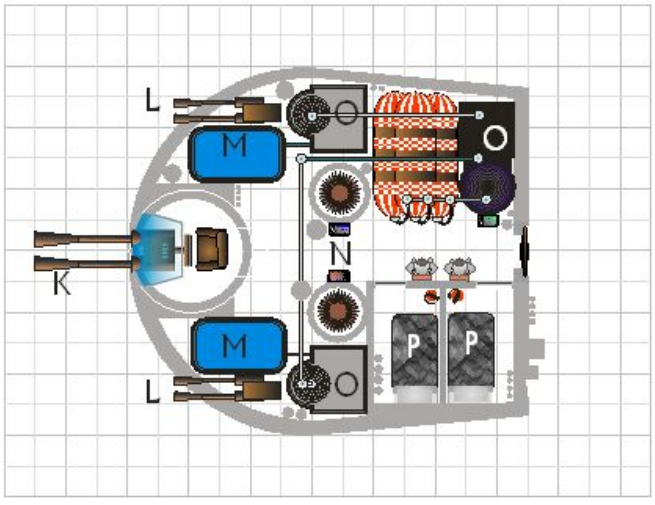
There isn't actually much physical room for a lot of extra cargo, but the extra capacity can be useful if (for example) a heavy but compact machine has to be transported to Mars.

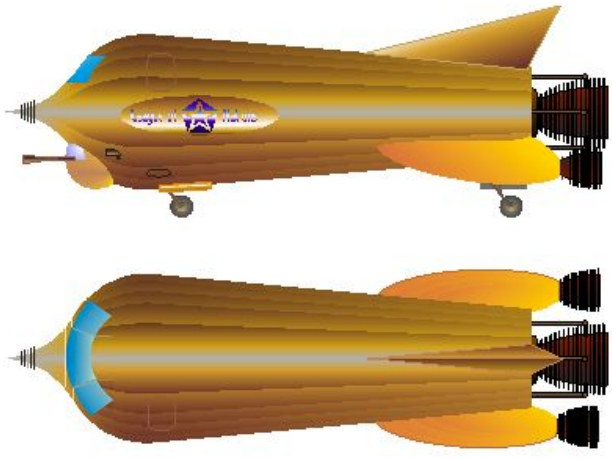
Endeavour has radium blasts, which means that her normal fuel is pulverised iron or copper ore. If necessary she can run on salt instead, but salt is less dense than iron ore and takes up more room – her tanks only have room for about eighty tons, enough for sixteen days cruising.

Endeavour: One of the British ships assigned to the League of Nations Patrol, primarily a police craft but used for exploration, diplomacy, etc. Capable of Earth-Jupiter, Jupiter-Saturn, etc.
301.27 tons, $1,352,641
6 cramped accommodation, life support and supplies for 5 weeks, 1 head, small galley, life support supply cost $750 per flight. 10 tons cargo.
Two pilots, long-range radio, meteor warning / electric plumb, air lock, 1 spacesuit recharge point
Radium engine, horizontal landing on underjets, cruise 0.03g, emergency power 3g, 200 tons fuel (40 days at cruising power).
Engine maintenance cost $6,243 P/A
4 machine guns (fixed mount firing forward), 2 turret-mounted flame guns (forward arc)
BODY 23, Hull armour 3, Cramped, Lively, -2 Difficulty Pilot skill rolls, +1 Difficulty Engineering-related skill rolls.



A: Control room; pilots, engineering console, chart table
B: Head (WC, shower, etc.)
C: Galley
D: Airlock
E: Spacesuit recharge bay
F: Cabins (double bunks)
G: Fuel tanks over hold (also under deck below hold)
H: Hold (catwalk over cargo etc.)
I: Main atomic blast
J: Nacelles containing underjets, steering blasts, landing gear
K: Flame cannon turret
L: Machine cannon
M: Water ballast / reserve
N: Underjets
O: Recycling equipment etc.
P: Single cabins





Plans scaled for 25mm / 28mm figures can be downloaded from the author's web site.

Endeavour was specified by a committee, and is supposed to be useful in a variety of roles, but as usual there had to be a few compromises. At a comparatively late stage the specification was changed to add two more cabins, to house occasional passengers or extra crew members, which are awkwardly wedged in on the lower deck, originally a machinery space with no accommodation.

As a result of these changes the ship is cramped and cluttered, especially on the lower deck, with pipes, air ducts, and electrical junction boxes etc. obstructing movement. The lower cabins have limited headroom and are adjacent to the recycling equipment, which hums loudly and makes odd gurgling noises, and are intolerably noisy when the underjets are in use. They are also two airtight doors away from the control room, galley, head, and other facilities; two extra space suits are kept on the lower deck for emergencies, which may not inspire complete confidence.

Pipes run up the walls and across the ceiling, some low enough to bash someone in a hurry (e.g. running to the forward turret). Fuse boxes and ducts protrude from the walls. As an example of the engineering compromises, the only way to reload the machine cannon is to climb over the water tanks, wriggle through a gap about eighteen inches high, and reach down to feed the belts in from above. This takes about twenty minutes. If the cannon malfunction they can only be serviced from outside the ship, by taking off some of the hull plating, which takes several hours. Cargo is also loaded and unloaded by removing hull plating; a big cargo airlock would add too much weight, and a hatch without an airlock is too great a safety risk. It's safer to have an opening that can only be breached with the aid of heavy tools.

The ship is divided into four **pressure sections**, areas separated by armoured bulkheads and airtight hatches. These are the **upper deck** (the control room and most cabins), the **lower deck** (containing the lower cabins, weapons, and life support equipment, the **hold**, and the aft **engineering compartment**. Internal doors within pressure sections are fire-retardant but won't hold pressure.

Upper Deck

Pilot's controls, HMSS *Endeavour*

The **control room** is the nerve centre of the ship. It's also cluttered, with positions for two pilots and an engineer, and a chart table for navigation, and difficult to get past them to reach important parts of the ship such as the airlock or the head without jogging someone's elbow.

Basic facilities in all **cabins** are single or double tier bunks, fitted with safety straps, drawers and cupboards for clothing, and a strong locker for valuables for each occupant. The cabin normally used by the Captain has a small safe, big enough for his gun, some confidential documents, a code-book for encrypted messages from the League, and a few thousand dollars for emergencies. Needless to say every penny must be accounted for.

The **head** has a small WC, wash basin and shower, all fitted with air fans to suck out fluids in flight, and all regularly going wrong and needing an engineer's attention at some point during most flights. The usual result of a malfunction is soaked clothes, but occasionally large blobs of water or less desirable materials manage to escape. It's customary for the person who caused the problem to mop up the mess.

The **galley** is a standard small design, with magnetic clamps to hold the cooking utensils in place, and pots etc. fitted with clear lids for use in freefall. There are serious problems with cooking in low gravity (e.g. blobs of boiling water / cooking oil spraying out around the ship, kitchen fires, etc.), but someone with the *Artist (zero gravity chef)* skill, such as Ham Hammond, can handle it; it's even possible to fry eggs in flight if the frying pan is carefully greased and held at exactly the right angle. Without such a cook the facilities are generally used to warm pre-packaged foods, with more normal forms of cooking left until the ship is on the ground. The designers omitted a dedicated dining area; at meal times a folding table is set up in the corridor between the cabins, and seats fold out from the corridor walls.

The **airlock** is about 30ft above the ground, with a folding metal ladder extending below the outer hatch. The position is often a nuisance; it would have made more sense to put it on the lower deck, with easier access to the ground and the hold, and no need to walk through the control room in spacesuits. The adjacent **suit recharge bay** is a rack for six spacesuits, with hoses for replenishing their internal oxygen tanks, supplies for the air filters, etc. As part of the process the suits are inflated to three atmospheres to test that they have no leaks, with an alarm sounding if pressure drops, then deflated again. During this process the arms and legs sometimes appear to move, which may startle the unwary. All of the suits generally kept there are the general-purpose "soft" design.

Lower Deck

Life support ducting, HMSS *Endeavour*

Primarily designed as an engineering space, the lower deck is cluttered and uncomfortable. The machinery in this section includes air and water **recycling systems**, the forward **underjets** (two massive steel cylinders containing small downward-pointing atomic blasts), **water tanks** used partly as a reserve for drinking, but also to trim the centre of gravity of the ship, and the forward **gun turret**, containing two **flame cannon**. Four **machine cannon** are installed behind the water tanks, and difficult to reload in flight. The two **cabins** on this deck are noisy and uncomfortable, with ducts and pipes crossing the ceiling and reducing head room below 6ft at some points. Since this deck is a separate pressure compartment two spacesuits are kept handy for emergencies. They can't be recharged on this deck, and must be periodically swapped for suits in the recharge bay. The forward landing gear is under the deck aft of the underjets.

Hold

The **hold** is simply a large space, about 30ft long and 25ft to 20ft wide, with 10ft headroom under an overhead **catwalk** linking the upper deck and the main engineering compartment. The deck is flat, with ring bolts every few feet for securing cargo. One of the three **fuel tanks** (more precisely a fuel hopper, since it contains powder rather than liquid, but the term is seldom used) is under the deck; the other two are in the upper half of the hull to either side of the catwalk.

Aft Engineering Compartment

The aft engineering compartment is the cleanest and most organised part of the ship. It contains the main **atomic blast** and controls for the other blasts, some basic engineering tools and a workbench, etc. A radiation-protected hard spacesuit is kept in this compartment, for use by the Engineer. Two smaller blasts used mainly for steering are built into the **nacelles** to either side of the hull, and can only be serviced from the outside, by removing hull plating. The nacelles also house the rear underjets and landing gear, and have an aerodynamic shape which generates some lift when *Endeavour* is flying in atmosphere.

Choosing Accommodation

Regulations require the pilots to be accommodated in the same pressure section as the control room, so that they will be able to reach the controls quickly in an emergency. If the sample team is used the most plausible allocation of cabins is thus Commander Palmer and Lieutenant Jones in one double cabin, Patricia and 'Ham' Hammond in the other, and Professor Morton and Doctor Gerber in the single cabins – Morton because nobody wants to share with him, Gerber because he wants privacy for his work and files. Arrangements which put Patricia in a cabin alone or with anyone other than her husband are unlikely.

Adventure Seeds

… 'talks with local law enforcement organizations on subjects of mutual interest;' improved co-operation on tracking fugitives, the trade in illegal drugs, piracy, etc.

The Space Pilot's Association and the Union of Spaceship Engineers have again expressed concern about attempts to develop automated control systems. Donald Cunigghiuni, representing the SPA/USE Local 32…

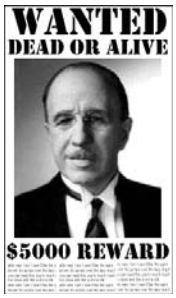
The newspaper story about the flight and Gerber's real mission suggest several potential adventure seeds:

Fugitives

Most colonies have a few citizens with chequered pasts, fugitives who left Earth a step or two ahead of the police and will probably never be able to return. In the colonies they build new lives, and in the absence of opportunities for crime may become pillars of the community. At the moment there is little cooperation between the police forces of Earth, the League, and the colonial authorities; each world keeps its own records, but their police forces rarely compare notes – if they began to share criminal records and information on fugitives as a matter of routine, things might become very difficult for these escapees. The story can be read as implying that such a change is under consideration.

There isn't much organisation behind these fugitives, but some of them are lethally dangerous individuals who may feel that their future depends on stopping such cooperation before it ever starts. One way to do this might be to eliminate Doctor Gerber; cooler heads will realise that this could be a very bad move, attracting attention exactly where it isn't wanted, and feel that the first move should be to find out what Gerber is really up to. Either way, there's likely to be some sort of impact on the adventurers sooner or later.

Adventure Idea: Where No Man Pursueth



Eight years ago Boston neurologist Reginald Kemble killed his wife Rebecca and her lover, Doctor Curtis Knight, Kemble's former business partner, in a fit of jealous rage. Friends helped him to escape off-world, and occasionally supply him with funds and news. He dreams of returning home, but his friends warn him to keep clear – he would be arrested the second he returned to Earth. Kemble still has nightmares about the murder, but can't remember exactly how their argument escalated to the point of murder – he had filed for divorce anyway, and already had ample evidence of her infidelity.

Today Kemble is working as a paramedic on one of the colonies. It's the best medical job he can get without papers. He's tired of running. Hearing rumours that the search for fugitives may be intensified, and that *Endeavour* (currently visiting his colony) is carrying the League official who is responsible for the change, Kemble decides to surrender to the adventurers.

Assuming that they set the wheels in motion for extradition, they will then hear, days later, that Kemble *isn't* wanted. The "victims" are still very much alive; Rebecca divorced Kemble for desertion, married Knight, and recently inherited the balance of Kemble's estate when he was declared legally dead. But Kemble is adamant that he murdered Knight and will refuse to budge from that position. It's easy to conclude that he's insane, but he still has a couple of the letters warning him to keep clear, and the typeface doesn't match any typewriter in the colony. Oddly, the same typeface is used by two different alleged senders…

This can only be resolved by investigation on Earth, but the adventurers won't be back there for months. They're going to have to run the case indirectly, sending instructions to detectives on Earth.

The truth is strange; Knight was aware of Professor Albert Ludwig's development of a simulated environment based on a combination of high-resolution film and drugs (see *Pygmalion's Spectacles*) and added drug-enhanced hypnosis to convince Kemble that he had killed Rebecca. The 'friends' who helped Knight to escape were actors performing to the camera, unaware of the use to which the film would be put. Knight sent the letters and money.

No major crime actually occurred, and the time elapsed puts it outside the statute of limitations for criminal and civil offences. Or does it? Kemble was only declared dead a year ago, and Rebecca and Knight knew he was alive. Both are guilty of fraud, including tax fraud. The law doesn't allow criminals to benefit from their crimes; if the adventurers suggest it, the money confiscated from the couple may be given to Kemble as compensation.

Does the League plan to devote more resources to finding fugitives in the colonies? Thousands of criminals drop out of sight on Earth every year, only a tiny minority go off-world. Most are in hiding, dead, or keeping a low profile somewhere else on a very crowded planet. It would be possible to send their records to the colonies on microfilm, but most of the colonies have tiny police departments; it's likely that nobody would have the time to read them. There are already system-wide alerts for a handful of especially dangerous fugitives if there's a specific reason to think that they've escaped from Earth, more alerts on less dangerous criminals would probably be counter-productive. This will be the opinion of any law enforcement officers consulted on this point, on Earth or on any of the colony worlds; any change would be expensive and probably counter-productive.

Smugglers

There is a small drugs problem, but it's currently most notable as smuggling of drugs *from* Earth to the colonies. Drugs are most effective when their chemistry dovetails well with human biochemistry; this is most likely with drugs derived from Terran sources. With the exception of a few oddball chemicals such as Xixtchil, Ferverin, and Crephine, which happen to have metabolic effects on humans which are almost totally dissimilar to the effects they produce in native species on their home worlds, most alien drugs are toxic or have relatively minor effects on humans. Nothing found off-world is nearly as potent or addictive as heroin, cocaine, or hexylamine, and there is a small but lucrative market amongst the few colonists wealthy and desperate enough to pay for smuggled drugs. The trade *to* Earth is mostly aimed at rich pleasure-seekers looking for an exotic "high," and relatively small. At least some of the off-world drugs on Earth's black market are fakes – a notable example was the "Venusian black lotus" scam of 2106-7, in which New York and Washington sophisticates were sold dyed *Bhang Ki Thandai* (an Indian beverage based on cannabis leaves, almonds, spices, milk and sugar) at exorbitant prices.

Ships arriving on Earth are subject to much more stringent customs checks than those that leave, although the main reason for that is the search for other forms of contraband such as undeclared gems and precious metals, Plutonian living crystals, and stolen Martian antiquities. Earth's customs officers pay relatively little attention to outgoing vessels, since there's a general perception that all of the smuggling goes the other way. In fact this perception is wrong. As well as drugs, the smugglers involved in this trade are into many other rackets in the colonies, not least prostitution and "mail order bride" scams, sometimes involving kidnapped or under-age women. They go unnoticed because nobody really bothers to look, and because certain port officials are bribed to turn a blind eye. All that could change if the League decides that it's time to crack down on the drugs trade, starts taking more of an interest in outgoing ships, and realises that drugs are just the relatively small tip of the iceberg.

The gangs involved will attempt to keep a low profile when *Endeavour* is around, and try to perpetuate the illusion that any smuggling goes the other way. They might even set up a patsy to be caught smuggling a relatively worthless quantity of drugs onto a ship to Earth.

Does the League plan to crack down on drug smuggling? Not at present. While the League does oppose traffic in illegal drugs, in practice enforcement is primarily a matter for the customs authorities at each port. It does take some interest in Martian antiquities (whose theft might provoke a Martian response) and other looted materials, since the League charter frowns on the exploitation of "natives," but existing customs regulations seem to cover things reasonably well.

Human rights and in particular "trafficking in persons" are very much part of the League's core mandate, and have been so since its foundation, but so far the League is more or less unaware of the extent of the problem; there have been occasional complaints that the agencies involved have been dishonest when describing the 'lovely' young women in their catalogues, or have misled women about the desirability of the men who are courting them at long range, but it isn't obvious that organised crime is involved. Evidence of an organised and illegal traffic would require an appropriate response.

Adventure Idea: Human Traffic

While the adventurers are on Venus, or another colony world with several isolated settlements, they hear that an unidentified woman has been found, suffering from amnesia, dehydration, and a fever, apparently the victim of a savage assault. If the adventurers check it out they'll find her in the local hospital, still delirious. Despite various drip feeds etc. it's obvious that she's attractive. She occasionally mutters in a language that might be Dutch or German – on a difficult Linguist roll it will be recognised as Afrikaans, implying that she is from South Africa. If the suggested team of adventurers is used Commander Palmer will have an idea that he's met her. One possibility that the adventurers might come up with is that she's a member of the Patrol, or someone he might have met while serving in the Royal Navy, but they should think of it for themselves.

Eventually she recovers sufficiently to talk coherently; she's Maryke Van Graan, a civilian Patrol employee, Chief Astrogator at Cape Town Spaceport. Her job is to calculate and prepare flight plans for civilian and military ships. About four weeks ago (plus travel time) she was abducted from a restaurant near the port; her last memory is of waiting for her fiancée to arrive. She has no idea how she was transported off-world, or memory of the trip.

Her first memories after the abduction are waking on the bed of a remote cabin to find "a man pawing at me." She tried to fight back and was badly beaten, but somehow tripped him, causing him to fall and hit his head on the cabin's atomic power unit. The injury killed him. Once she was sure that he was dead she found maps that showed a route to the town, took his Transkin™ over-suit and filter mask (or whatever other protective clothing is needed for the planet in question), and set off to seek help. Unfortunately things went wrong – on Venus, for example, the map was eaten by spores, on Titan she was lost in a wind storm – and her wounds went septic, leading to her fever.

- She's been reported missing by her office; there was no report from her fiancée. Two ships made the trip from Earth while she was missing; there would have been time for her to have been transported to either port.
- She wrote a flight plan for Palmer's previous ship six years ago. He collected it; they had no other contact.
- If she's questioned about her fiancée, she'll name him as Piet Heerden from Durban, but she's vague about his details; it was a whirlwind romance and she's only known him a few weeks. He was staying at the Liverpool Hotel in Cape Town at the time of her abduction. He's no longer there, and the address he gave doesn't exist.
- If they try to trace the cabin she describes they'll find it eventually, about half way between the two settlements; unfortunately there is little left of her assailant. On Venus the cabin was left open and is now full of spores, on Titan something has tried to eat the corpse, died, and been eaten, leaving scattered human and alien remains.
- If they check out the ships they will find that the passengers can be accounted for. The cargo has been unloaded and delivered to various addresses around the ports. Most can easily be accounted for. If the adventurers persevere they'll find that one packing case seems to have vanished from the second ship's cargo at some point during unloading. The contents are described as "mixed personal items," the delivery address doesn't exist, and the mass is about right for one person plus basic life support equipment and supplies for the journey.

There are two options:

- **Maryke is telling the truth:** Piet is a 'recruiter' who finds lonely attractive women for the 'mail order bride' racket. Their photographs are added to a catalogue circulated to clients in the colonies. Once someone takes an interest in one of the women the racketeers use every possible trick to get as much money as possible to pay for the trip and cover problems such as "sick relatives," usually without the bride's knowledge. Maryke wasn't interested in travelling off-world, but the customer was prepared to pay several thousand dollars on delivery, so the racketeers had her kidnapped and shipped anyway. Her rapid escape has caught the racketeers off-guard, and if the adventurers move fast they may be able to catch some small fry (such as the men who took the crate and delivered her) before everyone goes to ground, and work back towards more important criminals.
- **Maryke is lying:** She worked for the racketeers, and has modified dozens of flight plans to cover the extra mass and supplies needed for human cargo, drugs, etc. Piet was her contact, but Maryke got greedy and wanted a bigger cut. She met him thinking that he would give her the money; instead he drugged her and had her shipped to a particularly nasty customer, a profitable way to get rid of her. Proving this will be difficult, but she has more money in her bank account than can be explained by her wages. Her account of her relationship with Piet will sound a little off to a psychologist or detective, and some details will ring false to another woman – for example, her description of the engagement ring is vague. Again, her rapid escape may make it possible to trace the racketeers, and find other astrogators who have similarly large unexplained incomes.

Adventure Idea: Going Legit

Doctor Gary John of Ionian Products, a leading but less than reputable pharmaceutical and fur exporter based on Io, has discovered that Io's jungles are a near-perfect environment for growing coca plants, and that a mixture of cocaine and Ferverin in the right proportions gives a prolonged 'high' with intense hallucinations. He and Sutherland Chalk, the CEO of the company, have arranged to set up an experimental farm and processing plant on the edge of the jungle. Ostensibly the farm is to trial cultivation and on-site processing of Ferva plants; actually it's growing and processing coca plants too, and stocks of both drugs are starting to accumulate.

Dr. John and Chalk want to negotiate a distribution deal with the smugglers, but haven't researched the market properly. There's already too much cocaine on sale on Earth, prices are currently low, and it's a lot easier to move it around on Earth than smuggle it in from another planet. The smuggling gangs are happy with their existing sources and don't want to risk alienating them by buying elsewhere. On the other hand, the cocaine / Ferverin mix could be VERY lucrative on Earth. This has led to an odd situation; the drug smugglers want Ionian Products to abandon cocaine production and concentrate on Ferverin!

Since they can't persuade the hapless pair to cooperate, they've decided that sterner measures are required; they'll be exposed as drug lords and put out of business by the League, then the smugglers will quietly buy up Ionian Products, ramp up production of Ferverin, and ship it to Earth entirely legally. Fortuitously *Endeavour* arrives just as matters come to a head…

Arriving on Io, the adventurers should receive an anonymous note:

> *Check out Ionian Products' experimental farm on the edge of the jungle south of Junopolis. They're growing more than Ferva leaves there, look for the extra fields and check the processing plant. Don't let them ruin more lives!!!*
>
> *A Friend*

If the adventurers act on this advice they'll soon figure out what's going on – if the suggested team is used Patricia will immediately know that there are Terran plants growing in some of the fields, although it will take her a while (and possibly a message to botanists on Earth) to identify them as Coca plants, since she's mostly worked on Venus and the outer planets. Any competent policeman, customs officer, etc. should be able to spot cocaine. The Ionian Products workers can identify Dr. John and Chalk as their employers, and claim not to know what they're growing – it's just another plant that the bosses are interested in. Dr. John is on site at the processing plant, and will try to find a way to get rid of the cocaine when the adventurers arrive, but won't be done by the time the adventurers get to him. If they are questioned both will blame their smuggling contact, a mysterious Mr. Smith, who is, of course, nowhere to be found. They won't mention the unusual potency of the cocaine / Ferverin mixture, judging that they're already in enough trouble.

If the adventurers take things at face value there will be a shareholders meeting electing a new board within days. Soon the company will appear to be squeaky clean. Ferverin production will soon be ramped up, with exports to Earth quadrupled, possibly setting the scene for another adventure further down the line.

If the adventurers don't take things at face value they should be able to find out more about the mysterious Mister Smith, who hasn't been completely successful in covering his tracks. He'll turn out to be Silas Jones, a very recent investor in the company, who has taken advantage of the fall in share prices following the arrests to buy three very large blocks of shares under different names, giving him a cheap controlling interest, and made it very clear that he is an "ethical investor" who is determined to stamp out any trace of illegality in the company. Proving that he is actually a senior figure in the drug smuggling ring should be difficult, and working out why he wants the Ferverin should be very difficult until the modified cocaine hits the Terran market.

If another complication is wanted, before the coca fields are razed a scout party of Slinkers find them, sample the exotic plant, and discover that it's absolutely delicious – the best thing that they've ever tasted. There is no narcotic effect on them, but they definitely want to get a lot more. By the time the adventurers are ready to destroy the field Slinkers are already hard at work harvesting the crop, and will not be happy if someone uses e.g. a flame gun to destroy the field and wipes out most of their tribe. This might lead to war with the Slinkers (see page 54), but wise adventurers will let them help themselves and make sure that that the field is clear before destroying the remains of the crop. In later years botanists will discover that the Slinkers are growing their own, but that's a problem for another day.

Union Trouble

The *Space Pilot's Association* and the *Union of Spaceship Engineers* are the main American unions for civilian space crew, with strong links to the AFL, CIO, and other labour organisations. In 2106 they merged as the SPA/USE. Since most of the members are intelligent – stupid people rarely get jobs aboard spaceships – they have taken steps to limit the power of the President of the union, and its local officials, to ensure that organised crime can't gain control. As an honest union with a strong interest in the welfare of its members, the SPA/USE is a considerable thorn in the side of the Interplanetary Corporation, and has for years been negotiating for better crew conditions, better safety equipment, and above all reliable control systems that *don't* require incessant supervision and correction.

They're in favour of automated controls, provided that they aren't used to replace skilled personnel. Unfortunately the current owners of the New York Times are in the pockets of Interplanetary and vehemently anti-union, seizing on any opportunity to make the SPA/USE look bad. The interview with Donald Cunigghiuni was heavily edited – he was told that Interplanetary planned to use the new technology to phase out skilled pilots and engineers in favour of robots, and reacted to that. The paper will run a retraction in a couple of days, once the union's lawyers get to work.

The story won't fool most SPA/USE members, but several other unions with less impressive credentials are taking an interest. Most notably, the Teamsters (who represent hundreds of thousands of transportation employees on Earth) are secretly working with Interplanetary, which is a major employer on Earth as well as in space, and plan to become the main spacefaring union if the SPA/USE can be discredited. Word is spreading out from the Teamsters to their affiliates on other worlds, and the Endeavour's flight will be plagued by "spontaneous" cargo handler's strikes etc. Meanwhile the SPA/USE has asked its members to keep an eye on the progress of *Endeavour's* trials, with a view to making sure that any worthwhile advances reach the civilian sector as soon as possible.

This is most likely to be a problem in places where the population is primarily American; anywhere in the United Americas on Earth, of course, Erotia on Venus, Nivia on Titan, and other American colonies. For the most part it will be a low-key nuisance, not a serious problem. Until the time it isn't…

Adventure Idea: Sabotage!

A few days after leaving one of the American colonies, the engineer notices atomic blast power fluctuations; over a few minutes thrust doubles or quadruples, then dies back to 0.03g. This makes it almost impossible to hold a steady course, since the timing of the phenomenon is very irregular. Certainly no automated system, however sophisticated, could cope.

Instrument readings suggest that the blast is working normally but the fuel supply isn't consistent. The fuel feed (a complicated arrangement of pipes, electromagnets, and Archimedean screws that move the finely ground iron ore) seems to be working normally. This leaves the fuel itself as the most likely suspect.

In order to keep the fuel load balanced, equal amounts are taken from each tank and combined at the engine room. It's possible to sample it as it enters the engine room; the mixture from the port upper tank looks different to that from the other tanks – it's darker and seems unevenly mixed. If it's tested with e.g. a magnet it separates into a mixture of slightly magnetic brown powder, with a small proportion of strongly magnetic dark grit, recognisable as iron filings. The fuel from the other tanks is homogenous brown powder.

To find out more it will be necessary to get into the tank itself, but it's difficult to access it in flight; they're filled from outside the hull, and designed on the assumption that they're only going to be opened under gravity. If the caps are opened clouds of powder will float up into the face of the person opening them, sticking to space suits, especially to their boots. Once it's open it's possible to take samples from various depths. In the end it will turn out that about 250lb of iron filings have been added to the tank via the aft filling hatch. The position suggests that they went in after the rest of the fuel, probably within hours of takeoff since the engineer would have checked fuel samples as it was loaded. Since the pure metal was denser and more magnetic than the ore it rapidly "sank" to the rear of the tanks, and into the engine feed.

Continued next page

Cutting off the fuel from the suspect tank isn't difficult, and will fix the immediate problem, but that leaves the ship short of fuel and increasingly unbalanced if the flight continues.

Provided that the adventurers fix this reasonably quickly it's a nuisance rather than a serious problem. The actual quantity of iron added is small enough that mixing it in more thoroughly will fix things. This can be done by shaking the entire ship (using the underjets etc.), or by re-routing a few pipes so that the fuel from the affected tank goes into the other two tanks, rather than directly to the engines; by the time it gets to the engine it will be thoroughly mixed. Alternatively, most of the iron filings could be removed by a strong magnet – they'd tend to be attracted to it much faster than the iron ore. Any method the adventurers come up with should be allowed to work, unless it seems excessively stupid.

Investigating the incident isn't entirely straightforward, because *Endeavour* is heading away from the landing field at several miles a second, but that's what radio is for. Eventually the local police will find two cargo handlers who were on duty the night before takeoff and had access to the fuelling crane. Both are Teamsters, and claim that they didn't mean to do more than cause a minor nuisance, mess things up just enough that machines wouldn't be able to control the ship.

- If the adventurers want to prosecute they will still have to do things by remote control, or wait months until they're back on the right world. The most logical charge is sabotage, but penalties range from long prison sentences to death, since sabotage of a spaceship can be lethally dangerous. If convicted the workers will become martyrs to the union cause, and the union problems will continue and start to affect other ships. They may also extend to foreign unions, such as those in the British and Dutch colonies on Venus. Eventually things will quieten down, but it will take longer, and in the end cost much more, than a little leniency.
- A lesser charge such as vandalism has the useful side effect of making the saboteurs look less effective. The penalty is a fine or a few months in prison, which ought to deter copy-cats, and they will lose their jobs. When it becomes obvious that they're gaining little more than ridicule the campaign against *Endeavour* will lose a lot of impetus, and will gradually be forgotten as the union finds other causes.
- If the adventurers don't press charges at all then nothing will be done about the sabotage, and the union members will be encouraged to continue to harass Endeavour. This is a continuing nuisance, rather than a serious problem, and sooner or later adventurers will get used to harassment by pickets, biased reporting of their activities, bar-room brawls, etc.

Trouble Shooting: If the adventurers don't do anything to fix the fuel problem, raise the Difficulty of Pilot and Engineering skill rolls related to the problem +1 per day:

Each failed Pilot roll adds a day to the journey

On a natural 11 or 12 Pilot roll add 2-4 days

On a natural 11 Engineering roll the atomic blast is out of action for 1D6 hours, adding 3D6 hours to the flight.

On a natural 12 Engineering roll the atomic blast needs major servicing taking 1-3 days and adding 2-6 days to the flight.

If nothing is done, and the flight is prolonged beyond the ship's life support endurance, the air starts to get a bit stale and eventually everybody dies. It isn't likely that players will be that stupid, but if they are their characters must pay the price. Space isn't a forgiving environment.

Automation

If Professor Morton is being run as a player character the player should make all decisions about the nature and scope of his automation project. Getting from the current manual controls to a fully automated suite will be a very difficult project, starting at Difficulty 6 and working up from there. Automating the atomic blast is part of this project, but separate from it – it's possible to improve the controls without improving the atomic blast, or vice versa. Some suggested goals and times needed to make improvements:

Difficulty 6: Study operations of flight controls and atomic blast – minimum study time two weeks or one flight.

Difficulty 7: Simplify existing flight controls and atomic blast controls – minimum development time four weeks and a minimum of two flights.

Difficulty 8: Rudimentary autopilot, not usable in asteroid belt or for takeoff/landing, can fly the ship for 1-3 hours without course correction. Rudimentary automatic controls for atomic blast, usable only at cruising acceleration, allow unattended operation for 2D6 hours. – minimum four weeks, two flights.

Difficulty 9: Improved autopilot, not usable in asteroid belt or for takeoff/landing, can fly the ship for 2-6 hours without course correction, includes automatic meteor avoidance (but course must then be corrected manually). Improved automatic controls for atomic blast, usable only at cruising acceleration, allow unattended operation for 4D6 hours. – minimum four weeks, two flights.

Difficulty 10: Improved autopilot, not usable for takeoff/landing, can fly the ship for 2D6 hours without course correction, includes automatic meteor avoidance and will return to course automatically after evasion. Improved automatic controls for atomic blast, usable only at cruising acceleration, allow unattended operation for 6D6 hours. – minimum four weeks, two flights.

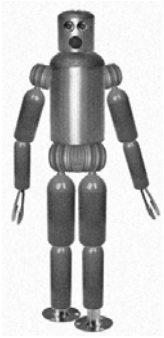
Difficulty 11: Improved autopilot, usable during takeoff but not for landing, can fly the ship for 3D6 hours without course correction, includes automatic meteor avoidance and will return to course automatically after evasion. Improved automatic controls for atomic blast, usable only at cruising acceleration, allow unattended operation for 2-3 days. – minimum four weeks, two flights.

Difficulty 12: Autopilot as 11 and Pilot skill Difficulty reduced -1 when operating the controls manually; no further improvement possible. Atomic blast as 11 but all Engineering skill rolls related to the blast are now at -1 difficulty, no further improvement possible. – six weeks, three flights.

The end result should be a ship that is easier to operate, but still needs pilots and engineers to take care of emergencies and keep things running smoothly. Players may have different or less realistic goals, it's up to the referee to decide what can and can't be done. For example, in one of the play tests Morton wanted to build a radio control which would let a skilled pilot fly the ship from the ground, with a range of several miles; this was made Difficulty 9, with all of the steps at Difficulty 6 to 9 above needed before the device could be built.

If Morton is being run as an NPC the adventure idea below may be useful:

Adventure Idea: Robert



Morton doesn't just want to build an automatic pilot; he wants to build a robotic pilot, a mechanical replacement for a human. The prototype is (inevitably) called the Morton Robotic Pilot, but everyone else calls it Robert. It's exactly like the robot in every B movie you've ever seen; incredibly literal-minded, stupid, but capable of following orders provided that every step is detailed. This is, of course, exactly what the unions *don't* want. Although Morton talks it up as a solution to the problems of spaceship operation, it doesn't actually fly a spaceship very well. Attempts to improve it just make its shortcomings more obvious; it's slow, lacks the instincts and reflexes of a skilled pilot, weighs a quarter of a ton, and is totally incapable of improvising if anything goes wrong. It is, however, very strong.

If Morton is allowed to continue developing the robot, it will be little more than a nuisance; every so often he will want to let it fly the ship, if allowed to do so it works for a while then gradually loses the course, and has to be ordered to release the controls. Gradually Morton will lose heart and return to more conventional forms of automation, eventually following the steps outlined above. But if he is opposed in any way he will snap and order Robert to obey his voice only, take the controls and stay there, and resist any attempt to remove it.

Robert (Robot pilot and thug)

BODY [8], MIND [2], SOUL [-], ATHLETE (RUNNING) [4], BRAWLING [8], PILOT [3], STEALTH [0]

PUNCH, EFFECT 8, A:B, B:KO, C:I+KO

Armoured, -4 Effect to all attacks. Disintegrating bullets approved for use aboard ship will not penetrate Robert's armour, but will penetrate its camera eyes or speaker grille (small targets, -2 to hit). For safety it shuts down if its cameras stop working. It is also vulnerable to sonic stunners; on a C result some of the vacuum tubes shatter and it collapses. Creative attacks on e.g. joints, service panels, etc. should also be allowed to work. Once Robert has been disabled Morton will suffer a nervous breakdown, and leave the ship (heavily sedated) at the next port of call.

League of Nations

Société Des Nations
Economic Committee
Anti-Trust Subcommittee
CONFIDENTIAL

To: Dr. Otto Gerber
Re: The Interplanetary Corporation

There is growing evidence that officers of the Interplanetary Corporation are guilty of continuing corporate crime, going back to at least the 2060s, with the intention of maintaining a monopoly on civilian space travel. These crimes include criminal negligence (various incidents of accidents and deaths caused by poor maintenance and hostile working hours), bribery and corruption of government and court officials, and collusion in criminal activities in attempts to place the spacefaring unions under the control of the Teamsters. Three incidents are considered to be especially significant:

* In the 2060s Interplanetary manipulated the American and European patent systems and the courts to steal the thermoid expansion chamber originally developed by the engineer Perry Maclane, one of the most important technologies in current atomic blasts. As a result Maclane became a pirate; his ship, the Red Peri, is still actively engaged in piracy under his daughter's captaincy.
* The Venusian gold rush of 2110 may have been engineered by Interplanetary to cause problems for their last big rival, the Planetary Trading Corporation; PTC committed to build extra ships for the Venus route, but was unable to pay for them when the rumours of gold were proved untrue and thousands of passages were cancelled. Interplanetary acquired PTC's assets at a fraction of their true value, but the economic collapse that followed exceeded all expectations, leaving Interplanetary dangerously over-extended. Interplanetary also came close to collapsing, but under the direction of its new CEO, Richard Harrick, made a gradual recovery. Harrick brought a good deal of new capital into the company, and the sources are unclear. Since he took office it has become apparent that he has intensified Interplanetary's attempts to maintain a monopoly.
* An apparently unrelated incident, the crash of the Gunderson Europa Expedition of 2110, is now attributed to sabotage by an agent who used the alias Kratska but has since been identified as Ivor Gogrol, a known associate of Herrick. In 2111 Gogrol joined the second expedition and made another sabotage attempt, which ended in his death. Interplanetary is now attempting to gain a monopoly on Gunderson's protactinium blast technology by means similar to those used in the Maclane case.

The Economic Committee has ruled that the Interplanetary Corporation represents a clear and present danger to Earth's economic stability, and to the future of Earth's colonies. It has resolved to investigate all of the Corporation's activities, on Earth and in space, with a view to bringing criminal charges against those officials complicit in criminal activities, and to breaking the monopoly by splitting Interplanetary into at least two competing companies.

It is vital that these investigations remain secret until the Committee is ready to take decisive action; for this reason all investigators have been given covers related to law enforcement etc. Your meetings with local officials etc. should always begin with this premise, and only refer to Interplanetary in passing until you are sure that there is no problem; it is likely that some corrupt officials may be in Interplanetary's pockets, if so they must not be briefed on the Committee's plans.

Note: The pirate "Red Peri" Maclane may have important information relevant to this case, including documentary evidence. If there is any opportunity to communicate with her you should do so. You are authorised to offer her a limited amnesty for this purpose; however, she must not be led to believe that a pardon is likely, or even possible. Psychiatric profiling suggests that she is dangerously unstable, and would react badly if an offer was later withdrawn.

Richard Herrick
CEO, Interplanetary Inc.

BODY 5, MIND 6, SOUL 3
ACTOR (CONCEAL ORIGINS) 7, ATHLETE (ROWING) 7, BRAWLING 8, BUSINESS 8, LINGUIST (ITALIAN, RUSSIAN, GERMAN) 8, MARKSMAN 8, MELEE WEAPON 7, PILOT (SPACESHIP) 8, STEALTH 5, THIEF 8

Richard Harrick appears to be a self-made millionaire with an impressive track record on the stock market, but he's actually a member of one of New York's major criminal families. During the 2110 market crash he bailed out Interplanetary with $75 million, allegedly from a range of private investors, but actually from the New York mob and the Teamsters. They expect a major return on their investment. The only way to be sure of that is to get a complete lock on civilian interplanetary travel and the shipbuilding industry, by driving smaller rivals out of business.

Harrick is *not* a "hands-on" villain; he's happy to work through proxies, indirectly hired minions who will have no idea who is really responsible for their orders. Gogrol[1] was a rare mistake; he was the son of a senior mob figure, groomed to eventually become another senior Interplanetary executive, and somehow concealed his drug addiction. He was given the job of stealing Gunderson's formulae to 'make his bones'. He was supposed to steal the papers during the first flight, but failed to find them and panicked during the landing, fearing that he would be 'rubbed out' as the price of failure. He blamed the crash on Jack Sands; Herrick believed him and gave him a second chance, which led to his unmasking and death.

[1] *Redemption Cairn*

The Interplanetary Corporation

- If Gerber is a player character the player should be given the memo on the previous page.
- If Gerber is an NPC this information should be revealed to players as it becomes useful; for example, following an unsuccessful attempt to kill Gerber, or during an encounter with the *Red Peri*.
- Optionally the document could come to light after Gerber's death.

Interplanetary has always been ruthless, using all possible means to maintain a near-monopoly on space travel and to minimise costs, often at the expense of safety, and usually at the very edge of legality. With the appointment of Richard Herrick as CEO the company has stepped far over the edge.

The situation is actually considerably worse than is implied by Gerber's briefing; Interplanetary is behind several recent "accidents" to ships belonging to smaller lines and independent ship-owners, leading to long and expensive repairs and several injuries, and has planted drugs and other contraband on others. In the long term, the company is behind legislation to impose new insurance practices that will discriminate against smaller businesses. The legislation is due to be discussed by the League in the first half of 2116, but Interplanetary are already pushing hard for the change via lobbyists who claim to represent accident prevention groups and other concerned citizens.

Under the proposed legislation ship-owners will be required to post a bond of 25% of the replacement value of the most expensive ship they have insured. For Interplanetary this is a relatively minor one-off expense; their most valuable ship is worth a little over $2 million, so the bond costs about five hundred thousand dollars, easily available from the company's operating capital. Smaller businesses and independent operators generally own less valuable ships, but have much less liquid capital. Independent operators faced with a sudden bill for 25% of the value of their only ship will have real trouble raising the money; their ships may already be heavily mortgaged, and Interplanetary will do all it can to ensure that banks etc. are unsympathetic.

Similar bonding schemes are proposed for spaceship builders and related engineering companies. Interplanetary would again be able to absorb the costs relatively easily, its rivals would not.

Boyds of London, the main spaceship insurers, have done their sums; if the new bond scheme is introduced they estimate that there will be a short-term gain followed by long-term losses. Roughly 30% of the smaller lines and independent

operators will go out of business, with their ships either scrapped or taken over by Interplanetary or another large carrier. On the whole large carriers pay a smaller proportion of the value of their ships in premiums, since they are generally considered to be better risks, and the end result would be a significant reduction in income. They're handling this by lobbying League representatives in Geneva and their home nations, making the case against the insurance change (on the grounds, of course, that the smaller carriers will suffer; Boyds' profit margin isn't mentioned). Gerber is just senior enough that he might be consulted about the legislation, so Boyds will do their best to present their views in the best possible light. Naturally they are aware that Interplanetary are behind the proposals; you can't really keep something like that secret when so many people are involved.

Actuaries at Boyds have also noticed the rise in accidents, and determined that some were probably the result of sabotage. Boyds has teams of investigators at work, and they will inevitably cross paths with the adventurers eventually. Their typical investigatory team consists of an engineer or pilot and a detective, with any other specialists hired as needed. Boyds Investigators have a good reputation with law enforcement on Earth and throughout the colonies.

Optionally the final player in this game is Red Peri, still active after at least forty years of piracy, and aware that Interplanetary is stepping out onto very thin ice. If she's still around, she has confidential documents recently confiscated from the safes of Interplanetary ships, including messages to the company offices on Mars, Venus, and Ganymede. There's nothing immediately incriminating, but a careful reading of the documents shows that Interplanetary is counting on being able to buy up the assets of its competitors at bargain rates over the next two to four years, expects to be building protactinium blast ships within ten years, and appears not to have factored patent royalties into its operating expenses for these ships. Note that if Red Peri does become involved, Boyds will be hot on her trail; her crimes face an automatic death penalty if she can be captured and tried in a British court.

Harrick knows that some sort of investigation is under way, but doesn't have an informant at a high enough level to learn exactly what is planned. Gerber is one of four League officials with a background in law enforcement and economics who are currently off-world and may be involved in the investigation. It's possible that one or another of these officials may be vulnerable to seduction, bribery, threats, etc. Interplanetary may also consider sabotaging the ship or arranging an "accident" to delay the investigation, but this is very much a last resort – there's nothing more likely to attract more official attention.

Adventure Idea: The Hunting Party

While visiting one of the British colonies on e.g. Venus or Io, the adventurers are invited to join a hunting party organised by the Deputy Governor in one of the more habitable areas, e.g. the Cool Country on Venus, the borders of the jungle on Io. It's an opportunity to relax with the cream of colonial society, and there's a hint that there might be an opportunity to discuss "delicate matters that it might be impolitic to discuss in a formal setting."

This isn't exaggeration; the Deputy Governor has learned that the Governor is taking bribes from Interplanetary, and does all that he can to smooth things for visiting Interplanetary ships, while making life as difficult as possible for their rivals.

Unfortunately the Governor knows that the Deputy Governor is planning to , and has made his own plan to discredit his deputy, by framing him for theft. One of the women accompanying the expedition will claim that her rubies have been stolen, and plant them in his belongings.

Unknown to the Governor, someone else in the party has his or her own plans for the 'robbery victim', who will turn up dead soon after making the accusation; maybe the murderer is a jealous lover who thinks that she had an assignation with the deputy governor, maybe she's been blackmailing someone – the motive is left for the referee.

Run this as a murder mystery, with a cast of suspicious-looking characters, the adventurers hampered by the remote location (for some reason it will take at least a couple of days for help to arrive, e.g. a landslide has blocked the route they used to reach the camp site) and lacking forensic equipment etc. unless they can improvise something. It's time to use those little grey cells…

Keeping the Peace

Above all else, it's the duty of the Patrol to keep the peace and suppress piracy. Mostly this is done by the simple act of patrolling; flying the space lanes and keeping alert for trouble, checking ship movements and compliance with the provisions of the Interplanetary Treaty, and by doing so reminding trouble-makers that the League is a force to be reckoned with. At most times at least half the League fleet is in space, with the remainder on standby for emergencies or docked for maintenance, leave, etc. *Endeavour* is one of the smaller long-range ships; others include the short-range rescue ships which respond to piracy and other incidents near Earth and long-range high-capacity transports. Actual acts of war are comparatively rare, but occasionally Earth's conflicts spill out into space and the Patrol must be ready to handle such situations as they arise.

Adventure Idea: Warlord of Mars

When the Japanese Empire fell at the end of the Pacific War, several garrisons in China refused to surrender. The current Chinese keeps these last outposts isolated but hasn't attempted to drive the soldiers out. The Chinese use mortars to fire propaganda leaflets into the Japanese camp, the Japanese retaliate with loudspeakers and radio broadcasts asserting Japanese sovereignty. Occasionally soldiers surrender, and are deported to Japan. It's illegal to supply the Japanese encampments, but smugglers sometimes get an aircraft or rocket past the Chinese blockade. Occasionally the Japanese mount raids into the areas around their bases to steal food.

The largest of these holdout garrisons was commanded by General Seitarou Ito. A week ago the Chinese commander in the area sent in a routine request that the Japanese surrender. To his surprise they asked for his terms. It became apparent that Ito and other officers had vanished, leaving junior officers in charge. With his departure morale plummeted, leading to the surrender. The Chinese have learned that Ito, three other officers and twenty soldiers boarded a smuggler's rocket, killed the smugglers, dumped the cargo, and took off. A search of Ito's quarters has found a large library of books and articles about Mars and the enigmatic Martians. In the absence of other evidence, the Chinese are assuming that Ito is en route to Mars, and has notified the League accordingly. He is wanted for looting, executing prisoners, and other crimes. The other officers have similar allegations against them.

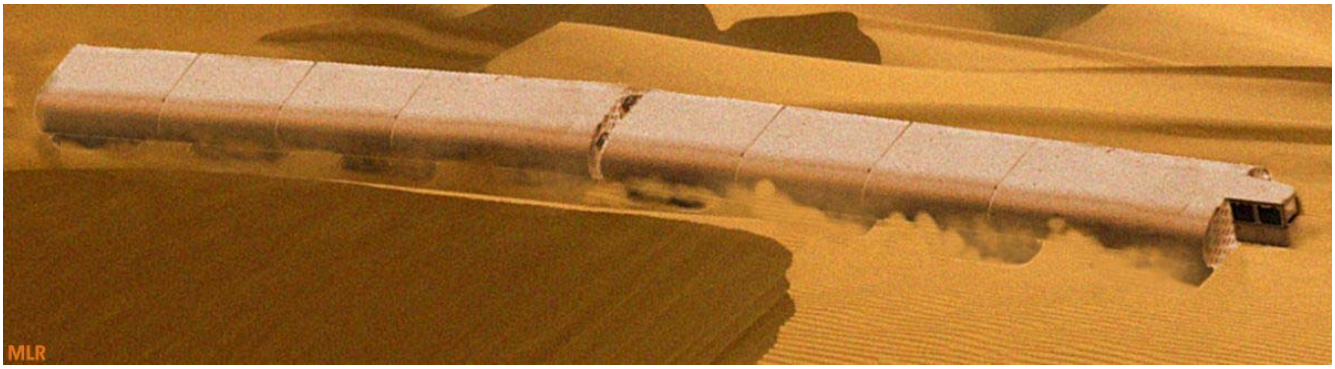
Endeavour is en route to Mars when the warning comes in. With the small antennae of a spaceship it takes nearly an hour to receive the entire message, with many repetitions, then another hour to decode it. Mars does not reply to messages; it could just be a radio breakdown, but the silence is worrying. While Ito's reasons for visiting Mars are unknown, his ship is probably headed for the only permanent colony, on the equator near Syrtis Parva; the field has landing lights and other aids, and Ito's pilot is presumably relatively inexperienced and will need all the help he can get. *Endeavour* is also headed there, but has ample fuel and much more manoeuvrability, and is equipped to land on unprepared areas. It will be possible to reconnoitre and if necessary land out of town. The League is always wary of antagonising the Martians, and it's vital that this is resolved as fast as possible and with minimum harm to them.

Ito has, of course, arrived, and his soldiers (armed with rifles, explosive bullets and flame guns) are holding the colony. His ship is on the landing field, but the landing gear and main blast have been badly damaged by a crash landing. It can't take off again without major repairs.

Ito's motive is simple; he has stomach cancer, and wants one of the Martian radioactive stones to cure his illness. He hasn't gone to one of the hostpitals that has one, such as John Hopkins in Baltimore, because he knows he will be arrested; instead he's trying to force the Martians (the Thoth) to give him a stone. He's shot two humans and a Martian (non-fatally) to prove that he's serious, and shown the Martians pictures of the stones so that they know what he wants.

The adventurers should arrive as this situation is reaching its climax, and encounter a Thoth who is bringing in one of the stones. What he doesn't explain, because he isn't sure who the adventurers are, is that there are several *hundred* mound-builders on his trail, all of them determined to get the stone back and totally indifferent to their own safety. The Thoth plan is to delay things until the mound-builders are a few minutes away, give Ito the stone, then free the hostages in the confusion as the mound-builders arrive to take it back.

In play-testing this ended with Ito carried away by the mound-builders, all shouting 'We are v-r-r-riends! Ouch!' while Ito's troops went down fighting and the adventurers, aided by the Thoth, rescued the prisoners. Of course the adventurers may have other plans, such as using the stone to haggle for Ito's surrender. But the mound-builders will arrive sooner or later, smashing buildings and trampling anyone who gets in their way.



With A Pinch of Salt

ONE of the problems common to all of the Venusian colonies is the lack of convenient supplies of metals and other minerals, most notably salt.

As elsewhere, the colonists rely on atomic blasts for power; while the uranium fuel can be imported from Earth and lasts for years, the blasts also need a supply of lighter material to break down to generate energy. Sodium in the form of sodium chloride is the ideal conversion mass for uranium blasts; cheap, usually abundant, and easily handled. Unfortunately it isn't readily available on the more habitable parts of Venus; there are no oceans, in most areas the ground is too unstable to allow mining, and Venusian rivers run deep below the surface of the Hotland swamps and out into the Brightside deserts, taking dissolved minerals and salt with them. They eventually evaporate or explode as geysers as the water meets near-molten rock. The evaporating water leaves behind layers of salt and other minerals, in flats which cover thousands of square miles.

Factory crawlers are used to collect these minerals and purify them for shipment to the colonies. It makes no economic sense to collect salt alone; it's far more efficient to feed some of the salt into an atomic blast and use the power to process the most useful materials *in situ*. Typically the output of a factory is a ton of purified salt and a quarter ton of iron, aluminium and other light metals and nitrates per day. While this isn't a cheap way to extract minerals, it's cheaper than shipment from Earth.

The factories can move at up to 10 MPH (but usually limit speed to 5MPH) and cost several hundred thousand dollars to construct. Facilities include air-conditioned living quarters for a

The 'Grand Tour' Campaign

This is a good introductory adventure if you're using HMSS *Endeavour* and the 'Grand Tour' campaign described above, with Venoble on Venus as the first port of call.

As stated in the newspaper story that introduces the campaign, *Endeavour* left Earth several weeks after the Earth-Venus conjunction, arriving on Venus at a time when salt stocks are at their lowest. An additional problem is disrupting supplies. *Endeavour* has a radium blast and uses iron salts rather than sodium compounds, and left Earth with full tanks, so the shortage doesn't affect her; she has enough fuel to reach Earth or Mars. However, investigating the problem and fixing things is well within the Patrol's remit, since it helps keep the colony functioning and doesn't conflict with other duties.

If the adventurers are using a ship that has a uranium blast they should have enough salt for a couple of point-to-point flight anywhere on Venus, but not enough to fly to another planet. This gives them an additional reason to be interested in solving the problem, but if they aren't, there is no point trying to force the players to cooperate; they can fly to one of the other Venus colonies and refuel there instead.

Civilian adventurers will be offered money to investigate, or to transport a team of trouble-shooters to investigate.

crew of ten or twelve men, loading bays for the amphibious trucks that carry supplies and goods to and from the factories, and everything else that might be needed for their arduous task. Under ideal conditions a good driver can leave the Cool Country, cross the Hotlands, reach the Bright Side and rendezvous in about a week, and return in similar time, but if conditions are poor it can take a day or two longer. Trucks are sent out once a week, or as soon as one is available if there are unusual delays. Usually this averages out so that about ten to twelve tons of minerals are delivered every week, about 75% of it salt. This may seem a lot, but a typical passenger ship or large freighter on the Earth-Venus route needs a hundred tons of salt to refuel. Salt gathering continues throughout the year, regardless of demand, so that there are adequate stockpiles when Venus is closest to the Earth.

Britain's colony is supplied from a crawler owned by Harlech Hallta Ltd. (a Welsh company whose name simply means Welsh Salt Ltd.) When the adventurers arrive on Venus it is nearly three weeks since their last truck returned to Venoble, and salt stocks are getting dangerously low. The colony's power plants need a regular supply, as do the ferry rockets that supply *Xixtchil* traders. Most other vehicles and the isolated huts used by traders run on atomic batteries and will be unaffected in the short term.

Due to continuous massive radio interference from storms around the Mountains of Eternity it isn't possible to contact the crawler or the trucks; radio has a range of a few miles at best. The only way to find out what's happening will be to travel to the crawler.

There's no need to be particularly subtle in introducing the situation to adventurers; the local papers are running worried stories about the shortage of salt, with suggestions that the League or the colonial government should do something about the situation. These suggestions range from martial law to nationalisation of the salt factories. One idea that may be suggested by the adventurers, flying one of the colony's small supply rockets out to look for the crawler, has been tried but failed; the rocket didn't have the fuel endurance to fly a prolonged search at low altitude, and couldn't find anything on a quick overflight of the estimated position of the crawler.

If adventurers are League personnel, serving aboard *Endeavour* or another ship, the colonists will initially assume that they are there specifically to resolve the problem. If League headquarters are told about it they will be ordered to lend all possible assistance.

If they are civilians, there will soon be several enquiries about chartering their ship, from Harlech Hallta Ltd., from the Governor of the colony, and from the local chamber of commerce. Let them haggle up to a maximum of £2,000 ($6,000); if they demand more than that there will be long delays and angry newspaper stories about the adventurers "profiteering from the salt crisis," companies that might have otherwise hired them to carry cargo will suddenly decide that the publicity will be too bad, and so forth. Unless they help, Venoble won't be a good place to do business in future.

If there are delays the situation slowly gets worse. After a week the Governor orders the power plants to shut down to conserve power, from 01.00 hours to 06.00 hours every "night"[1] This reduces salt consumption a little but causes problems for industrial users, hospitals, etc.

The Situation (Referees Only)

Driving amphibious trucks across Venus is a reasonably well-paid job, but it's boring and it's not possible to get rich that way. On Venus the main sources of wealth are *Xixtchil* pods and native silver artefacts, which is why there are scores of traders in the Hotland swamps. It's against the Harlech Hallta company rules to stop to trade with the natives, but most of

[1] There aren't nights as such, since Venus is tidally locked, but the settlements keep to the time zones of their founding countries' capitals; Greenwich Mean time for the British colonies, Eastern Standard Time for the American colonies, and so forth.

the drivers will do so given the chance, and carry trade goods such as knives, beads, and mirrors to swap for more valuable merchandise.

There are several reasons why the company prefers its drivers to stay clear of the natives. One is that they've been known to attack traders without warning; another is that a prolonged haggling session can take hours. More importantly, while the drivers have Transkin oversuits and filter masks and the trucks have filtered air supplies and spray equipment to get rid of spores if the driver's cab has to be opened, the equipment is supposed to be for emergency use only. Until now that hasn't been a problem; unfortunately their luck has just run out.

The company currently has four trucks in service, numbered 03 to 06; earlier trucks have been "retired" and scrapped. 03 was the last to return. Three weeks ago, half way across the swamps, 04 ran into a band of natives and stopped to trade. Somehow a dough-pot spore got into the cab while the door was open, and survived the spray. The cab was cool, and there wasn't anything for the spore to eat, apart from crumbs on the floor, so the dough-pot only grew to the size of a pea by the time the truck reached the factory crawler.

Because it takes a lot of power to start or stop a crawler, goods are transferred from the crawler to the truck, and vice versa, while the vehicles are moving. The truck drivers take it in turns to board the crawler to shower before heading back to Venoble.

Unfortunately one of the drivers (Brian Jones) trod on the tiny dough-pot just before getting out of the truck to board the crawler, and went straight to the showers, carrying it to a warm moist environment on the sole of his boot. While he was showering it ate a towel, then ate him when he opened the shower door. After that it moved into the air ducts; before anyone was aware of the situation it reached the factory's control cab and attacked the drivers. As they were being attacked they lost control of the crawler and it suddenly swerved to the right and ran down the truck, crushing it under its massive caterpillar treads, then carried on with nobody at the wheel, going wildly off course. Meanwhile the doughpot continued to attack the crawler's crew, and everybody aboard was either eaten or jumped out to escape. Bright Side temperatures are well above the boiling point of water, and all of the escapees are now dried out corpses, twenty-five to thirty miles back along the trail of the crawler.

After thirty miles the crawler hit a patch of thin crust over a geyser and the first two sets of caterpillar tracks broke through, stopping the crawler. Occasional eruptions fill the crawler with steam, but the air conditioning was still working and the dough-pot survived inside the vents.

When Truck 05 found the crawler's trail and tracked it down, a week later, the drivers didn't realise what was happening, and made the mistake of boarding the crawler to investigate. While doing this they closed the loading bay doors, so that the cooling system would make it more habitable. Sensing the change the dough-pot moved into the factory again, catching the drivers before they could escape.

Truck 06 ran into a series of mud geysers as it crossed the swamps, and is massively behind schedule and well off course. At the time the adventurers first learn about the salt "crisis" it is still two days away from the crawler. If they take immediate action and get to the crawler first there is a good chance that they will save the lives of the drivers; if they delay, there will be two more deaths as history repeats itself.

The other driver (Peter Cross) is still alive aboard Truck 04, but seriously injured. The rear half of the truck is smashed, but fortunately the power plant survived. He doesn't know what happened aboard the factory; all that he knows is that the crawler smashed the truck, and half-crushed the cab. Both of his legs are broken, and he was unconscious for several hours. Miraculously the air conditioning continued to work, and he was able to close the gaps in the windscreen with duct tape. But he's in continuous pain and his food and water are slowly running out. He has no idea what happened aboard the crawler; all that he knows is that when he woke it had vanished over the next ridge, and he could see bodies in the sand in its trail. In view of his injuries he hasn't been able to investigate. He will also die if the adventurers don't investigate quickly.

Harlech Hallta Ltd.

Venoble's only factory crawler is run by Harlech Hallta Ltd., a Welsh company which formerly operated salt mines on Earth before the atomic blast made sea salt extraction much cheaper. The name translates as "Welsh Salt Ltd." Most of the employees are Welsh. The company owns four ten-ton amphibious trucks which are each crewed by two drivers and operate on a rotating cycle; basically, the drivers get one day off for each two days they've been travelling, to a maximum of ten days off, then set off for the factory again. Since travel times are unpredictable it's a good job for unattached men.

The company has a good reputation; its products are pure, wages are slightly above industry standard with a good safety record, and its trucks and other equipment are well-maintained. There haven't been any recent changes in management or operating procedures.

Huw Davies, Manager
BODY 3, MIND 4, SOUL 5
QUOTE: *"There was a mud geyser on that route last time, go further west."*
ACTOR (SING) 7, BRAWLING 4, BUSINESS 7, DRIVING 6, MARKSMAN 6, MECHANIC 6
Davies manages the company from its HQ in Venoble. His hobby is choral music, and he sings with the Venoble Welsh Choir. He is regarded as a pillar of the community. He's very worried about the situation.

Three trucks are currently out, presumably en route to or from the factory.
Truck 04: Brian Jones & Peter Cross
Truck 05: Arthur Williams & James Jones
Truck 06: Richard Jenkins & John James
All have DRIVING 6-7, MECHANIC 5-7

Truck 03 is ready for departure, but Davies has decided to wait another week before sending it out, since the others haven't returned. The drivers, Ben Walton & Thomas Cohen, are doing maintenance and warehouse work pending departure.

Other employees include Jane Davies, Huw's wife, who is also office manager, and William Williams, mechanic.

Preliminary Enquiries

If the adventurers want to help resolve the problem, they may wish to begin by finding out more about factory crawlers, the company, etc. However, enquiries will take time, which affects the number of survivors as described above.

There's nothing especially suspicious or unusual about Harlech Hallta Ltd; it's a profitable business that employs about twenty people and usually runs smoothly. It has a warehouse, garages, and offices in Venoble.

The drivers live in company-owned apartments above the garages where the trucks are kept. If the adventurers have a legitimate reason to investigate – for example, if they are League personnel or working for the company or the chamber of commerce – Huw Davies will let them into the rooms of the missing drivers. Walton and Cohen will object if their rooms are searched, but Davies has the last word.

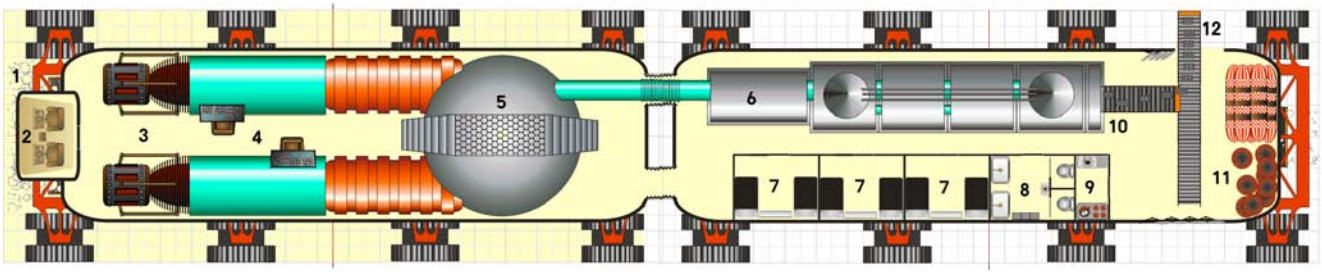
The main discovery to be made here is that all of the drivers have some trade goods in their rooms, and most have an item or two of native craftsmanship, or a small bag of *Xixtchil* pods, worth a few thousand dollars on Earth. It's not impossible that they've acquired the material locally – traders have been known to sell these things if they're short of cash, rather than waiting until they return to Earth – but it's very unlikely that all of them would be able to make that sort of deal. It's much more likely that they've been trading with the natives, in defiance of company policy. Davies will explain the reasons for this but won't emphasise the risk of contamination; although there's a safety rule it's never been a problem, he's much more worried about the waste of time. Since he has little personal experience of the swamps he thinks of this as a risk of disease, not in terms of being rotted alive by a fungus, or a man-eating monster getting aboard the trucks or the crawler.

Adventurers with experience of the Hotland swamps, such as the Hammonds, know better. There's a high death rate amongst traders, and most of the deaths aren't pleasant. Don't over-emphasise this point, Hotland species can't survive long under normal Bright Side conditions, but make it clear that he underestimates the danger.

If questioned, Walton and Cohen will eventually admit that "everybody does it"; it's the easiest way to earn some extra money, and it "doesn't do any harm." They don't encounter natives on every trip, but it's common enough that they always carry some trade goods. Davies will pretend to be furious, but he isn't really very surprised, it's happened

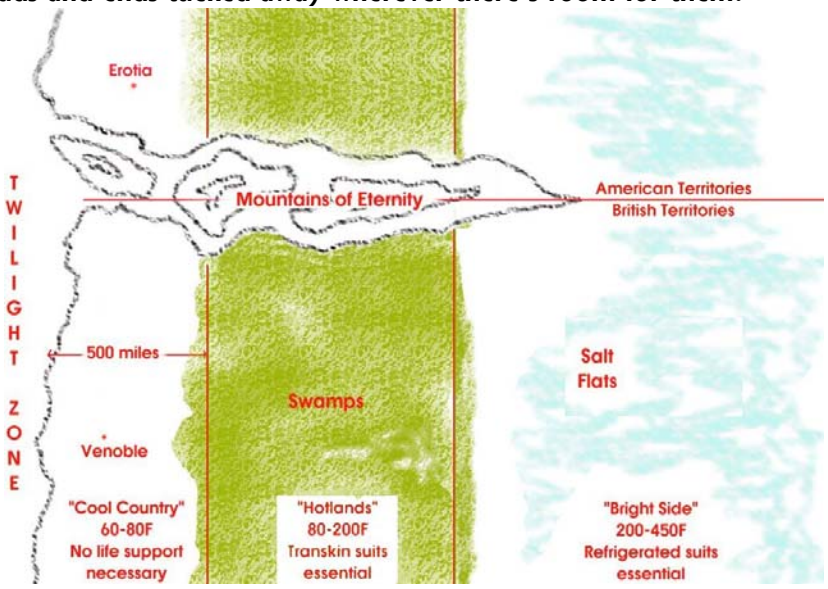
before. While company policy forbids it, he can't afford to lose competent drivers. It isn't easy to drive in the treacherous conditions of the swamps, and if he fires anyone it will take weeks to train a replacement.

If the adventurers want more information on the salt crawler, show them the plan below. A larger version scaled for 25/28mm figures can be downloaded from the author's web site.



The salt crawler is a massive vehicle designed in two coupled sections, running on sixteen sets of caterpillar tracks. A mixture of salt, rock, and sand is scraped onto a conveyor belt (1) under the control cab (2). Ducts feed it into two atomic blasts (3) where some of the salt is converted to energy, with the rest of the material converted to gas in the expansion chambers (4). The superheated gas is fed into a vortex chamber (5) which concentrates the gas, and eventually feeds it through a flexible duct into a magnetic separator (6) which sorts the material into its component compounds which are collected electrostatically. Crew quarters (7), the showers (8) and galley (9) are alongside the separator. At the end of the vehicle a conveyor (10) takes ingots of metal and tubs of salt etc. from the separator. They're stored (11) for transfer to the trucks via an extending conveyor (12). Waste sand etc. is dumped via a chute under the rear chassis of the crawler.

Davies has much more detailed engineering diagrams, of course, and points out that the basic plans only show the main features – for example, there's a maze of pipes and ducts under the deck and overhead for plumbing, life support, salt transfer, etc. It's also probably not nearly as tidy as shown; there are usually crates of supplies and other odds and ends tucked away wherever there's room for them.



The map shows the geography of the northern edge of British Venus. The most obvious physical features on the map are the Mountains of Eternity, whose highest peaks exceed 20 miles, forming the main border between the British and American zones. There are continuous electrical storms around the mountains, with the static making long-range radio impossible. For most of its length the range is considered an impenetrable barrier. Despite this it's only a landmark for a few miles north and south of the range; continuous low cloud means that the upper slopes and peaks are rarely visible. The swamps don't have many landmarks, since the terrain is continually churned by buried rivers, mud spouts, etc., and the salt flats aren't much better. About the only constant is the sun, and even that is diffused by clouds, making it impossible to use it to take an exact bearing. Navigation is thus very "hit and miss"; the rockets that supply traders use extremely expensive inertial navigation systems, other vehicles have to rely on odometers, compasses, dead reckoning, and short-range radio.

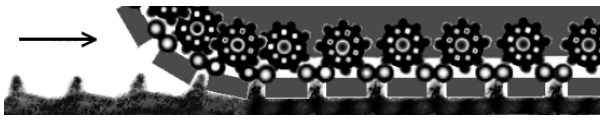
All of this means that the position of the crawler is only known approximately. Four weeks ago, when the last truck left the crawler, it was at the point indicated by the Salt Flats label on the map, driving in a slowly expanding spiral. When the crew were killed it was further south and heading east, and its final resting place is approximately 500 miles into the Bright Side due east of Venoble.

The Salt Flats

Sooner or later the adventurers should set off to find the crawler:

- If HMSS *Endeavour* is used, or another ship or aircraft equipped for sustained horizontal flight, the best way to find the crawler is to fly below the cloud cover, looking out for tracks. Although the surface of the flats is often disturbed by wind storms and geysers, the crawler is so big and churns up the sand and salt so much that it will be weeks before its tracks are completely obliterated:
    - Finding the tracks is relatively easy, requiring a Difficulty 4 Pilot roll to reach the right area, then Difficulty 6 to find the tracks, falling by 1 for each hour spent flying over the area, rising by 1 on a roll of 11-12:
        - A success means that the ship has found the tracks, but it's up to the adventurers to decide which way they want to follow them, and come up with a strategy for locating the crawler.
        - On a natural 2 the adventurers find Truck 04 and its driver, Peter Cross. Unless they have wasted at least two days he's alive but badly dehydrated. If not, they find the crushed truck, Cross dead inside it, and more bodies strewn along the trail.
- If the adventurers have a ship that's designed mainly for vertical flight, without underjets, they won't be able to fly low for extended periods. The best that they can do is make a series of short hops, up into the cloud layer then dropping down again a few miles away, looking out for signs of the crawler:
    - Finding the tracks requires an initial Difficulty 5 roll to reach the right general area, then Difficulty 7 to find the tracks, falling by 1 for each "hop", rising by 1 on a roll of 11. Using an electric plumb to gauge altitude before exiting the cloud layer reduces the Difficulty -1:
        - A success means that the ship has found the tracks as above.
        - On a natural 2 the adventurers find Truck 04 as above.
        - On a 12 the ship comes down too fast, and the pilot must roll versus Difficulty 8 to avoid a crash landing:
            - On a 12 the ship crashes hard enough to need 1-3 days of repairs. Everyone aboard must resist an Effect 6 impact A:B+F, B:I, C:I+KO
            - If the roll fails on 11 or less the ship crashes hard enough to damage the landing gear.
            - On a success the ship lands, everyone aboard is shaken but unharmed.

Once the adventurers have found the tracks, the next problem is to work out which way the crawler was travelling. If Cross or his truck have been found, or any of the dehydrated bodies scattered along the trail, it's comparatively simple to work out – this should be an automatic success unless someone does something truly stupid. Additionally, by the time the adventurers are that close the crawler's radio beacon should just be audible over the background interference.



If the adventures are further away when they find the tracks, the solution is simple; as the crawler moves along the ground the surface is flattened, then as the last section of the track lifts off the ground the pressure is released. The back edge of the track section lifts off first, and debris falls in from the gaps between the tracks. The result is that there is a slight slope on the indentations left by the track. They're deepest in the direction the crawler is moving. This will be spotted on an easy Detective or Military Arms roll.

Don't make things too difficult for the players; if the adventurers work on it they should soon find the crawler. Then their problems *really* start…

Salty Badness

There are several bodies on the sand over the next five miles after the truck wreck. All of them are wearing thermal suits, but they're only designed to protect the wearer for a few hours. The water tanks are empty, and the corpses are obviously dehydrated. One of the suits is empty, apart from some grey dust.

Venus Thermal suit – $300 (Venus price) – 25 lb, BODY 3, Armour 1.
Add $30 for a suit tailored to a perfect fit.

Thermal suits are similar to the suits worn by spaceport fire-fighters on Earth, fitted with a radium-powered cooling system to keep the wearer comfortable at high temperatures. Since Bright Side air is breathable if it is chilled there's no need for self-contained oxygen supplies; instead the wearer uses a breathing mask connected to the cooling system. The suits issued by Harlech Hallta incorporate a one-gallon water tank, a short-range radio, and a rations pack.

These suits are designed only for Bright Side conditions, not the Hotlands; they don't have the air filters used in Transkin suits, and have no resistance to the acids etc. secreted by Hotland creatures such as dough-pots.

NB: Space suits are a good substitute for thermal suits and have some resistance to Hotland spores etc., but they are not a complete defence; some of the metal fittings are vulnerable to e.g. a dough-pot's acids.

If the adventurers find the empty suit they will hopefully be VERY wary. The dust inside it is the remains of one of the crawler operators, who inhaled dough-pot spores before escaping, and was literally eaten from the inside out, including the bones. Fortunately the suit's cooling system was destroyed by the dough-pot's acid, and it has long since dried to nothingness. Even the spores have been sterilised, but they will be recognisable as dried spores if examined under a microscope. The species cannot be determined.

Once they find the crawler they ought to think of checking the exterior. On the whole it looks undamaged, although the front four sets of caterpillar tracks are submerged in a pool of bubbling white brine, and there is salt all over the first thirds of the hull. The driver's window is shattered. The factory loading doors are closed. There are no other windows; they cause too many problems with the cooling system etc.

There is another truck, number 05, parked about fifty yards behind the crawler. It's unoccupied, and doesn't contain any useful clues.

Eventually the adventurers should take a look inside the crawler. The interior is very hot (but cooler than the salt flats) and very messy, with signs of damage and grey dust everywhere, and steam billowing in from the broken windows of the driving cab. It's too hot for the steam to condense on the walls, but the exterior of space suit and cooling suit visors will be cooler; they fog up.

The grey dust is dough-pot spores. They are dormant, too warm to reproduce, but are NOT sterile; if transferred to a suitable environment such as the interior of a spaceship they will come back to life and start spreading into the air. If inhaled they will grow inside the host and devour him or her in minutes. They can be destroyed by a few minutes exposure to conditions on the salt flats, but if someone goes straight from the crawler to the ship without stopping some spores may survive.

The damage to the crawler includes bullet holes and scorch marks (someone panicked, and someone else tried to hold off the dough-pot with a welding torch), and pitting in the walls and floor, apparently caused by corrosion. If tested, the pits are acidic. The galley and stores are completely wrecked; anything edible has long since gone. The same is true of the cabins, the metal bunk frames remain but the bedding etc. is missing, it has also been eaten.

Most of the life support system is out of action; five vents are still working and blowing cool air, visible because it disturbs the steam inside the crawler, but the majority are out of action.

If someone opens one of the faulty ducts to check, they will find that there are large holes corroded in the heat exchanger system.

There are small dough-pots surviving behind two of the five working vents; the referee should decide where they are located. By sheer chance they haven't yet done enough damage to the heat exchangers to stop the vents from working. They are roughly the size of footballs, and slowly diminishing in size as they digest their own bodies. They will "sense" anything living that comes close to them and try to attack it.

Currently most of the interior of the crawler is too hot for the dough-pots; inside the coolant vents they are in their "comfort zone," hot enough for their metabolisms to work sluggishly but not so hot that they dehydrate. If left undisturbed they will eventually die (in another day or so after the adventurers arrive) and release more spores.

	BODY	Weapon	Effect	A	B	C
Small Dough-pot	2-4	Bludgeon	BODY + 1	F	I/C	C/K
		Wrestle[1]	BODY + 1	F	I	C/K
		Suffocation	1 + 1/30 sec	I	I	C/K

[1] The term "wrestle" is used very loosely. Essentially the victim is engulfed. Attacks are accompanied by the use of digestive enzymes and infective spores. Without a Transkin suit they are not survivable, regardless of duration.

- Wearers of space suits can survive for 1-3 minutes before the dough-pot acid and spores eat through and infects them.
- Wearers of thermal suits designed for Bright Side conditions are not defended against spores etc.

Any attempt to cool the interior of the crawler is thus inviting the dough-pots to come out to play, and allows the spores on the floor to start to multiply; as they become active they will eat their neighbours, forming small dough-pots which eat each other until there are several more small dough-pots loose in the crawler.

It's likely that the adventurers will encounter the existing dough-pots first, and may kill them before they become aware of the danger from the spores. Fortunately this isn't a subtle process; as soon as conditions inside the crawler get a little cooler the dust will start to churn as the spores attack and consume each other. It's readily apparent to anyone watching.

- The active dough-pots can be killed by Boland bullets – on a K result they will be blown into fragments too small to survive, although they will live on as spores.
- A flame pistol will kill them instantly, of course, but this will do at least $50,000 worth of damage to the crawler. It will kill all the spores in the compartment in which it is fired. Don't expect to get the crawler working again without shipping expensive parts from Earth, which won't be possible for several months. Meanwhile it will be necessary to buy salt from the other colonies and fly it in at colossal expense.
- Firing a flame pistol in the forward compartment is a VERY bad idea – on an 11-12 the flame burns through one of the atomic blast expansion chambers, and the explosion destroys the crawler. Anyone inside the forward compartment will die instantly, with the explosion flashing back into the aft compartment; Effect 12, A:F, B:I, C:C/K.

A better way to get rid of the dough-pots is to use controlled heat against them; turning off the cooling system completely will kill the active dough pots in a couple of hours. The spores can be destroyed by any good portable heat source, or anything else that will make them burn well. For example, the adventurers' ship will have liquid oxygen in its life support system; pour some of that onto the floor, get out fast, and throw in a flare, and the spores will burn explosively. Given all of the equipment aboard a spaceship, it won't be difficult to come up with a powerful portable heat source and clean out any spores surviving in odd corners.

The truck has a decontamination spray; there isn't nearly enough to treat the entire crawler, but it could be used to get into awkward corners. Alternatively, the adventurers could fly back to Venoble and pick up a few gallons of the stuff and some spraying equipment, it's readily available, and use that to decontaminate the whole crawler.

End Game

If the adventurers are cautious it should be possible to get rid of the dough-pots and spores without taking unnecessary risks. Having done that, the problem of getting the crawler running again needs to be solved. If the adventurers haven't made things much worse, they need to deal with the following problems

- The front third of the crawler is immersed in a pool of brine, shorting out tread motors etc.
- The control cab has been almost completely destroyed.
- The life support system is badly damaged.
- Food and other supplies have been destroyed.
- There's lots of superficial damage to e.g. the deck, furniture, etc.
- The processing equipment (the atomic blasts, expansion chamber, vortex chamber, separator, etc.) are still in full working order, apart from superficial damage to the control panels etc. However, the scoop equipment can only get salt to the blasts if the crawler is moving.

Fixing all of these problems is a daunting task; however, the adventurers don't have to do all of the work. The first priority is to make things safe, by getting rid of the dough-pots, after that they can try to patch things up a little. Most importantly, they need to get some processed salt back to Venoble as a stop-gap until the crawler can be repaired properly, and there's virtually none aboard; it was being loaded onto truck 04 when the dough-pot first broke out, was crushed under the treads, and has since blown away.

Encourage the adventurers to think "out of the box" on this one. For example, the processing equipment can be used if someone comes up with a way to supply the blasts with raw salt, regardless of whether the crawler is moving or not. There's a pool of hot saturated brine just outside the front cab, it shouldn't take an Einstein to think of pumping brine to the blasts and processing that. Getting this to work will require Difficulty 5 Mechanic *and* Scientist (Nuclear physics) skill rolls, but it isn't new technology; most power plants on Earth run on sea water. Failed skill rolls just mean the job takes longer.

Hopefully the adventurers will be set up to make some pure salt by the time truck 06 arrives (assuming that they didn't delay so long that the crew were killed). Remember that the crew of this truck have been out of communication for nearly two weeks and have no idea what's been happening, they may even assume that the adventurers have attacked the crawler!

Once salt production is resumed the adventurers may think of loading their ship with salt and flying it back immediately. They probably can't carry a huge amount, but even a ton or two will keep the power plants running for several days. Some other things they might think of include:

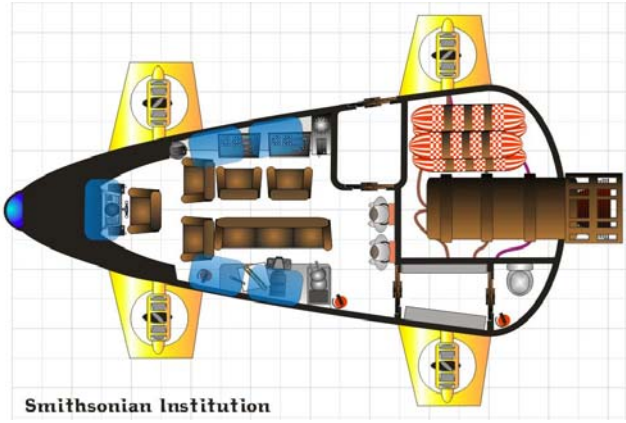
- Flying out drivers to take truck 05 back to Venoble loaded with salt.
- Flying out mechanics, engineering components, etc. to make repairs.
- Using the rear motors of the crawler and the truck winches to pull the crawler out of the brine pool.

Anything that they try, within reason, should work provided that it isn't ridiculously over-ambitious. For example, the crawler weighs so much that it will not be possible to use a spaceship to lift or pull it; any attempt will probably do serious damage to their ship. No skill roll is required to know this.

Bonus Points

This is a dangerous scenario if the adventurers aren't reasonably careful:

- Award 2 Bonus Points per adventurer for each truck driver surviving.
- Award 3 Bonus Points per adventurer if at least five tons of salt is delivered to Venoble in the first week after the crawler is found, 5 points if 10 tons or more is delivered.
- Halve bonus points if the crawler is badly damaged or destroyed by the adventurers' actions.
- Add individual bonus points for cunning plans, creative use of skills, heroics, making the referee laugh, and anything else that makes the game more entertaining.



The **SILGRS** (Smithsonian Institution Low-Gravity Research Submarine) is designed for use in the interior of asteroids or moons found to contain liquid water. Since it operates in very low gravity where ballast tanks would be ineffective, its motion is controlled entirely by its propellers and fins.

Powered by a sodium-fuelled atomic blast, the SILGRS has four steerable electric propellers for a cruising speed of 15-20 KPH; in an emergency the atomic blast can be run at full power, for estimated speeds of 30-40 KPH. However, instrumentation and sonic obstacle detection may be ineffective at higher speeds, and the steering function of the electric engines will be impaired. The hull has been rated for vacuum and for depths to 100 KM within Ceres.

There is accommodation for up to eight occupants including the pilot, navigator / radio operator and engineer; oxygen is supplied via electrolysis, with carbon dioxide and other waste gases vented automatically, so life support is not a limiting factor. Scientific equipment includes still and cine cameras, sampling ports and probes, external thermometers and other sensors, fixed and movable lights, UV lights, a refrigerated microscope and refrigerated specimen storage, etc.

While the SILGRS has not been designed as a spacecraft, the atomic blast may be used to melt a route through ice, and it is capable of attaining orbital velocity from Ceres – these capabilities may be useful if it is necessary to surface at a point remote from the base camp. However, there is no landing system and attitude control in vacuum is VERY limited, the occupants will have to wait for rescue. This procedure should only be undertaken in an emergency.

Smithsonian Institution

Extraterrestrial Biology Department, Washington DC

Ceres Expedition – Vacancies
$16200 - $18500 p.a.

There are vacancies for personnel on the scientific and support teams for the forthcoming expedition to Ceres, to be undertaken by the Smithsonian Institution with the co-operation of the League of Nations Scientific Council.

The expedition will attempt to explore the aquatic environment of the asteroid's water-ice layer.

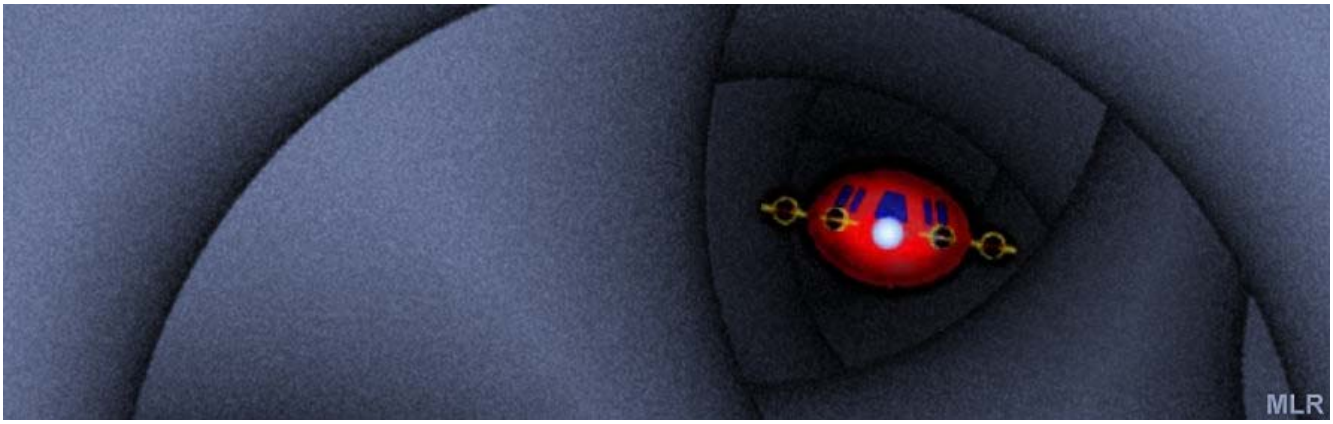
Applicants are expected to have a background in field biology and biochemistry *or* planetary geology and geophysics, with an emphasis on sub-zero marine and/or extraterrestrial environments, and/or expertise in at least one of the following areas:

- Deep sea diving using rigid diving suits
- Operation of submarines or bathyspheres
- Engineering related to the above
- Underwater photography
- Speleology.

If you are interested in participating please contact the department with details of your experience, academic background, etc., an outline of a research project you would undertake as part of the exploration of Ceres, and the names of two referees.[1]

Successful applicants must be prepared to submit to rigorous medical and psychological tests and commit to take part in preliminary training, up to six months in space, and post-expedition analysis of results and follow-up after the return to Earth. The exact time requirement will be determined once construction and testing of equipment is complete and transportation has been arranged.

[1]Referees may be contacted even if you are not short-listed.



A Ceres of Unfortunate Events

CERES, the largest asteroid, has always been the subject of intense scientific speculation. It ought to be a solid ball of ice, with a thin crust of meteoric dust, but there is evidence that there is liquid water under the crust; occasional plumes of ice crystals as jets of water boil off into space, and seismic noise that suggests slow internal activity.

Theory suggests that the ice layer is actually a mixture of ice and supercooled water, with some form of 'antifreeze' plus radioactive heat from the solid core keeping a portion of the ice from freezing. The structure predicted is a network of interconnected ice tunnels eroded by convection currents.

The last expedition found such a tunnel under a deep ravine and ice crevasse. Drilling revealed that it is roughly fifty meters wide, of indeterminate length, and has slow water currents. The water contained enough ammonia, which acts as a natural antifreeze, to stay liquid at -40°C, plus organic compounds which deteriorated *en route* to Earth and could not be conclusively identified.

This discovery makes it likely that it will be possible to explore the interior of the asteroid by submarine. Now that it is certain that there's liquid water the Smithsonian Institute plans an expedition to the interior, and the SILGRS (Smithsonian Institution Low-Gravity Research Submarine) has moved from the drawing board to a finished vessel in less than a year.

Exploration of the interior is expected to produce a wealth of information on the formation of the asteroids; if life is present there may be advances in biology, new pharmaceutical chemicals, and other sources of knowledge and profit.

The 'Grand Tour' Campaign

This expedition easily fits into the 'Grand Tour' campaign described above; the Smithsonian Institution provides the equipment, with the League supplying transport and some of the personnel. This explains why *Endeavour's* crew includes the Hammonds, who are primarily civilian explorers. The SILGRS vessel is too big to be carried by *Endeavour,* so a team of engineers is already on the asteroid preparing the submarine, but too sensible to use it themselves…

Captain Palmer has experience of piloting small submarines, making him an excellent choice to pilot the SILGRS.

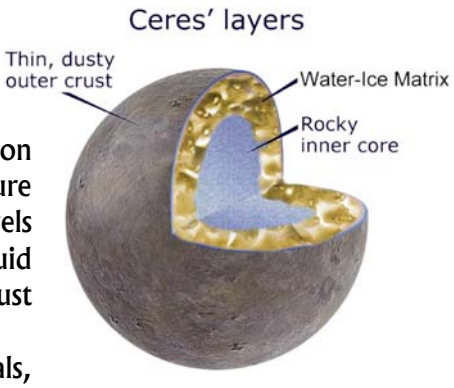
Byron Jones is well qualified to operate the submarine's power plant, auxiliary controls and communications systems. He has used high-pressure rigid space suits.

The Hammonds are both experienced explorers used to unusual environments such as the fogs of Uranus and the dark side of Venus. They made first contact with the Dark Side natives, the so-called Lotus Eaters.

For all his faults, **Milton Morton** is a competent engineer who can help to assemble and test the submarine.

Otto Gerber doesn't have any obvious part to play in the mission, but he's a League official, perfect to observe it and report back, and has some experience underwater, though only for sport.

The World Ceres (Referees Only)



Ceres isn't just the home of life; the asteroid itself is alive – a vast and intelligent organism made mostly of ice which circulates a mixture of water and other chemicals as its 'blood'. Its life force is primarily based on static electricity, not chemistry energy, and an elaborate tunnel structure behaves somewhat like a Van de Graaff generator. The water travels through the tunnels by convection, and "bubbles" of a silicon-based liquid gradually pick up electrostatic charge as they are carried close to the crust then carry it down to Ceres' seat of consciousness near the core.

In order to maintain this process it needs various chemicals, manufactured by thermosynthesis; conversion of infra-red radiation to chemical energy. The source of the heat for convection and for thermosynthesis is radioactivity in the core. This is a finite heat source, slowly dwindling as isotopes decay, but Ceres would normally expect to live another two to three million years. Unfortunately it is currently ill, infected with silicon-based parasites, and will die within the next few thousand years without help.

Unlike most other intelligent species, Ceres can't make or build tools; it has some control of its internal structure, via complex chemical and electro-chemical processes, but can't manipulate its environment.

The asteroid's 'circulation' is simply water with additives, including specialised 'cells' resembling balloons of various shapes and sizes. Mostly they carry chemicals which store electrostatic charge and change the viscosity (flow), electrical conductivity, or freezing point of water. It pumps the water around its body by selectively expanding and contracting tunnels; the 'cells' release ammonia and other anti-freeze chemicals to make tunnels expand, or other chemicals which neutralise the anti-freeze compounds to make them start to freeze closed. It thinks by transferring electrostatic charges from one point to another, mostly deep down towards the core of the asteroid, but its "nervous system" extends throughout the ice layer, as thin veins of conductive chemicals in the ice.

Ceres has repair mechanisms, evolved to deal with meteor impacts, but they can adapt to deal with damage from other sources. Its typical way of handling damage is to melt out an area much wider than a tunnel so that the crust collapses to plug the hole with debris, freeze it again, and wait a few years before tunnelling in that direction again. If necessary it can pump water to blow an "irritant" out onto the surface – occasional geysers are this process at work, used to expel meteors or accumulated toxic chemicals. All of this works slowly, but fast enough to cause problems for explorers. Unfortunately none of this helps against its silicon invaders.

While these physiological and mental processes are slow by the standards of human thought, its "brain" is vast and thousands of millions of electrostatic transfers occur simultaneously, so that Ceres can simultaneously examine every possible aspect of a problem and come up with an optimum solution. It might take hours to process an idea, but it usually ends up with the right answer.

It senses the outside world via very long wave radio, gravity waves, various subatomic particles, and (at really close range) the electrical impulses other species use for thought.

Ceres is aware that there are other intelligent beings in the universe. Over the last few million years it has detected gravity wave and ultra long-wave radio signals several times, and replied with signals of its own. Most recently (as it thinks of it), just fifteen thousand years ago, it was visited by a Martian spaceship, and acquired several interesting ideas from the Thoth. It's only just beginning to notice the existence of humanity. Just "moments" ago it detected some radio signals (Marconi's 1901-1903 transatlantic trials) which it thinks might be evidence of another species out there.

The aim of this adventure is for the adventurers to make peaceful contact with Ceres, hopefully help it with its illness, and survive the experience. It won't be entirely straightforward...

Troubleshooting

What if the adventurers simply aren't interested in advancing science? Here are some alternative motivators for use with different teams or types of character, which will need some work by the referee:

Profit: It's a new world, and new worlds usually mean new discoveries. What if there's something inside Ceres as valuable as Titan flame gems, or as Venusian *Xixtchil?* Or worthwhile amounts of gold, radium, or any of a dozen other valuable minerals? Instead of a primarily scientific mission, the aim is to make a fast buck; get inside, find out what's there, and if it's valuable bring enough back to make a killing, but not so much that people assume it isn't valuable. The adventurers are looking for new drugs, gems, exciting native art work, etc. This can also be a motive for individual members of a science team, of course, with characters planning to smuggle back their finds to sell, rather than treating them as scientific specimens.

Hiding Out: The adventurers are pirates, or some other type of fugitives, looking for a long-term hiding place; perhaps they're working with *Red Peri* (or hiding from her), perhaps they're on the run from an oppressive government, false accusations, etc. Somehow they get hold of the SILGRS craft, and it suggests the possibility of finding a *really* obscure hiding place.

Stop The Presses: The adventurers are a news team, sent independently to Ceres to film and photograph the first expedition into the interior, try to find a way to be aboard during the maiden trip of the SILGRS craft, etc. They are not at all welcomed by the serious scientists. Or are the scientists up to something, and worried about being exposed?

Salvage: The adventurers discover the SILGRS craft orbiting Ceres, empty. The base camp used by the expedition is also empty or simply can't be found. There are no clues to the fate of the missing scientists… unless the adventurers want to go looking for them.

Mirror, Mirror: The year is 2145, not 2115, and the adventurers are natives of the less advanced version of this universe described in the scenario outline *Time-Slip on Titan,* but of course don't know that there is more than one universe.

There never was a Smithsonian Institution expedition to Ceres, submarine technology isn't up to it yet, and the SILGRS is found in some extremely unlikely place; in the Arizona desert, on top of Mount Everest, on Phobos, or wherever seems likely to get the team's attention. There are several space-suit clad skeletons inside, and all of the control labels, papers, etc. inside are written in mirror writing. Even the screws are threaded the wrong way, and the molecules in the skeletons (and other organic materials) are isomers, mirror-reversed versions of the normal material. Maybe there are clues in the papers, but deciphering mirror-reversed scrawls isn't easy, and they mention weird things like the League of Nations and the Russian Empire continuing into the 22nd century, surviving intelligent life on Mars, a version of Venus that has swamps instead of seas, and other anomalies.

Clues should gradually lead the adventurers to some sort of time portal, inside Ceres, and the possibility of trading with a different and in some ways more advanced universe.

Murder Most Foul: This works best as a motive for an individual character who is a newcomer to the group; for some reason the newcomer wants to kill another character, but doesn't catch up with him (or her) before the team leaves for Ceres. The goal here is to commit murder and get away with it; some sort of accident inside Ceres seems the best bet, but arranging it won't be easy.

Betting On Success: Another motive for an individual character; the Ceres expedition has aroused a lot of interest and a lot of money is riding on its success – or its failure. Unfortunately the adventurer has run into a 'small' financial problem with his bookie, and received an ultimatum; if any truly intelligent life is found the bookie will be ruined, but intends to make sure that the adventurer goes down with him. If intelligent life is found it must be reported as 'pseudo-intelligent,' like the Slinkers of Io, regardless of the facts.

Training Montage

If you're using the sample characters they're already working as a team. Nevertheless, a mission of this importance needs preparation. This can mostly happen off-stage, or can just be mentioned as having happened without many details. The main elements are:

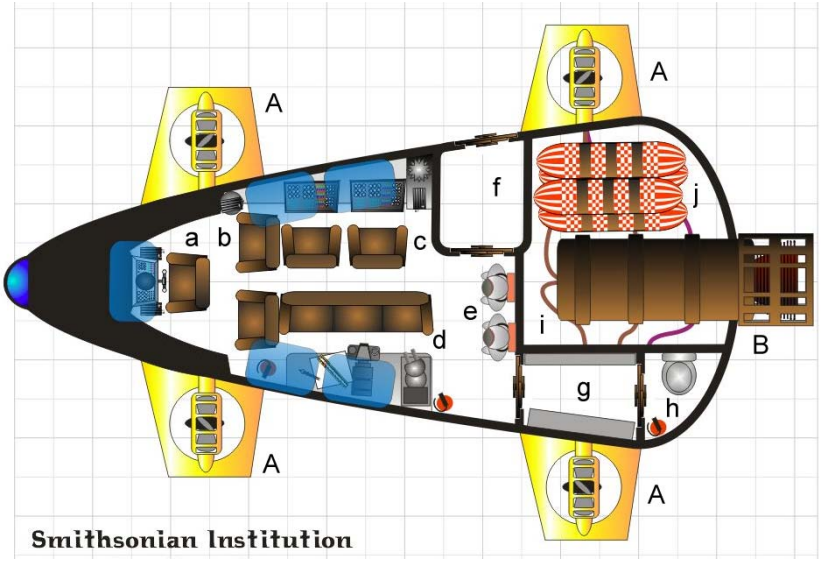
- Pilots and engineers learn to operate the SILGRS – since the training is run on Earth rather than in low gravity it can't be completely accurate. The training program uses a mock-up of the submarine in motorised gimbals, rigged to respond as much like the real thing as possible. For example, if the propellers aren't aligned properly it will start to rotate around its mid-point or tumble end over end.
- Another mock-up is designed for submerged training, lowered into a deep water tank. The trainees can practice operating the sampling equipment, using the air lock for divers, etc. It doesn't have working propulsion systems, but everything else apart from gravity is as realistic as possible.
- There's also a good deal of theoretical training on the science side, with an emphasis on ice formation, hydrology (water flow), low-temperature chemical analysis, etc.

If this is played out in any detail there should always be a sense of urgency, with the "window" for a fast flight to Ceres closing in fast, and the SILGRS initially under construction, later under tests (and running into endless teething problems), and finally available for some training sessions only days before it must be prepared for shipment to Ceres. It's very sluggish under Earth conditions; the best speed is 5 KPH with the electric engines, 18 KPH with the atomic blast. In Ceres it should be considerably faster. The summary of its performance above is mostly based on calculations and to some extent educated guesses; the reality is below.

The SILGRS in Depth

The most obvious external features of the SILGRS vessel are the steerable propellers and control fins (A) and the atomic blast (B).

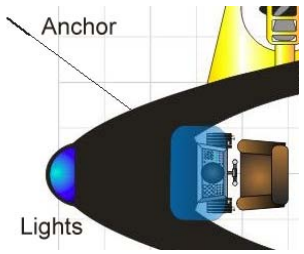
The interior is cramped, with little head room in most areas. The pilot (a) has the forward seat. The seats immediately behind him (b) can be used for observers and the scientific team. Behind them are the engineering, communications, and navigation equipment (c) and science equipment (d), including still and cine cameras, sampling ports for collecting specimens from the water, a refrigerated microscope, and refrigerated storage for specimens. There are two deep-water pressure suits (e), all crew will have space suits. The air lock (f) incorporates UV lights and anti-bacterial sprays, and a gas absorption system to remove ammonia. The rear compartments include a store room with galley facilities (g) and a small washroom (h). The engine compartment contains the atomic blast (i) and tanks of concentrated brine (j) to fuel it. For safety reasons the compartment can't be entered while the vessel is submerged. Life support equipment is under the deck and in overhead ducts etc., contributing to the lack of headroom.



A PDF version of this plan sized for 25mm / 28mm figures can be downloaded from the author's web site

The hull is made of titanium steel with clear synthetic quartz viewports. The engineers who designed the ship estimated that it would be able to withstand pressure to depths of approximately 120 KM below the surface of Ceres, but red-lined the depth gauges at 100 KM as a safety precaution. In fact the hull is stronger than anticipated, and won't show signs of strains until it reaches a depth of 140 KM. At this point water starts to leak in around the windows and the sampling ports, the hull groans, the engine compartment starts to flood, and if they ignores it and continue to dive they will eventually die. The ice layer is nearly 200 KM thick, and the sub will implode long before it reaches the core. The hull is also rated safe for use in vacuum. In game terms it's BODY 30, ARMOUR -5

The deep-water pressure suits are rated to 50 KM depth inside Ceres, BODY 10, ARMOUR -3. Normal spacesuits will work down to about 1 KM, but the radios will be damaged by any immersion. At greater depths the external pressure makes it impossible for the wearer to breathe.



The submarine is unarmed; the nearest approximation to weapons are two harpoon-like anchors on 75-metre cables, which fire to the left and right forward of the submarine. The cables are strong enough to anchor the submarine against currents up to 10-15 KPH. The harpoons are designed to embed deeply into ice, like pitons, and incorporate electrical heaters which can be used to free them by melting the ice around them. They can then be retracted for reuse. They're not nearly accurate enough to be used as weapons, but if anything is unlucky enough to be hit they have EFFECT 12, A:F, B:I, C:C/K

The light cluster at the front of the submarine includes red, white, and ultra-violet lamps, all with variable brightness. Dim red light is felt to be the least threatening if timid life forms are found, white is probably best for general-purpose illumination, and ultra-violet may reveal hidden details such as transparent plankton etc. There are two more portable lights in the science section, which can be moved to any of the ports. They have rubber shields around the lens so that they be pressed against the glass to illuminate the exterior of the submarine without light reflecting back inside.

Navigation and communications equipment includes SONAR, a gyroscopic inertial navigation device, and an ultra-low frequency radio which should be able to communicate through the ice at short range.

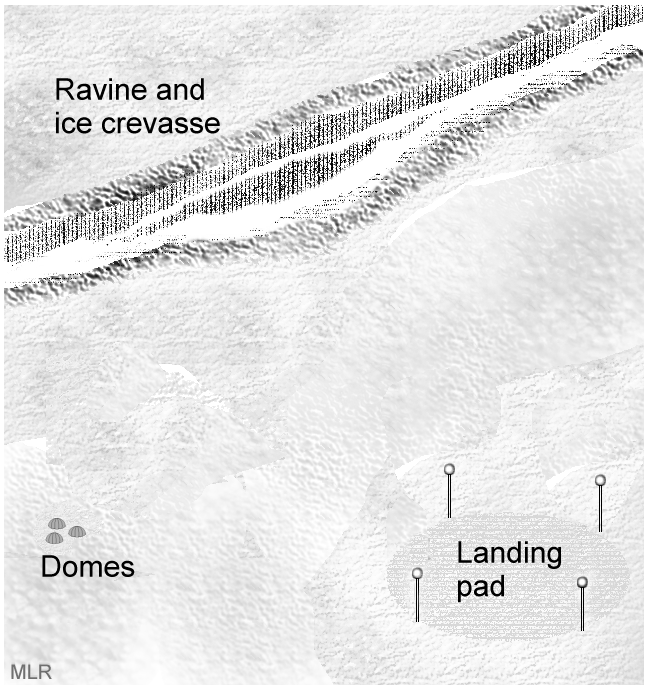
The specifications supplied to the team are mostly accurate, but there are some errors and omissions. Most notably, while the speed running on electric motors was correctly estimated at up to 20 KPH, speed using the atomic blast was wildly under-estimated at 30-40 KPH; the calculation didn't make enough allowance for the expansion of steam behind the sub. The *minimum* speed on the blast is 40 KPH at the lowest power setting; at full power the speed can exceed 60 KPH. But even at 40 KPH the handling is lousy (+3 to Pilot Difficulty), the sonar is useless, and there isn't time to steer away from anything revealed by the lights before over-running it.

There is also a flaw in the emergency escape system. This assumes that if the submarine gets lost or trapped it may escape from the ice miles from the base camp, and should then use the main engine to go into orbit around the asteroid, so that it can be found easily. Even ignoring the problems likely to arise in trying to find another route to the surface, there's a basic flaw in the idea; the SILGRS life support system uses electrolysis to generate oxygen from water, and the main source of water will be gone once the SILGRS is in space. There's enough drinking water aboard to keep the air fresh for a few hours, and the adventurers should have air for several hours in their space suits. After that everyone suffocates.

If the players read through the description and think about this they should spot the flaw, and the characters may want to make changes before the expedition begins. If so, an additional four day supply of air can be added without major structural changes. Adding more requires serious modifications and will delay the expedition past the best launch date. The tanks etc. needed to add the four day supply can also be installed on arrival at Ceres, but installing them will take two days.

Base Camp

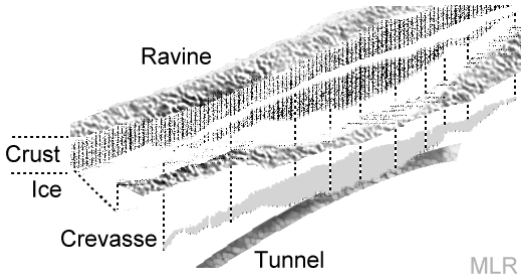
Ceres base camp consists of three domes, set up by the previous expedition, a few hundred yards from the crevasse where the ice tunnel was found. A landing pad has been cleared and levelled, and landing poles and lights have been installed to guide ships to a safe touchdown – it's actually a little too close to the domes for safety, but so far there haven't been problems.



Pilots landing at this site must make a Difficulty 4 skill roll; on 11-12 the ship drifts out of the landing area. Roll 2D6 for direction (as on a clock face, e.g. 6 is south), and 2D6-1 for distance in multiples of 50 yards, e.g. roll 11-1 = 500 yards. On a result of 9 for direction and 8 (400 yards) for distance the ship comes down directly above the domes, and another Pilot roll, Difficulty 8, must be made to sheer off. If that roll also fails the domes are damaged, requiring several hours repair; on a 12 the ship actually lands on top of one of the domes, destroying it. If anyone is killed the pilot can expect to be charged with gross negligence.

The domes contain basic accommodation, a workshop, and a laboratory, and can accommodate up to twelve persons without overloading the life support system. Equipment includes a drill for taking ice samples to a depth of several hundred metres, and two vehicles, small caterpillar-tracked "trucks" holding up to four persons plus several tons of cargo. They are fitted with extendable cranes, bulldozer blades, winches, and ground anchors. In Ceres' low gravity they are a little too fast; it's easy to drive over a rise and find that a truck flies ten or twenty yards before landing.

Anything over 20 KPH is probably too fast; the first time this happens the driver should roll against Difficulty 5, on a failure the truck rocks violently on landing but isn't harmed. On a 12 a track pin shears, and one of the tracks comes off, an annoying repair which takes 30-45 minutes. After two or three successful rolls it becomes instinct to take rises slowly, and no more rolls need be made.



At this point the outer crust of Ceres is unusually thin, just a few hundred feet, and a ravine has opened revealing the underlying ice, with a deep vertical crevasse in the floor of the widest part of the ravine. The ravine appears to be several hundred thousand years old, and there have been land-slips on the south side, so that there is a relatively gentle slope. The crevasse appears to be very recent in geological terms, and probably hasn't been open more than 300-400 years. The ice tunnel runs within a few feet of the crevasse floor; the ice isn't completely clear, but at the closest point the tunnel is visible as a slightly darker blue-grey shadow below the surface.

The floor of the crevasse is level. Mention this but don't explain it unless the players ask; on a Difficulty 4 Science roll it's apparent that at some time in the past the bottom of the crevasse filled with water, which then froze. One possible explanation is that the crevasse was originally deeper and filled from the tunnel. If analysed, the ice is almost pure water, with very little dissolved ammonia. The most likely hypothesis is that the ammonia evaporated in vacuum, leaving the water to freeze.

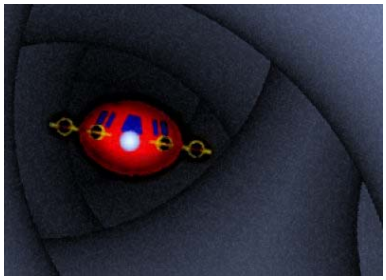
The submarine will be shipped out by freighter with its control fins and propellers removed (to reduce its diameter). If you're using the 'Grand Tour' campaign it's too big to fit inside *Endeavour;* the

adventurers travel separately and arrive a couple of days before the sub. Hopefully the captain will think of moving *Endeavour* well clear of the landing pad before a clumsy freighter arrives! Final assembly of the submarine takes three days, five if the extra air tanks mentioned above are added on-site.

- If the adventurers flew out separately from the SILGRS, the freighter that delivers the SILGRS will stay on Ceres for the duration of the mission, with its crew providing support and ready to rescue the submarine if it surfaces elsewhere on the asteroid or has to escape into space.
- If the adventurers flew the SILGRS out in their own ship, there should be some NPC support personnel already in place at the base, including at least one NPC pilot qualified to fly their ship.

The previous expedition bulldozed a track down the south side of the ravine, with the intention of transporting the submarine to the ravine and lowering it down the crevasse by crane. Once it's down the ice can be smashed (using jack hammers and pick axes) and the submarine can be lowered into the water for launching. Then the crew can board and begin their unusual voyage.

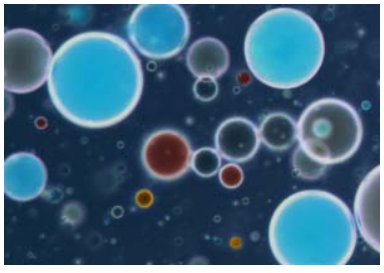
Ice Palace



In play tests the adventurers usually began very cautiously, with the submarine tethered to a winch in case the current was too powerful for the engines, and made equipment tests before venturing far from the opening. Encourage this – it gives players the illusion that they're in control and maybe this time things aren't going to go wrong…

Once the adventurers are sure that the submarine isn't sinking or flooding they will probably want to look round. Encourage them to try the lights, SONAR, radio, etc.

The tunnel is about fifty meters wide, but the structure is much more complicated than might be expected; a succession of evenly-spaced "buttresses" of ice cross the tunnel at intervals of about 150 meters, restricting the main bore to about twenty meters at any given point. There's room for the sub, but it's a close fit. They have a rounded "sculpted" look. On a Science roll (+2 bonus for any speciality related to fluid dynamics, hydraulics, etc.) this will be recognised as the result of thousands of years of turbulence; as water flows along the tunnel there are eddies and swirls, which wear away some ice while leaving it behind elsewhere. A similar process produces sand dunes. The water flows at about 4 KPH.



In white light the water looks completely clear, and there are no signs of anything resembling life. The same is true in red light, but ultra-violet reveals a world of wonders. There are thousands of luminous balls, from the size of marbles to balloons, glowing in different colours, drifting with the current. Mostly they're clear, only visible because their edges glow, but some are red, blue, or gold. They don't seem to react to the light or SONAR. They'll disintegrate if sucked into the propellers, and they are impossible to avoid, there are just too many of them.

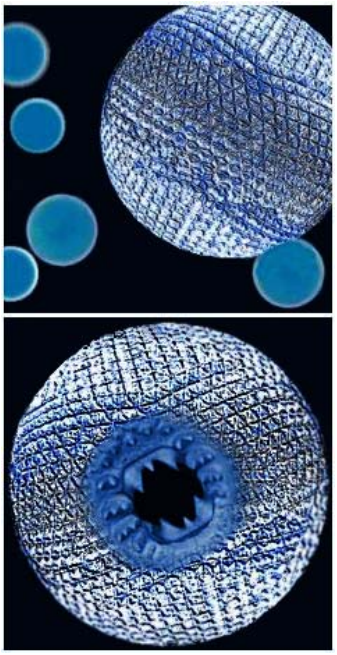
The balls contain water plus one or another of the chemicals that regulate Ceres' internal processes, inside a molecule-thick membrane that keeps the liquid together until needed. They're too big to be taken aboard intact through the sampling tubes, but there's equipment for taking liquid samples, which will work if it's used when a ball is by the end of the nozzle. There are four main types:

- **Clear** balls are water with higher than normal amounts of ammonia. They burst if they drift into water containing much less than the usual amount of ammonia.
- **Red** balls contain a chemical which forms sticky strands of gel when it reacts with ammonia. This decreases the amount of ammonia in the water, encouraging it to freeze, and also decreases flow rate. It's mostly important if Ceres is damaged; it stops water flowing out and makes it freeze, plugging the hole. The gel won't have much direct effect on the submarine – it's about as strong as dilute

wallpaper paste – but it could encourage ice to form on the propellers, or impede a diver. The chemical hasn't been described before, because it breaks down at about -20°C or when the water it's in freezes, but it's readily synthesised once known. It could be useful in some industrial processes, but it would be cheaper to make it on Earth than import it from Ceres.

- **Gold** balls contain a chemical that reduces turbulence to speed water flow. They're comparatively rare near the surface because Ceres actually needs turbulence in its upper tunnels, it encourages electron transfers. Mostly they're found in the broad vertical 'arteries' and 'veins'.
- **Blue** balls contain a silicon-based chemical which easily picks up electrostatic charges, with an outer insulating layer. They're equivalent to red blood cells, carrying charge in the same way that red blood cells carry oxygen. Mostly the charge is taken down to the centre of consciousness near the core, far below the maximum depth attainable by the SILGRS, but some is released nearer the surface.

The spheres are the equivalent of red cells, platelets, etc., but function by simple chemical processes. They can easily be mistaken for living organisms, but don't contain any of the mechanisms needed for reproduction etc. There are many other types, serving more specialised purposes, but they mostly look much like one or another of the above, and all of the other types are comparatively rare.



Soon some golf-ball sized spheres appear and start to engulf the smaller blue balls. These are the parasites that have invaded Ceres, as spores carried on a meteor that hit Ceres a few hundred years ago. They are living organisms in their own right, based on silicon, and use the stored electrostatic and chemical energy of the blue spheres to power their own metabolism. Without any natural predators, and with plenty of food available, they are rapidly growing in numbers and depriving Ceres of the energy it uses to power its thought processes. Ceres is aware of the problem, but hasn't been able to identify the cause or think of a way to get rid of them. They are visible without UV light.

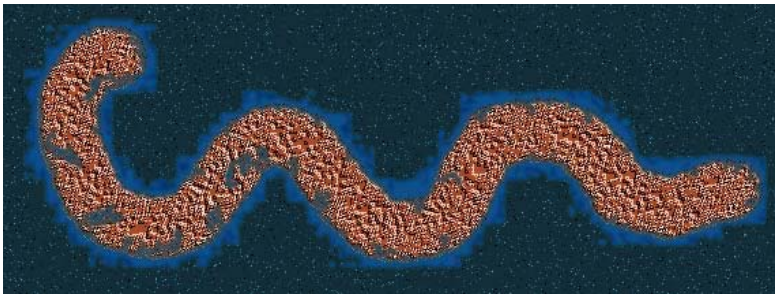
One of them approaches a balloon-sized blue sphere and somehow gets inside then rapidly splits into several smaller organisms. They explode out, leaving the blue sphere disintegrating behind them, then swim towards smaller blue spheres to attack them. Others start to cluster on the synthetic quartz viewports, revealing sharp-toothed maws that scrape at the windows. It will take hundreds of hours for them to do enough damage to endanger the SILGRS, but don't tell the players that.

If the spheres are examined under a microscope it can be seen that the outer surfaces have tiny silicon whiskers, which propel them through the water. If they are touched they will do their best to bite, even though they have no use for human flesh. They are a real danger to anyone wearing a non-armoured space suit in the water, attacking the silicon rubber and Silicelu visors in swarms:

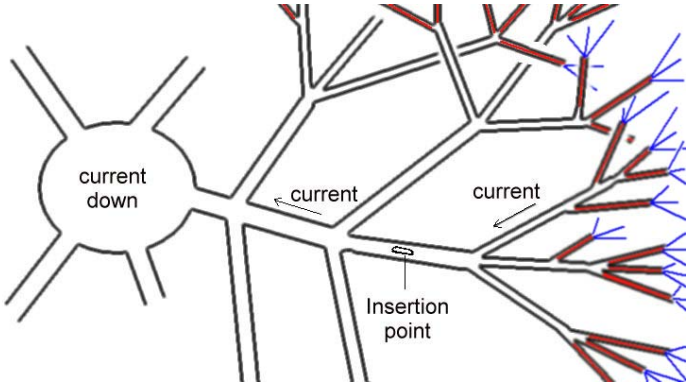
Silicon Eater: BODY 1, MIND –, SOUL –, Brawling 2, Bite Effect 2, A: F, B: F, C:I
Attack in swarms of 1D6+2. If attacking a space suit, on a natural 2 to hit, then I for damage, they penetrate the suit. Visors shatter, air leaks out or water leaks in if they damage other parts of the suit. They cannot do significant damage to armoured suits.

If the SONAR is used all of the silicon eaters in view disintegrate, shaken apart by the blast. This shouldn't be over-emphasised immediately, especially if the adventurers have no idea that the silicon eaters are intruders. If possible try to make them feel guilty about the destruction!

The last thing to appear is a wriggling form that looks vaguely like an enormously elongated sausage balloon, about thirty feet long and six inches wide, but moves through the water like a worm or an eel.



It's semi-transparent and there are no obvious internal organs, under UV light it glows red. Like the transparent spheres, it seems to ignore the submarine. This is a scavenger, which is also part of the Ceres organism; it absorbs metal ions and other chemicals that might harm Ceres. It's animated by chemical processes, but it would be natural to assume that it's alive. The 'worms' are harmless, but they'll move towards anything that releases metal ions; the exterior of the submarine is coated with plastic to reduce corrosion, but the rigid diving suits are not. Anyone seeing one will probably assume that it's another predator. These are made of soft gel resembling the mucus in frog spawn, but tinted different colours according to their diet; one that has absorbed a lot of iron ions will be red, copper gives a blue-green tinge, and so forth. Some have stripes of different colours. Despite these tints there isn't much metal in them, and attempts to process them for their chemicals will be uneconomic.



Once the adventurers have had a look around they'll probably want to start exploring. Cautious characters will probably want to go upstream, against the current, so that they can be sure that they'll be able to get back again. If so, they can travel about 3 KM before the tunnel branches into three narrower tunnels; each of the branches is only just wide enough for the submarine. The next branch of the tunnel is too narrow for the submarine (shown in red). If a diver tries to go further there are eventually more divisions, and the tunnel is soon too narrow for even a standard space suit (shown in blue). Remember that diving in an armoured suit takes a lot of effort; it's heavy and awkward even in low gravity, while a spacesuit wearer will lose contact with the submarine as his radio fails, and will be subject to attacks by the silicon eaters.

Going in the other direction, the opening is about 2 KM from a fork where three similarly sized tunnels meet; after the fork the tunnel is about 60 meters wide and the current has increased to 6 KPH. The depth slowly increases. After the next fork the tunnel is wider still, and the flow is about 8 KPH. And after another 1 KM the tunnel, and many others, enter a near-vertical shaft, several hundred meters wide, with a strong current downwards at about 12 KPH. The opening is close to the top of the shaft, and several other tunnels enter it from different angles, all of them with a flow of water into the shaft. This point is already below the crush depth for ordinary space suits.

Cautious adventurers will probably be VERY careful about this; another increase in speed could make it impossible to get to their entry point using the electric motors alone, and the atomic blast is still untested. If anyone worries about marking the tunnel, remind them that the inertial navigation system should easily find the route back; alternatively, some sort of marker could be added to the tunnel entrance, by (for example) going out in a diving suit and fixing a piece of cloth to the ice.

If they try another of the horizontal tunnels they'll find that it's nearly identical to the one they've come from, a series of branching tunnels getting narrower the further they go. There is no visible route to the surface. Because of the strong downward current it's difficult to get from one tunnel to another; no skill rolls are needed, it just takes a long time because most of the engine power is being used to counter the current.

By the time the SILGRS reaches the vertical shaft their original entrance will be closing. The red balls have done their job, and sticky gel has closed off the opening and encouraged ice to start forming. After an hour or so there will be half a meter of ice on the surface, after five or six hours the whole tunnel is obstructed by ice, spreading in both directions for fifty meters or so.

If the adventurers have left someone at their base camp (possibly NPCs) it can be assumed that they will attempt to communicate, and try to keep the water from freezing. But the more the ice is disturbed the more ammonia will evaporate from the water, and the faster it will freeze. Surprisingly, signals will still get through to the sub; Ceres incorporates salt ice structures equivalent to low-frequency antennae, and they'll serve to relay the signals. By using these frequencies the adventurers alert Ceres to their presence, of course, but it will be slow to respond. Keep track of how often they use the radio to determine this; for every time they use the radio roll 2D6, less the number of radio messages. On a modified result of zero or less Ceres begins to respond, as described in the section ***S... S... S...*** below.

At this point cautious characters may choose to head back to their original tunnel, get as close as they can to the insertion point, then use the atomic blast to melt the ice. This works, if they (a) anchor the sub with both anchors and (b) run the propellers on full reverse. If only the anchors are used they rip free, and the sub suddenly blasts forward at 40 KPH. If only the propellers are used, the sub goes forward at a minimum of 20 KPH, with very little control. The pilot needs to keep making skill rolls at Difficulty 8 at 40 KPH, Difficulty 6 at 20 KPH, until the atomic blast is cut.

- If the roll is a success all collisions are avoided. The sub goes forward, of course, which may not be what was planned. Reduce the Difficulty of the next roll -1, to a minimum of Difficulty 3.
- If any roll is a failure the sub hits the ice hard enough to shake everyone, but doesn't take real damage. However, each impact throws the sub off balance and makes it harder to control. Raise Difficulty +1.
- On a 12 one of the propellers is damaged, and all control is lost. The sub crashes into the ice and the engines start to drive it in, until the power is cut. There are spares in the store room, but fixing this will require someone to venture out and replace the propeller, which requires a Difficulty 5 Mechanic or Science (Engineer) skill roll.

If the adventurers do everything right they should be able to get back to the original insertion point, and the sub can be retrieved (if it's left in the water it will be frozen in place within a few hours). If that happens further developments must await their next expedition into the interior of the asteroid.

Dive, Dive, Dive

The mission is planned to spend several weeks on and in Ceres, and is expected to produce some results. Eventually the adventurers will probably risk going deeper into the asteroid; if they don't, they won't learn much more about it, and the expedition's sponsors will not be happy.

Troubleshooting: If adventurers refuse to have anything more to do with the SILGRS or the interior of Ceres, remind them that their careers, academic standing, reputations etc. are linked to the success of the expedition. If there's a difference of opinion, anyone who doesn't want to go into the asteroid again could remain on the surface helping to man the base camp, but there isn't much to do and they'll get no glory. If nobody wants to go back inside there are flight plans prepared for the return to Earth, but all of them will require them to wait on Ceres for weeks to months before returning. If anyone has trained as an astrogator they can plot an entirely new plan and return earlier, of course. Explaining this to e.g. the Smithsonian or the League Science Council won't be easy.

The next stage of the journey is the shaft down; this has the same corrugated look as the tunnels (the word "organic" should not be used at this point) but is of course much wider. It's tilted about five degrees from the vertical. There are the same ice buttresses criss-crossing the shaft every few hundred metres.

After fifteen kilometres several shafts enter the top of an egg-shaped chamber, roughly ten kilometres in diameter and thirty kilometres deep, with tens of thousands of needle-like icicles, each about thirty metres long, protruding from its walls. They're covered with a silicon-based insulator similar to the coating of the blue spheres. A central pillar about two hundred metres wide, covered in longer icicles, runs up its central axis. This is a major nexus in which the silicon charge-carrier spheres shed and take on static electricity. Bands of blue light move up and down the sides of the chamber and the central column, each made of hundreds of spikes glowing as they shed or gain charges simultaneously. If the SILGRS touches the spikes it will be hit by occasional static charges; they're harmless, since the hull of the submarine is a good Faraday cage, but disconcerting. Anyone touching the metal instruments that protrude through the hull, such as the sampling probes, will feel a distinct tingle of electricity. The spike material is coated ice contaminated with salt and trace elements of other electrical conductors. Veins of this material run back into the walls of the chamber.

Anyone going outside in a diving suit and touching one of these icicles will feel a distinct tingle of electricity, but it's harmless; the suits are too heavily insulated for a dangerous shock. Optionally this initiates the process of mental contact described in the next section.

Part of one side of the chamber is dark, in an irregular dark splodge about 200 metres wide and 500 metres long. If this is checked tens of thousands of the golf-ball sized silicon eaters will be found, swimming around the spikes and eating the blue charge-carrying spheres. The spikes in this region look damaged; the specialised chemical packets that should repair them are being eaten. The infestation is slowly expanding. Here, as elsewhere, if the adventurers use their sonar the silicon eaters will disintegrate.

This is only the first of these chambers; if they go deeper they will encounter another at a depth of 30 kilometres, the next at 43 kilometres. All of them show the same pulsing blue patterns, and have sections which seem to be damaged by the silicon eaters.

By now the adventurers will hopefully have the idea that there is some sort of organizing process responsible for these phenomena, and may guess that the silicon eaters are disrupting things. Soon they will have proof.

S... S... S...

Ceres "recently" noticed the existence of humanity when it detected a repeated radio signal, a pattern of three pulses, originating much nearer the Sun. This was actually Marconi's first transatlantic radio signal of 1901. Almost "instantly" it detected more signals, of ever-increasing complexity, and began to memorise them for later analysis. 214 years later it has identified the separate letters etc. of Morse code, but is no closer to understanding what they mean. It assumes that SSS is a greeting.

After it has picked up enough radio messages, as described above, or at a moment convenient to the referee, Ceres will attempt to contact the adventurers by radio. This should occur when they are in one of the chambers described above.

The message consists simply of the letters SSS followed by a repeat of one or another of their previous messages. It's accompanied by waves of blue light moving up the chamber walls in time with their signal. After each repetition the pattern changes to concentric waves of light, converging to a point on one of the chamber walls. The adventurers may be forgiven for assuming that somehow they have been noticed; in fact this is happening in all of these chambers throughout the asteroid.

If the submarine approaches the point where the lights converge they will find an unusually complicated arrangement of ice branches, which on a Difficulty 5 Science roll (or any other appropriate skill roll) will be recognised as an array of ultra-short-wave antennae, focused on a point about fifty metres from the chamber wall. These are capable of picking up the electrical signals associated with

human (and Martian) thought. As soon as the submarine approaches within a few metres of the focus of the antennae they will begin to relay everyone's thoughts to Ceres. It doesn't *understand* them at first, but it can start to process them and look for patterns it recognises, most notably Morse code, and use that to unlock words and their meanings. It repeatedly transmits the messages it has heard, analyses the thought patterns they trigger, and uses them to decode human language. This process begins as soon as the submarine goes anywhere near the antennas, completing in about forty-five minutes; halve this time if the submarine stays at the focus throughout this period.

Troubleshooting: If the submarine stays away from the focus this process takes several hours – Ceres has a poorer record of their thoughts – but the results are the same.

Once Ceres has learned a little English it can start to try to communicate. Remember that Ceres has no experience of human life, or understanding of human emotions. It's logical and *strange*, with the emphasis on strangeness.

It's impossible to predict every question that may be asked once the adventurers realise that they are in contact with something alien. Here are a few possibilities:

Q: Who are you?

A: "I am." If some expansion is requested, Ceres will respond "I am the whole." Only gradually reveal that it means that it is the whole asteroid.

Q: What do you want?

A: "Want?" It doesn't really understand the idea of wanting things; as far as it is concerned, situations either "are" or "are not," there is little that can be done to change them. This might be changed if the adventurers suggest that they may be able to help destroy the silicon eaters, once they explain what the silicon eaters are; Ceres knows that something has been disrupting its internal processes, but has no real idea of the cause.

Q: What do you eat?

A: "Eat?" Ceres has no idea of eating, food, etc., but it can describe its electrical life-style and circulation in great detail. This should include mentioning that something is disrupting its internal processes.

Q: Where do the tunnels go?

A: "Down" The adventurers are in a section of Ceres' circulation, an "artery" that leads inexorably downwards to the core, far below the sub's crush depth. They can get back to the surface slowly by travelling against the current. However, there are occasional "capillaries" connecting the downward and upward channels, used to speed the movement of chemicals and waste. They're wide enough for the submarine if the pilot is careful, and can be melted a little wider with the main engine if necessary.

Q: Is there anything valuable here?

A: "Define valuable." It has absolutely no idea. There are undoubtedly rare minerals in the core, and in the concentrated toxic waste it is occasionally forced to expel, but it has no idea what would be useful to humans, and no easy way to get materials to the surface. The concept of *exchanging* valuables or services is totally outside its experience.

- An exchange or gift of information is more familiar to it; it has previous experience with the Martians of 15,000 BC, who told it much that it will find very difficult to explain.
- It can "play back" speeded-up recordings of the signals it has received from sources outside the solar system, ultra-long-wave radio and gravity wave messages which were received over thousands of years. It doesn't understand them, but perhaps humans will be interested.
- If presented with a complex mathematical problem, no matter its nature, it can probably solve it; it may take weeks to decades, but eventually it will find some sort of answer. It will know if a question is meaningless or unanswerable. It will be happy to tackle problems, they make life more interesting.

Q: Is it possible to destroy the silicon eaters?

A: Ceres doesn't know. It hasn't considered the idea, since it has little direct control of its internal processes. Humans may have other ideas.

- The simplest solution appears to be to zap the silicon eaters with ultrasonic sound, which makes them disintegrate. There are a few problems with this idea – the most obvious is that the SILGRS sonar only destroys silicon eaters within fifty metres or so, and there are tens of thousands of kilometres of tunnels. Additionally, destroying the silicon eaters does not destroy their spores, which are tough enough to withstand vacuum and impacts at several kilometres a second. If anything it spreads them much faster than they would spread by themselves, since thousands are released for every eater that shatters! At first Ceres will feel temporary relief, but within a year or so the problem will be worse than ever, and much harder to cure.
- A better answer might seem to be something that attacks the silicon eaters chemically or biologically, if it doesn't simultaneously harm Ceres. The problem is the sheer size of Ceres; tens of thousands of tons of chemicals would be needed to make any significant change to the chemistry of the water, and all of its processes have evolved to maintain the status quo. They would be working to counteract any changes that were made.
- While there are organisms that could live under the conditions inside Ceres in the seas of Ganymede, none are particularly likely to want to eat the silicon eaters, and they would most likely be just as big a threat to the status quo as the silicon eaters themselves.
- The best answer can be found in the basic building blocks of their bodies, the silicon structures which function as cells. High power sound waves shake them apart, but they survive as spores. Radio waves of exactly the right frequency shatter the spores themselves, reducing them to harmless flecks of silicon oxide. This takes a lot of power, but Ceres has plenty to spare. Once a suitable frequency has been found it can "listen" to it and start to transmit it throughout its body, destroying the silicon eaters in a few hours. This will also damage electrical equipment if the SILGRS is inside Ceres, so it's probably best to wait it out. Realistically, this cure is most likely to be found as the result of a prolonged research project, long after the adventurers leave Ceres, but if the characters spend a lot of time on research and experiment on the silicon eaters, and it's made clear that they're trying a variety of approaches to the problem, a kind referee may let them come up with it while they're still on Ceres. By doing so they will earn the gratitude of a minor planet, which ought to be good for their careers!

Q: How do we get out of here?

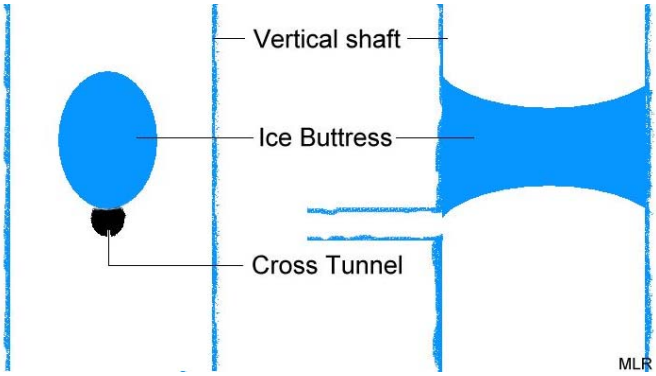
A: This is most likely to be asked if the adventurers have lost track of the route back to the surface, or an unkind referee has chosen to close the tunnels. Ceres doesn't know exactly where they are; basically, they're somewhere inside its peripheral nervous system, but that could be anywhere in more than a hundred million cubic kilometres of ice. If it's asked to come up with a better answer it can locate them by radio – but it doesn't have any detailed knowledge of the upper tunnels, that would be like asking someone to describe the precise layout of the capillaries in their skin. Tunnels are formed as they are needed, to maintain a steady supply of energy to the central core. Occasionally there are breaks in the surface; some are cracks, as in the crevasse that the adventurers used to enter Ceres, others are similar to geysers, triggered by unusual accumulations of toxic waste. There are occasional ice-filled shafts leading through the crust to the outer surface; autonomic processes concentrate the toxic waste in "cysts" then melt the ice and blast the material out onto the crust. This is rare, but by chance will be happening in about twenty hours; Ceres can feel a cyst forming in their approximate area. The adventurers may be able to get to it in time by following toxic waste carriers, the wormlike structures described above.

The next section assumes that this is how the adventurers get out.

Upwards and Outwards

Assuming that the adventurers haven't taken immense trouble to secure an escape route, the original entrance they used may now be closed off by several kilotons of ice. It might be possible to melt their way back to the crevasse, but doing so will put an enormous strain on the SILGRs, especially on the propulsion systems and anchors. Finding an alternative route may seem a better option, especially if you ask for a lot of skill rolls and describe a disappointing amount of progress and more damage with every failure.

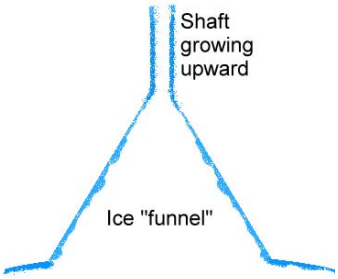
The first step towards finding an escape route is to find a cross-shaft that leads in the direction of the correct upward-bound shaft. There are lots of them, about one per kilometre of vertical shaft, but most lead to the wrong shaft. The entrances are below the bases of some of the broad ice buttresses that cross the vertical shafts. In the upward-flowing shafts they're above the buttresses. This makes them easy to overlook if you're travelling in the direction in which the current is flowing. The right one can be identified because dozens of the coloured "worms" are moving towards it, some swimming against the current to reach the entrance. UV light is needed to see this, of course.



If the adventurers follow them they'll find that the tunnel is just about navigable, although the steering fins will scrape against the ice occasionally. This won't do more than cosmetic damage unless the pilot rolls a 12 – if this happens a propeller blade replacement is needed, as described above.

In the next shaft there are a lot more of the "worms", but it isn't the right one either – after going another six kilometres upwards, the worms enter another side tunnel. This is narrower, and the side fins scrape on any failed Pilot roll, with blade replacements needed on 11-12.

The next shaft is obviously the right one – there are so many "worms" that the water seems to be constantly rippling, and the engines labour as the screws chew up their mucus-like "flesh." More can be seen flowing in at occasional cross tunnels. At the top of the shaft there's a wide opening leading into a conical ice chamber, a few hundred metres wide, like an ice "funnel" which is packed with the "worms." The top of the chamber slowly melts up into the ice as a vertical shaft about twenty metres wide, running first through ice, then eventually through rock, while the entrance of the funnel freezes closed below it, and below the submarine. The base of the funnel begins to solidify as ice, and the pressure begins to rise rapidly, although not enough to damage the submarine. Eventually the top of the shaft breaks through the surface of Ceres and everything inside is pumped out by the pressure, becoming a "geyser" of water vapour then ice crystals, which either evaporate or fall back to the surface of Ceres, along with the contaminants Ceres has eliminated; a few tons of various pollutants including arsenic, barium, beryllium and cobalt salts, and most of the rest of the chemical alphabet. There isn't enough of any one chemical to be worth salvaging.



- If the adventurers do nothing the submarine is blasted out at about 70 KPH, flies a few hundred metres, then crashes back to the surface. This is survivable if the adventurers are strapped down in their seats and wearing their spacesuits; the crash shatters one of the ports, and anyone without a suit starts to take damage from vacuum, anyone not strapped down also takes impact damage:
  Exposure to Vacuum, Effect 6+1/5 sec, A: F, B: I, C: C/K
  Impact, Effect 5, A: F, B: I, C: C/K

- If they run the propellers in reverse they can slow the ship to about 40 KPH; this will leave everyone shaken but uninjured if they were strapped down. There will be a slow air leak, rather than sudden decompression, giving everyone time to get their suits on. If they weren't strapped down they take impact damage:

  Impact, Effect 3, A: F, B: I, C: C/K
- If they used the anchors as well as reverse thrust they can ride out the initial geyser then release the anchors and float to the surface, without injury. The top of the shaft will start to freeze over after a few minutes, within hours it will be frozen solid to a depth of several hundred metres. This is probably the optional solution.

All of the above results leave the submarine on the surface about 12 kilometres from base camp, and easily recovered by the tractors. However, it's possible that they will instead decide to fire up the main engine and blast into space:

- If they try this while still in the narrow shaft there's a massive steam explosion behind the submarine, which sends the SILGRS into space but leaves it tumbling end over end until the pilot can make a Difficulty 8 skill roll to stop it, using some of the precious supply of compressed air in attitude control jets, then Difficulty 6 to get into a stable orbit.
- If they wait until the geyser has erupted only the latter roll is needed.
- If these rolls fail on 11 or less there is time to make more skill rolls, but Difficulty rises with each failure. If Difficulty passes 12 the SILGRS crashes as described below.
- If either roll fails on a natural 12 the SILGRS ploughs back into the surface of Ceres at high speed, with the occupants taking impact damage:

  Impact, Effect 10, A: F, B: I, C: C/K (Effect halved if they are strapped in)

  Additionally the occupants take damage from vacuum as above if they aren't wearing suits. The SILGRS is probably damaged beyond repair, and ends up on the surface 3D6 x 10 KM from base camp. Recovery will take several hours.
- If the SILGRS makes it into space it can be recovered by the support ship within 2D6 hours. This shouldn't be a problem if the adventurers added reserve tanks for this contingency; if not, they will need to put on space suits if rescue takes more than 6 hours, because supplies will be running out. This is inconvenient but not disastrous, and the submarine can be recovered and returned to the surface for subsequent expeditions.

Troubleshooting: If the adventurers don't take advantage of this escape route they will have to find another way out. Using their engines to melt their way back to the surface at their entry point is probably the best option, but it will be a difficult and uncomfortable ride, with the SILGRS getting hot as it is immersed in hot water, and food and other supplies running low by the time they find the crevasse and get out again. This means of escape does so much damage that Ceres' defences collapse all the tunnels in a radius of several kilometres; it will be virtually impossible to use this route to go back inside and continue exploration. It will also alienate Ceres, who will be aware of the damage that they are doing.

End Game

Once the adventurers have made contact with Ceres, they're potentially sitting on a scientific goldmine. All they need do is ask the right questions and keep Ceres interested. Of course it will help if Ceres isn't actually dying, which means that they need to come up with a good way of getting rid of the silicon eaters, as described above. One point to bear in mind is that Ceres has no grasp of the idea of being in a hurry; it thinks of its year, about 4.6 Earth years, the way that a human might think of a day or two. This means that it may not always be possible to get a quick answer. It also wants answers to questions of its own, such as the real meaning of hundreds of Morse messages it has picked up over the years; not just the

literal meaning of the words, it already knows much of that, but the context in terms of human life and society. Since many of the messages it has picked up relate to emergencies of one sort or another including shipwrecks, piracy, mutiny and war this may give it a rather dim view of humanity. It's also hungry for details of the other inhabitants of the solar system, especially the current status of its old friends the Martians. Once the Martians hear about Ceres they will want to visit their old friend; arranging that may end up as another interesting experience.

Meanwhile, the adventurers will undoubtedly want details of Ceres' life, evolution, etc. It doesn't always know the answers, especially when asked about its own origins; it thinks that it started out as random flows of water and electrical charges inside the asteroid, and gradually developed into a consciousness, but doesn't know for sure. It's willing to consider the idea of a creator, God, etc. but will not be easy to convince.

Once they've made contact the news will soon spread across the solar system, since Ceres' signals will be picked up on Mars and Earth. They will receive dozens of signals from the Smithsonian, the League, and other interested parties, ranging from requests for information to threats, begging messages, even bizarre proposals of marriage – addressed to Ceres! This process begins while the SILGRS is still under the ice, since Ceres needs to transmit very powerful signals to penetrate to its visitors; there is no question of hushing up the discovery. Some think that it's all a hoax created by the adventurers, others that they're in touch with an alien civilisation based inside Ceres; the idea that the asteroid itself is alive is difficult to grasp. This is, of course, a big problem if the adventurers started out looking for somewhere to hide, or planning to discredit the idea of life in Ceres, as described in some of the optional motives above.

Bonus Points

This isn't a particularly dangerous scenario, although there are moments when things can go badly wrong. Bonus points should be awarded for success or failure in making contact with Ceres:

- The adventurers learn Ceres is alive, but alienate it by causing damage 1 point
- Friendly first contact and Ceres is willing to keep talking 3 points
- The silicon eater problem was recognised and study has begun 2 points
- The adventurers tried a sonic solution but didn't spot the flaws -1 point
- The adventurers look for better solutions 2 points
- The SILGRS is wrecked -2 points
- Add individual bonus points for cunning plans, creative use of skills, heroics, making the referee laugh, and anything else that makes the game more entertaining.

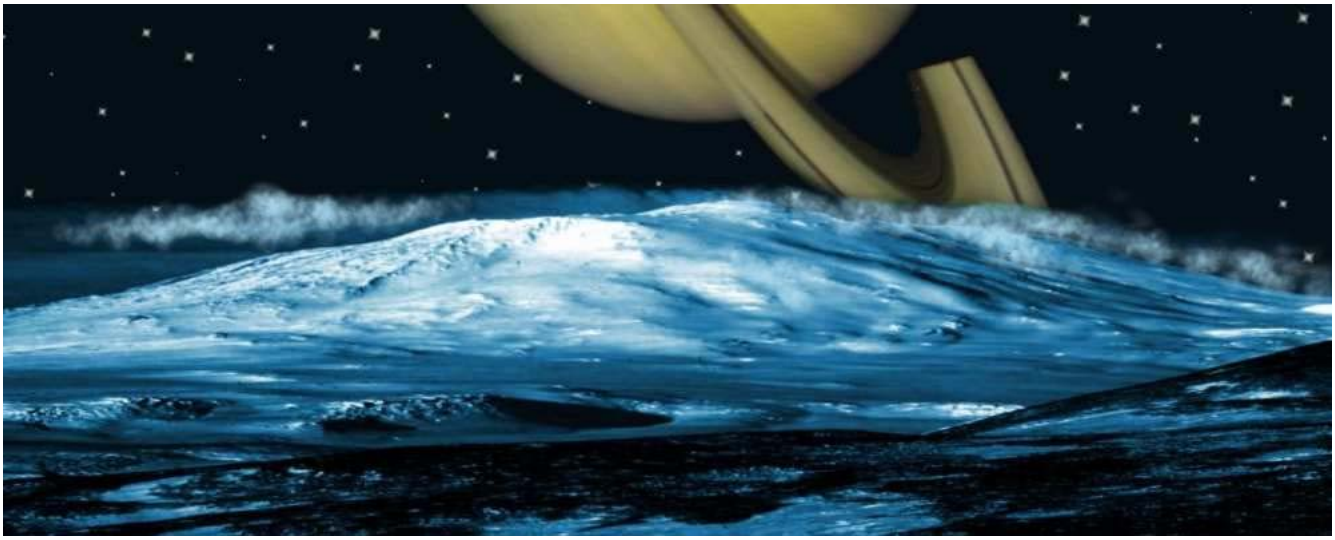
Notes

Ideas in this adventure were suggested by several sources, not least:

James White, *Major Operation* (1971)
Terry Pratchett, *The Far Side of the Sun* (1976)
Olaf Stapledon, *Star Maker* (1937)
Fantastic Voyage (Film 1966)
Sir Arthur Conan Doyle, *When the World Screamed* (1928)
Isaac Asimov, *The World Ceres*, science article (1972)
Jeff Barber and John Tynes, *Grace Under Pressure*, *Call of Cthulhu* adventure (1990)

For information on the real Ceres see Wikipedia's article and the Planetary Society web site:
http://planetary.org/explore/topics/asteroids_and_comets/ceres.html

The structure of the real Ceres may be much as described, although the ice layer is probably not as thick or complicated as in this adventure. Many thanks to everyone who suggested punning section names etc.; in the end I decided that two were probably enough.



Earth Girls Aren't Easy

WHEN the owner of Titan's largest gold mine dies under mysterious circumstances his daughter must return to Nivia, the City of Snow, to settle his affairs and unravel the mystery of his death. But Titan is a world of secrets, some of them lethally dangerous, and there may be problems...

Three months ago Sam Barton, owner of the Lucky Seven Mine in Nivia, died after the radium battery of his thermosuit exploded.

The incident is virtually unprecedented; most of the weight of a radium battery is armour and shielding designed to prevent such accidents. Barton's heir is his daughter Amanda, who was brought up by relatives after the death of her mother eleven years ago. Nobody is sure what she plans; will she close the mine and put a dozen men out of work, or find some way to revitalise the ailing business? Are the mines even relevant any more, when Titan flame-orchid gems are worth many times their weight in radium? And how will the arrival of a beautiful young heiress and her equally beautiful secretary affect the (mostly male) population of Earth's most remote colony? These and many other questions may or may not be answered in this adventure.

This scenario is designed for use with the melodramatic / romantic style of play, with the players running characters in a mystery set mainly in the "city" of Nivia (population 70). It's most suitable for use as a one-off game with the pre-generated characters provided, and has been run successfully at several conventions. It might also be used as a freeform game, although more characters would probably be needed.

The 'Grand Tour' Campaign

This adventure doesn't work well with the style of play and cast of the Grand Tour campaign described above, but it can be adapted as the background for a Grand Tour adventure, with the characters listed below used as NPCs.

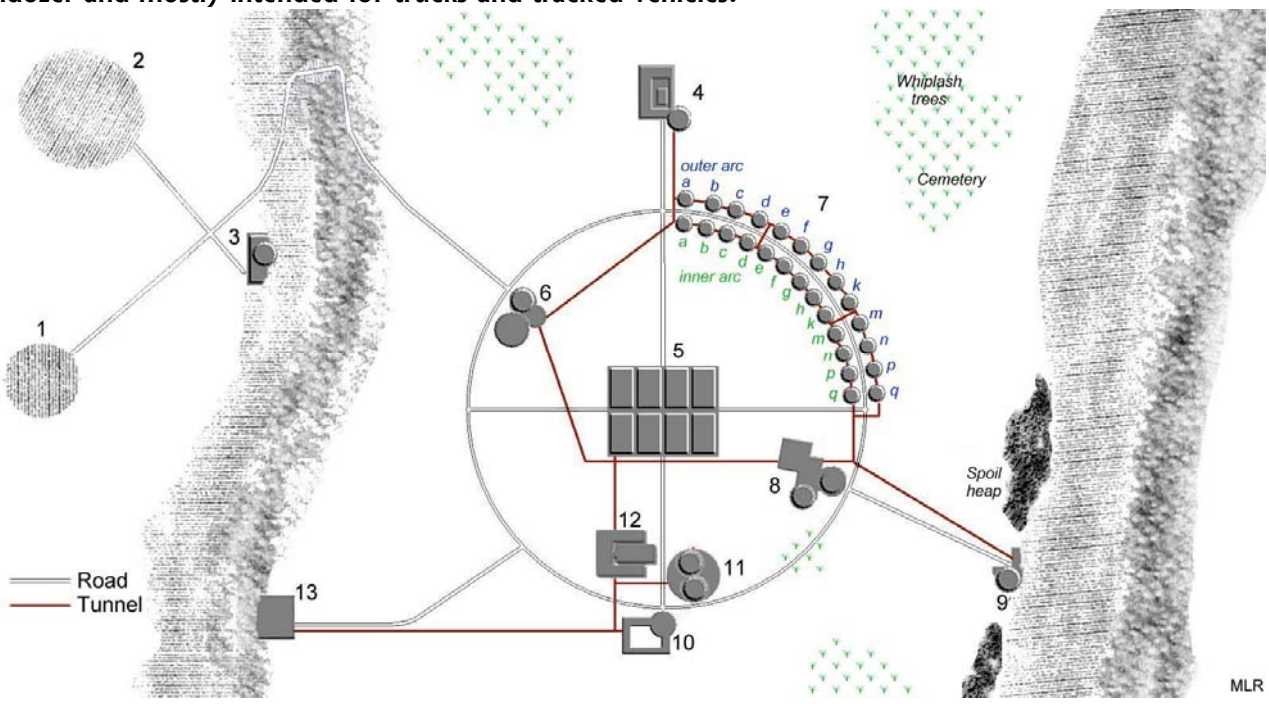
For this purpose the *Endeavour* has been sent to Titan on other business, which includes collecting spare parts which are to be delivered by the *Christiaan Huygens*, the liner which takes Amanda Barton to Titan. While waiting for the liner to arrive they'll hear all about Sam Barton's death, the impending arrival of his heir, etc. It doesn't appear to affect them personally, but Amanda will eventually appeal for help, having made sure that none of the adventurers were on Titan at the time of her father's death. Amanda hopes that her presence may shake loose a few answers; with League representatives around it might be possible to solve the mystery, and if the death is murder bring her father's killer to justice.

Nivia, the City of Snow

Titan is an American possession, with a total population of just over 100 excluding transients such as the crew of the *Christiaan Huygens*. Roughly seventy live in Nivia (the name is Latin for "Snow white"), the rest are traders and prospectors living in the wilderness, supplied by ferry rocket. The city is built in a valley in the upper plateau of the Mountains of the Damned, several thousand feet above mean ice level. To the east and west valley walls and rock ridges protect the city from the worst winds; the main slopes of the mountain are a mile or so further east and two miles to the west, several miles north and south.

While its name may seem a misnomer for a settlement with a population around seventy, American history has ample precedent for calling tiny settlements cities. The name is intended as a promise of things to come and a symbol of the colony's hopes for the future. Officially Nivia is an incorporated city governed by a mayor (actually a major since it is also technically a military base), twinned with Kodiak, Alaska, and the capital and economic hub of Titan.

Most buildings are constructed of native rock, with a minimum of materials shipped from Earth. Buildings rarely protrude more than one storey above ground, but may be dug down two or three storeys into the rock. They're linked by a network of "cut and cover" tunnels bulldozed into the ground and roofed over, carrying pedestrian traffic, pipes, and cables, and by some rough roads, also cleared by bulldozer and mostly intended for trucks and tracked vehicles.



The landing field has two cleared pads, one [1] normally used by the colony's ferry rocket, the other [2] by visiting ships. It's generally considered to be a dangerous landing site, with high wind speeds and snow the norm; there's a half-hour lull in the wind every seven and a half days, and visiting ships try to time their arrival and landing for that period. The ferry pilots are used to Titan's conditions and prepared to fly in anything short of a blizzard. The field has a warehouse and control tower [3] built into the side of the west ridge. On the other side of the ridge the main structures are the power plant [4], a food processing plant and hydroponic farm [5], the Iceberg Hotel [6], residential units [7], the hospital [8], the Lucky Seven gold mine [9], which also produces most of the copper used by the colony, the Mayor's residence and "city hall" [10], a shop [11], workshops [12], and an iron mine and small smelter [13]. Buildings etc. are described in a little more detail in later sections; briefly, they are utilitarian but the interiors are enlivened by occasional murals and other creative works of varying quality.

Titan's economy is based on gold and other minerals, scientific research, and support of expeditions to the outer planets. The recent recession cut funding for research, including exploration of the outer planets, and while the economy is slowly recovering the effects are slow to reach Titan.

There are no immediate plans to expand the city, but it's hoped that a domed park and a proper church and school will eventually be built. This will only be possible if there is some real economic growth. Fortunately the League plans construction of a Patrol base, to be used as a supply base and as a "springboard" for further exploration of the outermost planets; previous expeditions have done little more than stop on Titan to resupply, and contributed relatively little to the colony's economy.

A relatively new development is the Earth fashion for Titan flame-orchid gems, which has brought in dozens of newcomers, but does little for Titan's economy. The stones are still valuable, but the brutal fact is that hugely valuable gems only *remain* hugely valuable while they are rare. The first was sold for half a million dollars; now the average market price for a good sized stone is around fifty thousand and slowly falling. The gems are beautiful, but with so many traders trying to get rich it's possible that the market will eventually become saturated.

Trouble on Titan (Referee Only)

Titan's gold industry is in trouble; although the price of gold has risen a little since the economic recession began, the costs of mining it and getting it back to Earth have risen much more. Because profits were falling some investors began to sponsor flame-orchid prospectors instead of the mine, and Barton needed their money to buy equipment to expand the operation.

Barton's death was indirectly caused by the flame-orchid boom. For some time a few of the colonists have known that they can culture flame-orchids by placing fragments of a broken stone onto gravel found in caves on the Mountains of the Damned. It wasn't long before they got hold of the soil, and took a chance on smashing small gems to start their own production. They decided to conceal the news as long as they could, since flame-orchids could become worthless if it got out.

Barton decided to reveal the truth, hoping that if the flame-orchid boom ended there would be more investment in his mine. Unfortunately he made the decision while drunk, and while Titan was on the wrong side of Saturn for radio contact with Earth, and told exactly the wrong people what he planned to do; they both independently decided to eliminate the problem.

Mayor Williams plans to retire on the stones he has been cultivating; a soldier and demolitions expert, he found it easy to rig Barton's thermo-suit power pack to explode the next time it was exposed to cold, then warned Barton that there were signs of loose rocks on the ridge above the mine. Barton went out with three of his men to check the ridge, and was injured by the explosion and poisoned by debris that entered his body. That would have eventually killed him slowly, but another killer intervened.

Belle Nova, manager of the Iceberg hotel, is secretly a spy for a pirate gang, and has been tipping them off when cargoes of gold or flame-orchids are ready to ship to Earth. She realised that the stones would be worthless if the secret was revealed. When Barton seemed to be recovering she finished him off by smothering him with a pillow. So far nobody suspects.

Player characters include Amanda Barton and private eye Paula Gunn, both investigating the death; the killers, Mayor Williams and Belle Nova; and two others with an interest in the case, Doctor Grigori Hauser, who operated on Barton and isn't entirely sure how he died, and Dick Curtis, Barton's foreman and one of the witnesses to the "accident" that led to his death. The adventure should largely consist of their interaction; background details and some optional events are provided, but the players should make most of the action. If there are less than six players it's suggested that the referee should play Dick Curtis and/or Dr. Hauser and other NPCs. If there are more, some of the crew of *Endeavour* might be added.

This adventure is set a few years after the events of *Flight on Titan*, and the colony has grown slightly in the intervening years.

Andrea Walsh, secretary, age 23

BODY 4, MIND 5, SOUL 3 TRAITS: HEIRESS (DISGUISED) QUOTE: "*Should I take notes, Miss Barton?*"
ACTOR (PRETEND TO BE YOUR OWN SECRETARY) 5, ATHLETE (SWIMMING, CLIMBING) 6, BRAWLING 5, BUSINESS 7, MARKSMAN 6, PILOT (SPACESHIP) 5, SCIENTIST (GEOLOGY, MINEROLOGY) 6, STEALTH 4

You are really Amanda Barton, the daughter of Sam Barton, owner of the *Lucky Seven* gold mine on Titan. Following his death several months ago you have begun to suspect that he was murdered; the details that have reached Earth are so vague that you think someone is hiding something. Because you aren't an idiot you have decided to hire a professional to deal with it; private detective Paula Gunn, who is masquerading as you, while you pretend to be her secretary and will deal with any business or technical problems that arise. You're reasonably sure that nobody will recognise you; your father sent you to live with relatives on Earth after your mother died when you were twelve, and you've changed a lot since then, and you don't think your father had any recent photos. Paula actually looks more like you did as a teenager than you do! Together you've travelled to Titan in search of answers. You also need to make arrangements to ensure that the company can continue to operate without your father. The current recession has affected gold prices, and with the craze for flame-orchid gems you may need to raise wages, or some miners may decide to start trading with the natives instead of working for a living.

You are a romantic heroine; you pride yourself on your head for business, but can't deny that you sometimes let your romantic urges overcome your common sense. You yearn to be swept off your feet by Mister Right, and it hasn't escaped your attention that the population of Titan predominantly consists of unmarried young men. But you suspect that someone on Titan murdered your father. You will want to be VERY sure that Mister Right isn't Mister Wrong before you commit to him.

Relationships: You think of Paula Gunn as a friend and ally, but don't really know anyone on Titan any more. You vaguely remember Doctor Hauser, who wrote to tell you of your father's death, he gave you dozens of inoculations before you flew to Earth, but that's about all.

. 32 automatic, 4 clips bullets (fragmentation)
Thermoskin suit (protects against cold)
Portable typewriter, dictation recorder

Amanda Barton, heiress, age 23

BODY 5, MIND 4, SOUL 3 TRAITS: SECRET QUOTE: "*See to the luggage, and find out if there's room service.*"
ACTOR (DISGUISE, ASSUME FALSE IDENTITY) 6, ATHLETE (TRACK AND FIELD) 7, BRAWLING 8, BUSINESS 5, DETECTIVE 6, MARKSMAN 8, MELEE WEAPON 8, PSYCHOLOGY 5, STEALTH 6, THIEF (PICK LOCKS, POCKETS, ETC.) 6

You are really Paula Gunn, private detective, posing as Amanda Barton, daughter of Sam Barton, owner of the *Lucky Seven* mine on Titan. The real Amanda is travelling as your secretary, Andrea Walsh.

Following the death of her father several months ago she has begun to suspect that he was murdered; the details that have reached Earth are so vague that you both think someone is hiding something. She's hired you to investigate his death; since you think she might be another target, you've persuaded her to let you impersonate her. You think you stand a better chance of surviving an attack. Together you've travelled to Titan in search of answers.

One problem – you've never been off-world before, you're a little claustrophobic, and the pictures you've seen of Titan's natives aren't at all appealing. You also know little of the mining industry; if problems arise the real Amanda will have to handle them. You pretend to be the type of boss who makes her secretary do all the work.

You are a stereotypical private eye: your fists are quick (sometimes too quick) and you tend to meet problems with violence, not subtlety. It hasn't escaped your attention that the population of Titan is mostly unmarried young men, some of them owning incredibly valuable flame-orchid gems, but you're a cynic, and suspect that at best you might manage a brief fling before you have to leave or shoot someone. You will want to be VERY sure that Mister Right isn't Mister Wrong before you commit to anything more.

Relationships: You like Amanda, but she's primarily your client, not a friend. Remember that it's your job to protect her and investigate her father's death, and that you will be out a very large pay check if any harm comes to her. You don't believe you know anyone on Titan.

. 380 automatic, 4 clips fragmentation bullets, 2 clips Boland explosive bullets.
Lock Knife Effect 6, A:F, B:I, C:C/K Brass knuckles +1 Effect to punch
Thermoskin suit (protects against cold)

Dick Curtis, Mine foreman, age 32

BODY 5, MIND 4, SOUL 3 TRAITS: WANTED QUOTE: *"This part of the mine is dangerous, better stay clear."*
ATHLETE (MOUNTAINEER)_6, BRAWLING 8, BUSINESS 5, FIRST AID 5, MARKSMAN 6, MECHANIC 5, MELEE WEAPON 6, MILITARY WEAPONS (EXPLOSIVES) 5, STEALTH 3, THIEF 5

You are Dick Curtis (alias Arthur Gill, Terrence Cooper), former minor Chicago mobster. Five years ago you took it on the lam after a small accident; you accidentally boarded a rocket with $650,000 of your boss's money. By the time you'd spent most of the money the mob was closing in and you thought it best to move on; you heard that gold had been found on Titan, and parlayed some old union contacts into a mining job. A year later the stock market collapsed, wiping out your remaining assets on Earth. Fortunately you turned out to be a reasonably good miner, and were eventually promoted to foreman. As such you have a few nice little scams; most notably you have a pound or so of gold nuggets which the company will never miss, and nine flame-orchid gems growing in a box of rock dust in your refrigerator. They're worth a fortune on Earth, but if news that they can be cultured gets back they'll lose most of their value.

You saw the explosion that led to Barton's death. There are rumours that it wasn't accidental, and the news that his daughter will be on the next ship from Earth has you worried; you weren't involved in his death, but if there's going to be some sort of investigation you want to make sure that you won't be caught in the frame. It's time to turn on the old charm, make yourself as helpful as possible, and see what you can find out.

You are an anti-hero: Despite a shady past, the *right* woman may bring out the hero in you.

Relationships: You liked Sam Barton but thought of him as your boss, not a friend. You've never met Amanda, she left Titan long before your arrival; you're expecting a spoiled heiress. You've slept with Belle Nova but distrust her. Dr Hauser is a lush but a good doctor, Mayor Williams is an officious bureaucrat, but you don't know either well.

.45 automatic, 4 clips normal ammo, 1 clip Boland explosive bullets.
Jack Knife Effect 6, A:F, B:I, C:C/K
Thermoskin suit (protects against cold)
Access to mining supplies and tools

Doctor Grigori Hauser, Surgeon, age 55

BODY 2, MIND 5, SOUL 4 TRAITS: ADDICT, SECRET QUOTE: *"Ahh! I remember spring in Budapest..."*
BRAWLING 3, DOCTOR (SURGEON) 6, FIRST AID 8, LINGUIST (ENGLISH, GERMAN, FRENCH, RUSSIAN) 7, LINGUIST (MARTIAN) 2, LINGUIST (VENUSIAN) 1, PSYCHOLOGY 7, SCIENTIST (CHEMISTRY, BOTANY, TITAN ZOOLOGY) 7

You are Grigori Hauser, once a brilliant up-and-coming surgeon in Budapest, but now medical officer of the decrepit Titan base. our A patient died in Budapest because you operated on him while you were drunk. Now you believe that history may have repeated itself in Sam Barton's death – you don't remember doing anything wrong when you operated, but your memory of that fateful day is blurry at best, and he died just a few hours later.

There are other skeletons in your closet. In the early years of colonisation a supply shipment was lost, and food was running out. You improvised a way to process Titanian proteins to be edible by humans; unfortunately the only bulk source available was the semi-intelligent natives. You and the other survivors swore a vow of silence, but it's a very *loud* silence – everyone on Titan seems to know that something happened. Today the food factory can process Titan's plants for protein; you invented the technology, but would prefer its history to be forgotten. ***You are a tragic anti-hero,*** and would welcome an opportunity to atone for your misdeeds, even at the cost of your own life.

Titan's most valuable exports, flame-orchid gems, aren't as rare as everyone on Earth believes. They can be cultured by "planting" pieces of a broken gem in Titan soil. If the right chemicals are present new gems grow. If news of this reaches Earth their value will plummet. You have six roughly the size of acorns, worth tens of thousands, but that could change with a few incautious words.

Relationships: You just about remember Amanda Barton as a child; it will be interesting to see the woman. You have treated everyone at one time or another and know some secrets: the Mayor is a mild hexylamine addict, Belle Nova has twice contracted social diseases, Rick Deckard has bullet and knife scars. Naturally you would not dream of violating medical secrecy.

. 32 automatic, 4 clips bullets (fragmentation)
Thermoskin suit (protects against cold)
Medical kit, the resources of a well-equipped hospital.

Major Richard Williams (United Americas Army) age 45

BODY 5, MIND 4, SOUL 3 TRAITS: ADDICT, VILLAIN QUOTE: *"It was a terrible accident..."*
BRAWLING 7, BUSINESS 6, MARKSMAN 8, MELEE WEAPON 7, MILITARY ARMS 6, MORSE CODE 6, PILOT 7

You are Major Richard Williams, known to everyone as Mayor Williams, once a highly decorated soldier, now leader of America's least desirable colony. A none-too-discreet relationship with a General's wife led to your sudden "promotion" to this dead-end job, and there is little hope of a return to your old duties. These days you rarely even wear a uniform, and you command just six soldiers who mostly function as police. You have acquired a mild hexylamine addiction; if that ever comes out you might as well forget your military career.

The death of Sam Barton was an unfortunate necessity; Barton knew that there was little hope of investment in his mine while there was a craze for flame-orchid gems on Earth, and was planning to reveal that they can be "grown" in the right soil. That would destroy the market and leave gold as Titan's most valuable export; since you own eight large flame-orchid gems that wouldn't suit you at all. You killed him by sabotaging his Thermoskin suit; soon after he switched on its heating the radium battery exploded. For a while there you thought he might survive, but fortunately that didn't happen. He died, probably from heart failure, the following night.

You've heard that the passengers on the next ship will include Barton's daughter, who is presumably going to settle his affairs. You must do nothing to arouse her suspicions. After he died you searched his apartment, destroyed a draft report he planned to send to Earth, and took a large cultured flame-orchid gem from his office.

You are a melodramatic villain; as such you are destined to be caught! Your role in this adventure is to fail as memorably as possible, but if possible escape to be villainous another day!

Relationships: You've never met Amanda Barton or her secretary. Doctor Hauser is a lush, too drunk to be any sort of threat. You've slept with Belle Nova and don't trust her at all; she's a selfish money-grubbing bitch. Curtis was Barton's right-hand man and could be trouble.

.45 automatic, 4 clips normal ammo, 2 clip Boland explosive bullets.
Jack Knife Effect 6, A:F, B:I, C:C/K
Thermoskin suit (protects against cold)
Access to military weapons including explosives, flame pistols, machine guns, etc.

Belle Nova, "Hostess", age 27 (actually 39)

BODY 4, MIND 4, SOUL 2 TRAITS: SCARLET WOMAN, VILLAIN QUOTE: *"Just let me get more… comfortable."*
ACTRESS (SINGER) 6, ATHLETE (SEX) 5, BRAWLING 7, BUSINESS 6, MELEE WEAPON 7, MORSE CODE 7, THIEF 8.

You are Belle Nova (real name Bella Phelps, AKA Bella Graves, Belle Phillips), manager of Titan's Iceberg Hotel. You are a whore with a heart of flint; you won't do anything for customers without cash up front.

You have a few secrets; most notably, a long criminal record and your second job as a spy for one of the pirate gangs that plague the spaceways. You're not sure who you work for, there are too many intermediaries, but you suspect that it's Red Peri herself. You warn them of lucrative shipments heading for Earth; the pirates presumably do the rest. You know that two of the ships you reported vanished with some very valuable cargo.

Sam Barton told you that he planned to make flame-orchid gems worthless by revealing that they could be cultured. You knew that something had to be done to stop him. After he was fortuitously injured you sneaked into his room and smothered him with a pillow. You don't believe anyone knows how he really died.

The passengers on the next ship will include Barton's daughter, who is presumably going to settle his affairs. You don't want to arouse her suspicions. You're also expecting some movies from Earth, which you will show at the hotel. Some will be boring League "cultural" material, but you've paid to import a couple of money-makers.

You are a melodramatic villainess; as such you are destined to be caught! Your role in this adventure is to fail as memorably as possible, but if possible escape to be villainous another day!

Relationships: You've never met Amanda Barton. Doctor Hauser is an old lush, but he's harmless. He knows you sleep around; he's treated you for a social disease. Mayor Williams is a creep who expects a free ride. You've slept with Curtis but don't trust him; no way does a miner have that many bullet and knife scars. You think he might have been a soldier or mobster.

. 32 automatic, 4 clips bullets (fragmentation)
Radio transmitter (interplanetary range, concealed in your office)
Thermoskin suit (protects against cold)

Timetable

The only pre-determined events in this scenario are the arrival and departure of the liner *Christiaan Huygens*. She lands on Titan on October 1st, and starts to unload and refuel immediately. The optimum takeoff time for the return flight is one orbit later, on October 16th at 2.35 PM, with the window for a safe return to Earth October 14th to 18th. After that the next window is two days either side of November 26th; after that the ship can't carry enough fuel to reach Earth without exceeding safety limits, and the safest alternative is to fly via Ganymede. This is very much a last resort, and exceptional circumstances would be needed to make the ship delay even a minute past its scheduled takeoff time.

This is the only rigid time frame in this adventure; "Amanda" and "Andrea" are booked for the return flight, and will probably want to take it since it's the last ship for several months; apart from that, everything else happens as it is instigated by the characters, or in response to their actions.

Counting the passengers and crew of the *Huygens* there will be about eighty people in the city at the start of the adventure, with fourteen of the passengers heading off into the wilderness to seek fire-orchids over the next few days. Most of these treasure-seekers are single men in their twenties and thirties, with very little idea of just how hostile Titan can be. None of them impressed "Amanda" or "Andrea" as an appropriately eligible bachelor during the flight, and none have any relevance to the plot. The ship's crew will mostly be living aboard during their stay, apart from occasional trips into town on business.

Unless someone suggests other arrangements, "Amanda" and "Andrea" will probably want to stay in Sam Barton's home or the hotel.

Conditions on Titan

It's important to remind the players that the adventurers are not on Earth. Essentially, Titan is a more extreme climate than Antarctica, with a faster cycle of seasons as it orbits Saturn. In mid-"winter," ironically the time when Titan is at its closest to the Sun, the Sun isn't visible from Nivia and the temperature is "eighty below zero" (-80°F, about -62°C); in "summer" the temperature is a little above freezing. The *Christiaan Huygens* lands during the mid-"winter" lull, a period of about thirty minutes in which the wind slackens prior to changing direction. For most of the year anyone going outdoors without the full protection of a thermosuit will be dead in minutes; even in "summer" wind chill drops the effective temperature to 9°F, about -13°C. If the wind doesn't blow you away it will freeze you. Most people going outdoors rope up or travel in tracked vehicles. The xenon-rich air is dense, which affects the resonance of air in the human windpipe; voices sound deep and a little muffled.

Natives visit the city occasionally, apparently unaware of the fate that befell some of their ancestors. The natives in this area rarely have flame-orchid gems to trade – it's likely that they have already taken all that they can find. They often have other items such as stones carved to interesting shapes by the wind, mineral and vegetable samples, and so forth, which might be of interest to scientists or collectors.

On the surface it's easy to spot the route of the underground tunnels; the heat they release attracts ice-ants, and their domes follow the tunnel routes. They seem to have learned to avoid the roads, which are ploughed every few days. They're mostly harmless; there have been a few ice-ant incursions into the colony, but they don't thrive without snow and the fungi they prefer to eat, and are easily evicted. However, they will try to take anything organic left lying around, with a particular fondness for natural cloth (not synthetics), paper and leather. Despite this most colonists are rather fond of the little creatures, about the least dangerous species on Titan, and there have been suggestions that ice-ants should become Titan's "national animal," in the same way that the eagle was the national animal of the old USA.

Most of the other native animals avoid the area, or have been hunted out. Whiplash trees are the main vegetation; the food factory can process them if necessary. In a real emergency the ice-ants could also be processed, as could the fungus they eat, but this would be a last resort, trees are easier to handle.

Exploring the City

What follows is a brief description of the most important parts of the city, which referees may want to flesh out with more detail. Numbers in italics refer to the city map. All NPCs mentioned (such as radio operators, pilots, etc.) should be assumed to have BODY 3-5, MIND 4-5, SOUL 3-5 and whatever skills are required for their jobs. Names are given for many residents, but try to give the impression that there are others around who simply don't happen to be interacting with the adventurers. Many have multiple roles and duties; for example, the colony's police force are soldiers serving their tour of duty in America's most remote colony, and all have other jobs when the colony doesn't need police or soldiers. Adventurers may run into them in more than one role. The referee should be ready to brief players on parts of the city that they're associated with as needed; for example, Belle's player probably needs to know about the hotel's facilities, the movies expected, etc. The exact internal layout of buildings is not important; referees should invent details as they wish. All buildings are linked by telephone.

Landing field: Several square miles of rocky ground, with two landing pads *[1,2]* cleared of boulders, and cleared of snow before ships arrive. The facilities are good, with landing lights, radio aids, and a control tower *[3]* equipped to "talk down" ships in bad weather. The tower has storage and fuelling facilities, and can provide a good grade of powdered iron ore or a somewhat poorer grade of copper ore for radium engines; salt is not available in bulk, but that's not a problem since ships with uranium blasts probably couldn't make such a long trip anyway. The tower also houses Titan's main radio station, which has the range to reach the inner planets. The smaller landing pad is mostly used by the colony's ferry rocket, the *Opis* (named for Saturn's wife in Roman mythology). It's a rugged general-purpose craft able to travel to any part of Titan's surface with a few tons of cargo and passengers, equipped with underjets and wings for prolonged horizontal flight, but doesn't have life support (beyond a heater to keep the compartments warm) or the "legs" to reach the other moons or go further afield. There is always a radio operator on duty in the tower, listening out for messages from the other planets, distress calls, etc.

The tower is also the colony's weather station and local radio station, and the duty operator plays music wires and reads occasional news and weather bulletins on the rare days that the weather isn't completely predictable. The music is an eclectic mix; basically everything that has ever been shipped out gets played over and over again regardless of its nature or quality.

Harold Plumb	Radio operator, Army Corporal
Patrick Satterwhite	Radio operator, Meteorologist
Arthur Gaskill	Ferry Pilot, Engineer
Jeff Spector	Engineer, Driver, Army Sergeant
Joe Bolden	Warehouse manager, Army Corporal, Driver

Power Plant: The city gets its power and much of its heat from a small radium blast *[4]* burning few pounds of iron or copper ore a day. The exhaust heats water to drive a steam turbine and (via heat exchangers) warm the city. The equipment is kept manned in case of accidents or breakdown, but hasn't given serious problems in several years. Fuel for several weeks is kept on site, topped up as needed. One of the technicians will be leaving with the *Huygens*, which brought in his replacement:

Jacob Caro	Power plant technician, Cook
Gregory Weatherspoon	Power plant technician, Army Corporal; tour complete, leaving aboard the *Huygens*
Kenneth Magee	Power plant technician, Lay preacher (Baptist)
Sean Bauer	Heating engineer, Plumber

Food Factory: Titan is at the end of a long supply line, and several ships were lost in the early days. The colony survived partly by strict rationing, and partly by processing Titan life forms to make them edible (although unpleasant to eat). The colony now has a food factory *[5]*, which processes Titan's plants and animals to remove arsenic; in the early days of the colony this material was eaten by humans without much further processing, but it is now converted into much more palatable (but somewhat bland) food concentrates, or used as feed-stock for a new hydroponic farm. The farm produces staples such as rice and edible algae, and recently introduced several species of fish and crayfish. The farm is also the colony's sewage processing plant. Visitors expecting to see giant greenhouses will be disappointed; given Titan's distance from the sun it makes little sense to use sunlight for the plants, instead the farm is illuminated by banks of daylight fluorescent lights, and the roofs and walls are thick featureless slabs to conserve heat. One aspect of the operation should be mentioned; the factory produces nearly all of the beer and hard liquor on Titan, apart from rare and extraordinarily expensive imports. It's drinkable, but that's about all that can be said for it.

Nicholas Mcfarland	Hydroponics technician, Administrator
Jacob Potts	Chemical engineer, Ecologist
Jacob Beene	Chemical engineer, Hydroponics technician
Margarita Beene	Hydroponics technician, Typist, Photographer

Iceberg Hotel: Titan's only hotel and bar *[6]* has accommodation for 20 guests. Most of the time it's nearly empty, though the bar is busy most evenings. Obviously the economics of the business make little sense; it's heavily subsidised by the American government so that visitors will have somewhere to stay, and residents will have somewhere they can let off a little steam. The manager, Belle Nova, employs a part-time barman and (when busy) a part-time cook and housekeeper. The bar has a music wire player and card tables. There's a larger "ballroom" used for occasional social events such as parties and public meetings, amateur dramatics and for movies when films are delivered from Earth. The *Christiaan Huygens* has seven movies aboard, four provided by the League as part of its cultural unification program, one by the American government for similar reasons, and two ordered by Belle:

- *News Review* – a two-hour newsreel summary of the most recent news from Earth and the other planets up to a day or so before takeoff. It includes events on Earth, Venus, Mars, and the moons of Jupiter. If the adventurers have been in the public eye on any of these worlds it may be mentioned. The tone is generally upbeat; for example the financial news minimises the effects of the recent depression and concentrates on the economic recovery. Provided by the League.
- *Gold Diggers of 2115* – The latest smash hit musical, considered a significant cultural event in its inclusion of music from a dozen Earth nations, and an amazing zero-gravity dance routine. Provided by the League.
- *Romeo and Juliet* – The Royal Shakespeare Company's critically acclaimed production, set on Ganymede and featuring a mixed Human / Nympus cast. Provided by the League.
- *Family Fun* – a compilation of eight short animated films from studios in several nations featuring Micky Mouse, Donald Duck, the Road Runner, a Russian folk tale, and others, plus three episodes of the ever-popular serial *Planet Patrol*, based on "real adventures of the men and women of the League of Nations Patrol." Provided by the League.
- *America Today* – Similar to *News Review*, but concentrating much more on events inside the United Americas, and generally emphasising America's role as the most powerful nation in the Solar System. Provided by the American government.
- *Bon Baisers de Vénus (With Kisses From Venus)* – A romantic comedy, in which the goddess Venus assumes human form and travels from her world to Earth by stowing away on a freighter, wreaking havoc aboard ship and in Paris. Includes risqué situations and nudity, banned in Rome, Cleveland and Chicago. French with English subtitles. Ordered by Belle.
- *It Came from the Red Spot!* – SF / horror, in which a small isolated colony strangely like Nivia (the film uses stock newsreel footage of the city) but allegedly on an unnamed moon of Jupiter is menaced by hideous man-eating blobby monsters. Ordered by Belle.

Films provided by the League and the American government are supplied free of charge and are supposed to be shown with a minimal admission charge, just enough to cover expenses. Belle has somehow determined that this is $1.50 per movie. She charges $5.00 for the "premieres" of the two films she has personally ordered, $2.50 for subsequent showings. All films are shown several times. The two films Belle has purchased are her property; the others will be added to the colony's library.

The hotel has twenty rooms on two levels below the lobby; two six-room dormitories on the lower floor, with two shared bathrooms, and four double rooms with bathrooms on the upper. Belle also has an apartment on the upper floor. The rooms are moderately comfortable but expensive – a dormitory bed costs $5 a night, the double rooms cost $20 a night. Meals aren't included in the prices, of course. The hotel is utilitarian but more or less comfortable; all of the furnishings are getting a little old and shabby, but given the cost of shipment from Earth it's doubtful that anything will be done about it any time soon. There have been attempts to use the wood of whiplash trees for furniture, but it contains too much arsenic for safety.

Since most people visiting Titan stay longer than the turn-around time of a ship, the hotel is usually a temporary home for visitors who will eventually occupy apartments or venture further afield in search of flame-orchid gems. The hotel will be crowded for the first few days after the *Huygens* lands, then only three guests will stay on until accommodation is prepared for them.

Staff:	
Belle Nova	Manager
Brian Bentz	Barman, Mechanic
Melody Bentz	Part-time Cook / Housekeeper, Librarian
Guests:	
Mark Bowles	Power plant technician (Starting work at the city power plant)
Dennis Peterman	Engineer (Starting work at Titan Iron Inc)
Eric Felton	Dentist, Anaesthetist (Starting work at the hospital)

Residential Units: While it would be most practical for the colonists to live in a single structure with dormitories etc., that isn't the American way. Nivia was planned with the idea of it being a "small town in space" and so it has a street of "houses" *[7]*; basically underground four-room apartments. Buildings are identified by their side of the road ("inner arc" and "outer arc") and a letter. Roughly three-quarters of the apartments are occupied; most of the others are unfurnished shells which will be completed as the colony expands. Amazingly, despite the standardization of accommodation there is already some snobbery about addresses; inner arc apartments are regarded as more desirable. They are mostly occupied by more senior personnel.

Sam Barton lived in Inner Arc P; it has not been cleared since his death. See below.

Doctor Hauser lives in Inner Arc M but also has a small apartment at the hospital, used when there are patients.

Dick Curtis lives in Outer Arc H

Outer Arc D is currently used as the colony's school, with eight students aged 5-14 (younger children go to the crèche in the back room of Honest Jeff's Emporium *[11]*, older children are usually sent to Earth to attend high school and college). The children are taught communally, with the older children helping the younger. Despite relatively poor facilities the school's results are good, with most of the colony's adults helping out as needed; for example, science lessons often visit the food factory, crafts classes are taken to the workshops, etc. Any visitors from Earth who call in at the school will be subjected to a barrage of questions.

One of the students, Mildred Bentz (age 14), will be travelling to Earth aboard the *Huygens*. Since she has never been exposed to many Terran diseases she is undergoing a long series of inoculations and usually looks somewhat swollen. Female characters travelling to Earth on the *Huygens* may be asked to keep an eye on her, since she will be travelling alone – her parents can't afford to make the trip.

Craig Stack	Teacher, former soldier (mustered out on Titan in preference to returning to Earth)
Mamie Skipper	Teacher, Artist (has sold several pictures to galleries on Earth), engaged to Craig Stack

The Hospital: In view of Titan's isolation anyone who is injured or becomes ill must be treated there. Nivea's hospital *[8]* is as close to state of the art as it can be, but lacks the support a hospital on Earth would be able to get from other hospitals and specialised medical laboratories. Facilities include a well-equipped examination room, X-ray and dental equipment, four wards for a total of up to twelve patients, and a good general-purpose operating theatre. There's also an impressive medical laboratory complete with autopsy room and a small morgue. The hospital's main limitation is personnel; Hauser is the only doctor on Titan at present, and there is only one nurse, who will have problems coping if there are more than a handful of patients. There has been no dentist for the last eighteen months, and Hauser isn't a good substitute, but a replacement, Eric Felton, arrives with the *Christiaan Huygens* and will be taking care of a backlog of cases. Several other colonists have first aid training, and can help with patient care in the event of an emergency.

At the time the *Christiaan Huygens* lands the hospital has no patients. Sam Barton's body is on ice in the morgue, pending the arrival of his daughter and a proper funeral.

Dr. Grigori Hauser	Doctor, Biologist, Chemist
Dr. Eric Felton	Dentist, Anaesthetist
Jeanette Aleman	Nurse, Laboratory technician

The Lucky Seven Mine: This is Titan's only gold mine *[9];* in view of rising shipping and insurance costs and the current obsession with flame-orchid gems nobody is putting much effort into finding gold elsewhere. It actually produces a ton or so of copper ore and several tons of rubble for every few ounces of gold; fortunately the grade of the copper ore is generally acceptable for use as radium blast fuel, though occasional batches assay too low in copper to be suitable. Some of the richest ore is sent over to the iron mine *[13]*, where it is processed to extract pure copper. Waste rock is dumped on the surface north and south of the mine, and spoil heaps now stretch several hundred yards in each direction.

The mine currently consists of three levels of low-ceilinged tunnels, excavated with pneumatic drills, following the seam of copper ore north and south along the eastern ridge for several hundred feet. To the north the quality of the copper ore and its gold content are slowly deteriorating, to the south they are unchanged.

Surface installations include rock crushing machinery and equipment for separating the ore (and especially the gold) from worthless rock, plus an office, canteen, showers etc.

All of these tunnels and facilities are heated, lit and powered by the mine's radium power plant. This is now inadequate for the total size and power requirements of the mine, so additional power has to be purchased from the city.

Amanda Barton needs to make several decisions about the future of the mine:

- Should excavation continue to the north, or is it time to cut losses and concentrate on the southern tunnels? Shutting down the north tunnels would save on heating power etc., but the ore is far from exhausted, it's just not as good as the ore from the south. Once the tunnels are shut down they will slowly become unsafe, unless money is spent to keep them intact.
- Should another radium power plant be purchased (a high one-off expense), or would it be better to rely on the city power plant (a continuing expense)? Assuming that city power prices don't change, buying another radium power plant will pay for itself in about six years. Investors will be needed to pay for it, of course.
- Above all else, who is going to run the mine? Sam Barton ran everything himself and didn't have a deputy. Dick Curtis has done a reasonable job of keeping things going, but he isn't a businessman and the paperwork is a mess. Amanda could stay and run things, of course, but that isn't what she's planned for her life. It might be possible to recruit a suitable manager from the colonists, or hire someone on Earth, but decisions need to be made.

Only the last of these decisions is immediately important, the others are much more long term problems, and there may be big changes if a League base is built, but they should be mentioned to make it clear that the mine isn't just a source of wealth that runs without any input from its owner.

In the list of personnel below a star indicates a witness to the death of Sam Barton:

Dick Curtis	Mine foreman *
Alan Ray	Miner, Driver *
Frank Husted	Miner, Electrician
Justin Almeida	Miner, Explosives expert, Army Sergeant *
Philip Garay	Miner, Mechanic
Sean Bills	Miner, Plumber, Army Corporal
Shawn Swindell	Crushing machine operator, Mechanic
Steve Yoshida	Crushing machine operator, Electrician
Jennifer Turner	Cook, Typist (Sam Barton's mistress, will not advertise the fact)

City Hall: The colony's administrative centre, police station, army base, etc. *[10]*, and Mayor Williams' residence. Facilities include Williams' home (a larger and slightly more luxurious version of the apartments used by others), his office and those of his secretary and a couple of clerks, a two-man police "precinct" with two cells for prisoners, an armoury for the colony's soldiers (weapons include flame guns and cannon, machine cannon, blasters, etc.), and an automated telephone exchange. There's also a small hall used as a court-room and for occasional ceremonies such as weddings, although the ballroom of the Iceberg Hotel is generally more popular. It doubles as the colony's public library, with a collection of a few hundred books on paper and about twenty thousand on microfilm, and a hundred or so movies. Movie shows at the library are free, but the films tend to be older and less popular than the newest imports, which get their first showing at the *Iceberg*.

Bobby Calton	Clerk, Army Corporal
Andrew Paradis	Clerk, Army Private
Susie Cullen	Secretary, Accountant (engaged to Earl Toomey)
Raymond Olivera	Police / Army Sergeant, Librarian (see Police Enquiries, below.)
Randy Winn	Police / Army Corporal, Mechanic
Earl Toomey	Police / Army Corporal, Driver
Jason Mcphee	Army Sergeant (armourer), Electronics engineer

Honest Jeff's Bank and Emporium: Titan's only shop and bank *[11]* offers a wide range of products, both new and second-hand. Some are imported from Earth; most new items are manufactured or grown locally. It's the place to go if you need some ammo for your gun, a radium battery for your Thermoskin suit, an example of native carving, some ration packs, trade goods, second-hand prospecting equipment, etc., or want to cash a check. Jeff also buys books and operates a fee-paying lending library, concentrating on paperback thrillers etc. rather than the more "worthy" works at the public library. It's the most likely place to encounter natives in the colony, they're always keen to trade for "valuables" such as pocket knives, beads and mirrors, and Jeff keeps a large stock. His wife Louise helps with the store and runs a small crèche for the colony's handful of children under five. They also operate a small printing press ("no job too big or too small") although paper is fairly expensive, and publish Nivia's weekly newspaper, the *Titan Times*. Issues are typically 4-6 sides of pulp paper, a by-product from the food factory, contents include news (local and from the rest of the solar system), announcements, fiction, poetry, a crossword, etc.

Their son Gary helps out with the store, but will be travelling to Earth on the *Huygens* to attend high school and college. He is fifteen, and left the colony school a few months ago to work with his parents and await passage to Earth. He is undergoing a series of inoculations against Earth diseases.

Jeff Elwell	Trader, Printer, Handyman, Reporter, Banker
Louise Elwell	Trader, Baby-Sitter, Crossword compiler, Volunteer nursing assistant *
	* On volunteer duty at the time of Sam Barton's death; see next section
Gary Elwell	Teenager, Printer, Photographer

Workshops: Titan needs to be as self-sufficient as possible. The workshops *[12]* were set up to reduce dependence on goods imported from Earth, and are equipped with a comprehensive range of tools and components, from simple lathes and drills to a comprehensive electronics suite, a glass-making furnace, etc. They're usually busy, since Titan's harsh conditions are very hard on equipment. They also produce a wide range of domestic items, furnishings, plumbing fittings, etc., with a large library of specifications and diagrams on microfilm. Unusual care has been taken to limit the variety of spare parts needed by the colonists; for example, all vehicles approved for transportation to Titan must be built so that at least ninety percent of components and spares (such as nuts and bolts, headlight lamps, etc.) are manufactured to standardised patterns or can be manufactured on Titan using existing facilities. This raises the cost of vehicles, but a 200% price hike is nothing compared to the cost of exporting a wide range of spares that won't fit anything else. Some manufacturers have described these restrictions as "un-American" in stifling competition, most accept it as a necessary part of business.

The workshops have a staff of five, and facilities are available to anyone who needs them for nominal fees.

Joe Braithwaite	Smith, Metalworker, Mechanic
Fred Benjamin	Metalworker, Welder, Glassblower
Allen Bolden	Mould-maker, Plastics fabricator
Emily Bolden	Electrician, Electronics technician (Allen Bolden's sister; engaged to Danny Keyser)
Danny Kyser	Watchmaker, Camera repairer, Jeweller

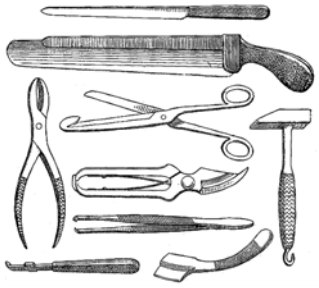
Titan Iron Inc.: Nivia's second mine *[13]* taps a large deposit of magnetite, a mixture of iron and quartz, estimated at several hundred million tons. Geologists have yet to explain why two dissimilar lodes of ore are so close together; it's presumably a peculiarity of Titan's crust formation. Since most of the ridge is made of the ore, mining is a very simple process; the rock is blasted to reduce it to large "chunks" about the size of footballs then bulldozed to the crushing machines. The ore is crushed repeatedly then the iron is separated magnetically. Fuel grade ore omits this final separation stage.

Once purified the iron is used to make various grades of steel. The current equipment can make about a ton a day, more than the colony needs. If plans for a League base go ahead a larger processing plant will be built, capable of manufacturing five or ten tons a day. At the moment some of the plant's spare capacity is used to refine copper ore from the Lucky Seven mine, a batch of a ton or so every couple of weeks.

One possibility that might be considered is a merger of the two mining companies, so that personnel and expertise can be used where most needed; Peter Kershaw has an excellent background in the industry and could easily manage both mines, and they are already working together on matters such as copper refining. This would require consultation with Titan Iron's board of directors on Earth, but could probably be agreed. The precise terms would need considerable negotiation, but would probably amount to buying out Amanda and giving her a large cash payment, a seat on the board, and shares in the new expanded company. Amanda does not have the resources to do things the other way. Titan Iron currently makes less money but the owners operate several other mines, on Earth and other worlds, and see it as a long-term investment that should pay off very nicely if a League base is eventually built. Kershaw might suggest this if Amanda seems to be unsure how to proceed.

Peter Kershaw	Mining engineer, CEO
Melissa Braithwaite	Secretary, Volunteer nursing assistant (Wife of Joe Braithwaite, see above)
Harold Beecher	Mine foreman, Explosives
William Thomasson	Mechanical engineer (returning to Earth with the *Christiaan Huygens*)
Stephen Carter	Bulldozer driver, Ore crusher operator
Peter Ryles	Bulldozer driver, Ore crusher operator
Michael Thurston	Furnace operator, Metallurgist
Damon Reinhardt	Mechanic, Crane operator

The Body in Question



Sam Barton's death has consequences; depending on their interests, the adventurers may want to investigate (or cover up) the circumstances, arrange a funeral or a wake, settle his affairs, etc. They might even want to arrange some sort of public enquiry to look into the death; if so, Mayor Williams would normally be the chairman.

How was Barton Injured?

The first person asked is likely to be Dick Curtis; if he is being run as a player character give the player this summary, otherwise the referee should use it:

> The day Sam Barton was injured you were getting ready for your shift when Barton called you into his office and said that he wanted you, a driver, and another hand to come outside with him to take a look at the ridge above the mine, where there were some loose rocks. You got Alan Ray and Justin Almeida, and met up with Barton in the garage. The ridge is steep above the mine, so you had to drive a mile or so north, cross it, then come back and work your way up the gentler slope on that side. When you got there you couldn't see any loose rocks, but Barton had you rope up to prevent anyone being blown away by the 100 MPH wind, then you all went out to check the slope.
>
> It was difficult to talk because of the noise of the wind, but you remember Barton saying something about his Thermoskin suit being too hot. You think he touched the temperature control, as he did so there was a loud bang and he collapsed, with a big hole in his side where the suit's battery had been. He lost a lot of blood, but you packed the wound with ice crystals to freeze it and stop the bleeding, and got him to the hospital as fast as you could. Alan nearly wrecked the truck going down the ridge.
>
> Barton was still alive when you got him to the hospital, and everyone thought for a while that he'd pull through, but he died that night.
>
> *Answer these questions if you are asked, but don't volunteer the information:*
>
> **Who told Barton about the rocks?** You don't know.
>
> **Why did you pick Ray and Almeida?** Ray was the only driver handy; everyone else was off shift or down the mine. Almeida does most of the explosives work for the mine; if there were rocks to clear he'd be the man to do it.
>
> **Why do you think Barton's battery exploded?** You don't know, but Almeida thought that it must have been sabotaged. Radium batteries just *don't* explode accidentally; half of the weight is safety mechanisms.

Almeida will probably be the next person questioned; he tells much the same story, but in his own words, and with enough differences to make it seem likely that both men are describing real events, not a story they've concocted. The same applies to Ray.

If Almeida is asked about the explosion, he'll confirm that radium batteries *can* explode, but there are safety mechanisms which should have stopped it from happening. It's possible to sabotage a battery to make it explode as an improvised blaster (nuclear grenade), he's done it as part of his army training. The explosion was small, but sometimes that happens. They were lucky it didn't kill all four of them.

If he's asked if there's any other reason to think it might have been sabotage, he'll mention that the sabotage technique he was taught would have made the battery put out extra power before it exploded, which might explain why Barton felt too hot; there would be too much power going through the heater circuits. The suit was radioactive after the explosion and would have been destroyed, with other radioactive waste, at the power plant.

If anyone checks, the suit was destroyed a few days after the accident. Standard procedure is to put such waste into an atomic blast, where it is reduced to elementary particles.

Cause of Death

Barton was treated by Dr. Grigori Hauser and Nurse Janice Aleman. If Hauser is run as a player character, tell the player that he took a few notes which summarise his memories of events:

10.15 AM – Sam Barton brought in with severe injuries to back (nr. Left kidney) caused by radium battery explosion. Wound treated in field, packed with ice (kidney frozen), highly radioactive. Administered morphine, excised metal shards, cauterised blood vessels. Unable to retrieve all of the radium fragments, prognosis poor.

12.45 PM – L. kidney too badly damaged for recovery, Must excise to prevent spread of necrosis.

2.10 PM – Excision apparently successful, Barton appears to be making a good recovery from surgery, has V. strong constitution. Still abnormal levels of radiation detectable, but encouraged by progress. Barton significantly radioactive, all personnel must wear protective clothing.

5.40 PM – Patient conscious, but very weak. Attempted to explain his condition, not sure he understood.. White blood cell count low; temperature very high. Administered morphine, febrifuge and anti-emetics.

7.30 PM – Barton apparently stable, sleeping. Long term prognosis now dependent on amount of radium absorbed.. Nurse to administer iodine tablets at 3-hourly intervals. NO VISITORS!

8.00 PM – Nothing to do for Barton immediately - will visit Elwell and Bentz families for inoculations postponed from afternoon. Everyone very concerned about Barton, of course, tried to reassure them that there was still some hope of recovery. Unlikely, of course, but he might pull through.

10.25 PM – NO change in Barton's condition. Will attempt to do more for him tomorrow. Janice on duty until midnight, then Loise Elwell has volunteered. Ordered hourly check of condition.

4.05 AM – Called by Louise – Barton died in his sleep, ETD approx 3.15 AM. Autopsy later.

10.30 AM – Unable to determine proximate cause of death; assume cumulative effect of injuries too much for him. Daughter should be notified. Body stored pending funeral arrangements.

In layman's terms Hauser treated Barton for his initial injuries (a large wound damaging his kidney), removed the kidney because it was badly damaged and would decay if left in place, attempted to remove shards of radium left from the battery but couldn't find all the pieces, then tried to use palliative treatment (painkillers, anti-nausea drugs, and fever-reducing drugs) to keep him from suffering too badly. He left Nurse Aleman in charge, while he went to inoculate two teenagers who will be travelling to Earth on the *Huygens*, then tried to get some sleep. Barton died later that night, but Hauser is unsure of the precise cause. The body is still on ice at the hospital.

What this account doesn't stress is that he left the hospital for more than two hours, while the inoculation would have only taken a few minutes at each family's home. While he was out he visited the hotel and had several drinks; that's where "everyone" was concerned about Barton's health. He came back drunk, and went to bed without examining him closely.

None of this explains precisely why Barton died – although he was likely to die, the radiation should have taken several days to kill him.

In fact Hauser's drunkenness made no difference to Barton's death. The hospital is short-staffed, so if a patient needs to be watched overnight volunteers help out. Janice Aleman was on duty until midnight, then Louise Elwell (see **Honest Jeff's Emporium** above) took over, checking Barton's condition every hour. She found him dead at 4.00 AM, and immediately called for Aleman and Hauser. If questioned, there was nobody else around when she found him dead. Hauser estimated that Barton had died about forty-five minutes earlier, but that was a rough approximation; it could be anything between thirty minutes and an hour before the body was found.

If Janice and Louise are questioned about visitors or intruders, Janice will say that several of Barton's friends came by during the evening, but were turned away without seeing him; she remembers Kenneth McGee from the power plant (a lay preacher who came to pray for him), some of the Lucky Seven miners (she can't remember exactly who), Dick Curtis, Belle Nova, Mayor Williams, Jennifer Turner (Barton's typist and occasional mistress, although that isn't generally known), and Jeff Elwell, who was writing a story about the "accident" for the *Titan Times*.

If questioned, all of the above have some good reason to want to see how Barton is getting on (Belle and Mayor Williams may have to lie a little). Two have additional information if questioned carefully:

Jennifer Turner won't readily admit that she was Barton's lover, but months later she's still visibly upset. Careful sympathetic questioning will reveal that she and Barton might have had a "thing" for a while, but she tries to pretend that it never went much past a few kisses. She's lying, of course, but not for any nefarious reason, she just wants to protect her reputation. She does have one interesting item of information, but won't remember it unless she is questioned at length about the events leading up to Barton's death – the morning of the explosion, the Mayor phoned Barton. She doesn't know why.

If the Mayor is an NPC he has a simple explanation; he was working on the annual budget and wanted to ask a few questions about the mine's use of power, water, etc. Barton said he would call him back, but he was injured first. If he is being run by a player, the player will presumably come up with an excuse.

Kenneth McGee was present from the end of his shift (a little after 9 PM) until about eleven. He saw Hauser return from his "out-patients" at about 10.15 but doesn't think that he then spent much time examining Barton: "He must have been in and out in a couple of minutes." If Hauser has been lying about the care he gave to his patient this will expose him; if not, all he need do is say that Barton was asleep and looked too ill to disturb. It's a red herring, but nobody (not even Hauser) knows that for sure.

There were no witnesses to Barton's death. Belle Nova sneaked into the hospital and suffocated him with a pillow while Louise was changing out of her protective clothing after the 3 AM check. She guessed (correctly) that Barton's nurse would check his condition exactly on the hour, but wouldn't want to be exposed to radioactivity any longer than absolutely necessary, so wouldn't stay in the ward.

At the time of his death there was no obvious reason to suspect that he was suffocated; everyone expected him to die anyway. Hauser didn't pay any special attention to Barton's face because he assumed that the cause of death was his heart or kidneys. But the body is still on ice, and there were some slow changes after death; if it is examined now there are signs of bruising on the face. There are also some flecks of white material in his mouth and nostrils; down from a pillow. All this strongly suggests that he was suffocated with a pillow some between 3 AM (his last medical check) and 4 AM (when the body was found). There is no reason to doubt Hauser's initial estimate of the time of death, about 3.15 AM, give or take ten or fifteen minutes. Louise is adamant that she spent most of the shift in the nurse's office next to the ward, but did leave a couple of times – to go to the lavatory, to get coffee, and when changing into and out of her protective clothing. This doesn't help solve the murder, since nobody has an alibi for that time, but it does help to establish how it was done. If Dr. Felton (the new dentist) is involved in examining the body he will definitely notice; he's an anaesthetist and always alert for signs of respiratory problems.

Inner Arc P

It's likely that Barton's home and office will be searched at some point, even if Amanda doesn't stay there; if nothing else his heir needs to check for papers related to the estate, objects of sentimental value, etc. His home is a typical underground structure with two rooms, kitchenette, and bathroom. It can be entered from the surface or the tunnel system; most visitors would have used the tunnel. There are scratch marks on the tunnel door's lock, suggesting that it might have been picked; expert examination will suggest that whoever picked it was an amateur.

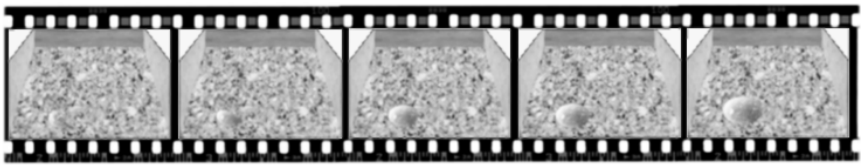
On the whole the apartment is fairly tidy; if anything it's tidier than might be expected from an apartment used by a bachelor. The bed is made up neatly with fresh sheets, there is no dirty washing up, and there is no rubbish in the kitchen or bathroom waste bins. One of the dresser drawers is empty, as is one side of the wardrobe. The bathroom is very clean, and the lavatory smells of bleach. This suggests that someone was in the apartment after Barton's death, and possibly removed clothing or evidence from the bathroom, the dresser and the wardrobe. There is no sign of valuables being missing; Barton's watch and wedding ring and a money clip containing several hundred dollars are in the bedside table drawer, there is a framed gold nugget worth about $1200 on the wall, and a Leica camera with two lenses on one of the shelves. There's a film in the camera, the results are in the pictures below.

Ignoring the camera for the moment, since it will take an hour or two to get the film developed, the most obvious (correct) assumption is that a woman removed evidence of her presence, but this should not be pointed out by the referee. There's evidence for this, if the apartment is searched thoroughly; some long brown hairs in the broom and the U-bend of the bathroom basin, a brown hairpin behind the cushion of an armchair, and a shred of metal foil under the bed that comes from a condom package.

If the adventurers talk to the neighbours, someone will eventually admit seeing "a woman" going into Barton's home a few nights before he was killed, but refuse to name names. If they make it seem serious enough another neighbour will eventually say that it was Jennifer Turner, typist at the mine; she lives just a few doors away. Once confronted, she will admit her indiscretion – it was harmless fun rather than a serious relationship. She covered it up to avoid being branded a scarlet woman, of course. She didn't pick the lock, she has a key.

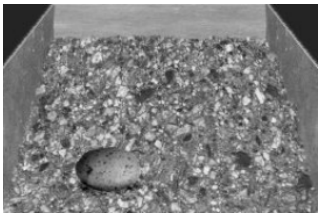
She doesn't really have anything useful to add, except to say that there were some burned scraps of paper in the bathroom basin when she removed her clothes from the apartment. She couldn't make anything out on what was left, and didn't keep the paper. She didn't notice if there was anything wrong with the lock. She knows that flame-orchid gems can be cultured, Barton told her, but doesn't associate the fact with his death and won't mention it unless someone else brings up the subject first.

Evidence in Camera



Barton wasn't a keen photographer; the camera and lenses originally belonged to Amanda's mother.

The film can be developed by Jeff Elwell ($2.50 plus 20¢ per 3x5" print) or using the hospital's small darkroom. Only five of twenty pictures have been used. All seem to show roughly the same thing; a box with something granular at the bottom, possibly gravel, with something egg-like sitting in it. The object is larger in successive pictures, suggesting that it is growing. None of the pictures are very sharp, and the camera is aimed a little up and to the right of the object, which implies that the photographer was trying to focus on something small and a little too close to the camera lens, too close for the viewfinder to work properly. The clearest picture is the fourth, and even that is blurry if examined closely. There is nothing to indicate the scale etc. The unchanging angle suggests the camera was on a tripod; there is no tripod in Barton's apartment.



If Amanda and Paula Gunn (the fake Amanda) have already visited the Lucky Seven mine they will remember seeing a tripod leaning against the wall in a corner of Barton's office.

If the player characters suggested at the start of this adventure are used, everyone from Titan will immediately realise that the photographs show a flame-orchid gem growing in a box of soil. In the first two negatives a small chunk of gem becomes more egg-like; in the last three it grows. It doesn't look like a particularly good specimen since there are some black marks on it which would have to be polished off before it could be worn. Paula should roll Detective or Psychology skill against the MIND or Acting skill of the Titan residents; if successful, she realises that they reacted to the picture, but does not know why. Any NPCs asked either don't know the truth or will lie about it: "Looks like some sort of fungus," "Maybe it's an egg of some sort, perhaps Barton discovered a new species," "Back on Earth I had a turtle that laid eggs like that," etc.

The Mayor will recognise the gem; he took it when he searched Barton's office after he was killed.

Troubleshooting: If for any reason the adventurers don't visit the apartment, or don't investigate the camera, it may be necessary to give them a little nudge via one or another NPC, or find another way to lead Amanda and Paula to the secret of the flame-orchid gems and Barton's interest in them. For example, Jeff Elwell might ask if Amanda plans to sell Barton's belongings; if so, would she be interested in selling him "your mother's old photographic equipment?" for his son. If they do so without checking the film he will develop it, realise what it shows, guess that it might be important, and tell Paula (whom he thinks is Amanda) about the gems. Alternatively, they might be suspicious of his offer and check out the camera for themselves; if so Elwell might become a suspect for a while, but there's no evidence against him so they should eventually look at other possibilities.

The Mayor and Belle Nova will probably be working to conceal the truth, of course, and if they come up with a sufficiently ingenious plan they should be allowed to get away with it. Mass murder of everyone else is *not* an ingenious plan; it just leads to more questions, and eventually the rival of a League patrol ship to investigate.

Samples

Barton's office has been left more or less as it was at the time of his death; Dick Curtis and Jennifer Turner have had to handle a lot of the papers, in order to keep things going, but otherwise they've left things alone. The lock is too battered to tell if anyone has picked it.

The floor is surfaced with anti-slip plastic; there are lots of scratches and scuff marks, of course, but if it's examined carefully a triangle of black smudges is just visible, several circular marks overlaid as though the tripod was set up in the same place several times, in front of a cabinet with dozens of small drawers containing mineral samples. Mostly the contents are labelled cloth bags, cardboard boxes and glass tubes filled with bits of rock, but one drawer is half-full of gravel and rock dust, with a small oval depression near the front. It looks a lot like the photograph, but of course the egg-shaped object is missing. Judging by the depression, it would have been about a half inch long.

If the photographs haven't been found when the office is searched this won't mean much, of course, but the contents of the drawer are the only "sample" that isn't labelled. If anyone wants to check the mineralogy, it has high quartz and basalt content, contains relatively little metal but does include a small percentage of rare earth elements, and matches the geology of the western slopes of the Mountains of the Damned. It actually comes from one of the caves discovered by Young during the early exploration of Titan[1], but you could find virtually identical rock within a mile or so of the city. An expedition to find the source will learn nothing useful and risks running into serious problems with weather and Titan's native animals. In fact flame-orchid gems will grow on most Titanian soil; they won't grow in the open on Earth because the atmosphere is wrong, but it would be easy to duplicate the process with a refrigerated box of gravel containing the same elements and supplied with a xenon-oxygen mix instead of nitrogen-oxygen. They grow best at low temperature; Barton's stone was flawed because he grew it at room temperature.

[1] *Flight on Titan*

Police Enquiries

If the investigation doesn't seem to be getting anywhere without help, it may be possible to rattle the villains by throwing in an investigation by the police, led by Sergeant Oliviera, who will turn out to be an Army CID Captain. He's been assigned to Titan undercover, to investigate persistent security leaks which have led to the loss of several ships to pirates. He'll start to take a keen interest in Barton's death; maybe he was some sort of threat to the pirate spy. Oliviera should be run as a conscientious and extremely honest cop, who has orders which allow him to ignore the Mayor if necessary. He'll be working with the same evidence, but he has access to army and other records which are not available to civilians. Needless to say he will explain his mission to Williams first, as a courtesy to his nominal commanding officer, and will instantly become suspicious if Williams tries to control the investigation or order him off the case.

Any attempt to neutralize Oliviera should backfire; if anyone tries to bribe or seduce him another officer will be listening, if anyone tries to kill him he's got backup ready to take out the threat. Amongst other things, he's organised continual radio monitoring over some frequencies that pirates sometimes use, and any signals that Belle sends will be detected and traced to the hotel. He isn't yet aware that flame-orchids can be cultured, but it's probably only a matter of time. Once out in the open he will check Barton's suit locker and office for fingerprints, and in general do everything possible to make it apparent that the criminals will eventually be caught.

Oliviera should only be used as a last resort; it's much more satisfying if the adventurers resolve matters without his help.

Reading the Will

Sam's will, last updated a few months before his death, is in his office safe; the combination is Amanda's date of birth. It's a very simple document; it leaves the mine to Amanda as expected, with individual bequests totalling a few thousand dollars to some of his employees and friends, and some local charities, most notably:

- Dick Curtis and Jennifer Turner are each left $1000 "with thanks for your hard work and loyal support over the years." There are smaller bequests to his other employees.
- Doctor Hauser receives $1000, with the proviso that it is to be used for equipment for the hospital.
- Jeanette Aleman receives $500 "in memory of the care that you gave my wife in her last illness."
- Mayor Williams receives Sam's rifle and flame pistol.
- Belle Nova receives $100 "to be spent on my wake."
- The library is left "my wife's portfolio of photographs of the early days of the colony."
- Peter Kershaw is left $250 "with thanks for your help and cooperation over the years, and hoping that it will continue in the future."

None of these bequests have any particular significance, with the exception of the gift to Jennifer Turner, which may seem unusually high for a secretary.

A hand-written note to Amanda expresses his love for her, then advises her to concentrate on the core business of the mine, and suggests some long-term strategies:

- Continue to mine gold but look for alternatives, shipment to Earth is too expensive. Uranium or radium would pay at least as well and attract fewer pirates, and there should be a big market for protactinium within the next few years. And don't forget tungsten, platinum, rare earths etc!
- Don't neglect the copper – if a League base is built there will be plenty of demand. It might be worth investing in wire-making machinery.
- Stay out of the flame-orchid business, the price is sure to fall. The word "sure" is underlined in ink that looks darker (and is probably more recent) than the rest of the text.
- Develop more markets – possibly the moons of Jupiter or the Venus colonies.

The will doesn't express any preference about funeral arrangements etc., apart from mentioning a wake in the bequest to Belle Nova.

Funeral Plans

One of the reasons for Amanda's trip to Titan is to arrange for her father's funeral. It isn't practical to ship the body back to Earth; it would cost more than transporting a living person, and the *Christiaan Huygens* doesn't have the spare freezer capacity anyway. It's needed for food for the passengers. The best alternatives are to bury him on Titan, or to cremate him so that his ashes can be transported to Earth. Sam's will doesn't express any preference for type of funeral, but his wife is buried on Titan, he might have liked to be buried next to her. She had a religious funeral.

If Amanda and Paula are still using their cover identities at this point, they need to decide how they want to handle things; its one thing pretending to be someone else to investigate a possible murder, another to carry on with the deception for something as solemn as a funeral. Sam Barton's friends may not be happy if they share their grief with someone who later turns out to be an imposter!

Most of the colonists will want to attend the ceremony, including all of the mine employees, and probably all of the player characters. At least thirty people will turn up, including some comparative strangers who are just there in hope of getting a free drink or two. A formal ceremony could be held at City Hall, if it's to become a wake the Iceberg's ballroom may be more suitable. Catering a wake (with some booze, nibbles, etc.) would cost a hundred dollars or so, small change for Amanda.

Nivea's **cemetery** is amongst the grove of whiplash trees to the south-east of the city; bodies buried here add nutrients to the soil, adding to the nutritional value of the trees when they are harvested and processed as food. Graves have metal markers a few inches in diameter, atop spikes driven into the ground; anything larger is soon blown away by the constant winds. A funeral can be arranged in a day or so, since all of the paperwork related to the death is complete (unless some sort of public enquiry has been initiated by the one or another of the characters). Kenneth Magee, one of the power plant technicians, is a Baptist lay preacher, and his church allows him to perform marriages and funeral services since there is currently no ordained minister on Titan; the last incumbent was murdered a year ago (see the scenario outline *Rough Justice* in the section on Titan) and has not yet been replaced. Alternatively, the Mayor can perform a non-denominational civil funeral. Given the weather conditions funeral services are held indoors, with the coffin (made of compressed whiplash tree pulp) transported to the grave by the mechanical digger, which lowers it into the grave then fills in the hole. A few people can watch from one of the colony's snow tractors.

The alternative is **cremation**. The procedure is very simple; after the service the coffin is transported through the tunnels to the power plant and loaded into a chamber used as an incinerator, then a baffle-plate is used to divert the atomic blast's flame into the chamber for a few seconds. After that there's nothing left but ashes, with a few small pieces of radioactive metal left from the explosion which can easily be removed with a Geiger counter and tweezers. They don't reveal anything useful, but the ashes can't be taken on board ship unless the radioactive material is removed or they're sealed in a lead container, which would add considerably to their weight and the cost of transporting them to Earth. A brass urn can be made by the workshops for a few dollars.

The funeral can be a good opportunity to plant a few clues or red herrings, overheard conversations, etc. if things seem to be slowing down, and of course it's an excellent opportunity for the characters to express real (or faked) grief and observe everyone else's behaviour. It might also be a good moment for some sort of confrontation if (for example) someone wants to accuse someone else of murdering Sam Barton.

End Game

This adventure has been left open-ended, and there is no "right" or "wrong" way for the characters to complete it. Some clues to the murder mystery are described above and summarised below; more can be prepared as needed.

Whodunit

There is evidence that Barton's suit was rigged to explode, and that he was suffocated after the first attempt was unsuccessful. This may lead characters to suspect that the same person committed both attacks, but the methods are different enough that the possibility of two killers may be considered.

- The explosion was obviously caused by someone who knew how to sabotage a radium battery and bypass its safety devices. That implies training with explosives or nuclear engineering. Unfortunately that leaves a big field of suspects; most of the military personnel on Titan, and quite a few civilians. The Mayor can legitimately refuse to give anyone access to military records if he chooses to do so. His own record shows that he has taken a demolitions course, but that's common, many soldiers do.
- There's evidence that someone searched Barton's home – the scratches on the door lock, and the burned papers Jennifer Turner saw when she collected her clothes and other belongings. Nothing appears to be missing. The condition of the lock implies someone with some ability to pick locks, but probably not a professional criminal. Developing the film should suggest that that something small and egg-shaped is missing, and eventually lead to the drawer in Barton's office.
- Unless the Mayor deliberately disposes of Barton's gem it is still in his possession, and easily recognizable. It would be a very valuable stone if the dark spots can be polished off, and Williams must roll MIND versus Difficulty 6 to deliberately destroy it or throw it away. Keep track of anything that's said about its location – unless Williams says otherwise, assume that it is with the other stones in his home. If Williams decides to dispose of it, how does he do so? It can be smashed, of course (roll as above), otherwise the easiest method is probably to throw it away somewhere. But like a bad penny, it will soon turn up again:

  If it is flushed down a drain it will be found in filters at the sewage processing plant (part of the hydroponic farm), causing a sensation. Who would flush a something that valuable, and why?

  If it is dumped outside a native will find it, and bring it in to the store to trade. Jeff Elwell will recognise it if he has seen the photograph, and give it to Amanda.

  Any other disposal method should run into similar problems.
- The second attack doesn't seem to have required any special expertise, just enough strength to suffocate a sedated man. The medical personnel can probably be ruled out; it's clear from the case notes that Doctor Hauser didn't expect Barton to survive, and he or the nurses could have easily killed him untraceably, by a deliberate medical "error." Given the time of night and easy access to the hospital almost anyone could have killed him.
- At the *Iceberg* Hauser told some of Barton's friends that there was still some hope that he might recover. Perhaps the killer believed him.
- If Belle or Hauser is asked who was there, the simple answer is "everyone"; it's where people meet to drink and discuss the day's events, and most people are there most nights. More than usual came in that night, wanting to know if there was any news of Barton's condition. Most would probably be at least a little drunk; the only people there likely to be sober are Belle Nova and Brian Benz.

Note that these clues, in themselves, are probably not enough to find the killers. Exactly how that happens is left open for the players and referee.

In the best tradition of romance novels and melodramas, heroes are heroes and villains are villains, and nobody gets away with murder. If the villains feel that they are endangered they may betray themselves by (for example) attempting to kill Amanda or another character. It's a "given" of this genre that they

won't get away with it, of course, there will always be a flaw in their plans, even if the referee has to bend the laws of the universe to make it happen. The briefing sheets for characters mention this, and referees should encourage them to act out the parts.

In play tests this has led to (for example) the Mayor staging a shoot-out with his accusers that ended up on the roof of City Hall ("Look at me, Ma, top of the world!"), Belle pretending to commit suicide but actually stowing away aboard the *Christiaan Huygens* to await rescue by her pirate friends, Dick Curtis sacrificing himself to save his true love, and Doctor Hauser sacrificing himself as a final act of atonement.

Of course players won't necessarily decide to follow these stereotypes; sometimes crime *does* pay, and good may compromise with evil if there's a hefty profit. In one test Belle went completely unsuspected because the other characters were concentrating on finding a way to manipulate the market in flame-orchid gems to maximise their profits.

Will either of the visitors from Earth find true love? That's really up to the players. Referees may prefer to provide some NPC suitors. Some possibilities:

Raymond Oliviera might be an interesting suitor for Paula Gunn, once people know that she's actually a detective. He isn't rich, but he's a detective and ruggedly handsome, they have a lot in common.

Peter Kershaw, CEO of Titan Iron Inc., might be a good catch for Amanda. They have a lot of common business interests, and similar backgrounds in the mining industry. While he doesn't own his company, he's reasonably wealthy and would be VERY interested in merging the assets of the companies. He's not especially handsome, but he'll turn out to be very romantic given the chance.

There are many other possibilities, especially for Amanda; towards the end of their stay eleven prospectors will arrive in town, heading back to Earth with a few flame-orchid gems apiece. Any one of them could be a good catch.

Bonus Points

If you've run this with the pre-generated characters they probably won't be used again, but award points for any or all of the following:

Amanda Barton: Finding out how Sam died, finding out who killed him, arranging his funeral, settling his affairs so that the mine continues to operate, finding romance, acting in character.

Paula Gunn: Finding out how Sam died, finding out who killed him, keeping Amanda alive, finding romance, making a profit, acting in character.

Dick Curtis: Staying out of trouble, finding out who killed Sam, making a profit, keeping his job (and all the little "perks" that go with it), finding romance (preferably with a rich heiress), acting in character

Grigori Hauser: Finding out how Sam really died, determining that he is not responsible for his death, helping with medical evidence etc., helping with science in other areas, finding a way to atone for his tragic past, acting in character.

Richard Williams: Avoiding suspicion, framing someone else or otherwise covering tracks, avoiding arrest, escaping if caught, acting in character, smiling and being a villain…

Belle Nova: Avoiding suspicion, avoiding arrest, getting away with the biggest possible haul if suspected, treating as many people as possible with contempt, oozing sexuality and otherwise acting in character.

If characters from the Grand Tour campaign are used they should be awarded points according to their role in solving the murder and neutralising the intelligence leak (Belle's radio link to the pirates), and for all other usual reasons. This shouldn't be a dangerous adventure, but it's important for the future of Titan.

Credits and Legalities

MANY contributors have been involved in the various releases of *Forgotten Futures* over the last seventeen years and it's well-nigh impossible to name all of them. For this version in particular thanks go especially to Brian Ameringen (Porcupine Books) and Roger Robinson (Beccon Publications) for their help in obtaining the fiction and clarifying the copyright status of Weinbaum's fiction, to Simon Bradshaw for legal advice, to play-testers at various conventions and on line, and to those who have contributed to discussion of the setting, rules rewrite, etc. via Livejournal, the rec.arts.sf.fandom, rec.arts.sf.written and uk.games.roleplay newsgroups, and elesewhere. There are too many to name, and I would hate to leave anyone out, so please accept the thought for the deed.

Islands in the Sky is a novel by Arthur C. Clarke. *Between Planets* and *Have Space Suit, Will Travel* are novels by Robert A. Heinlein. *Love and Rockets* is a comic series by Gilbert Hernandez and Jaime Hernandez. *Load Up On Guns (Friends Optional)* was suggested by Nirvana's song *Smells Like Teen Spirit*. The title of the last adventure derives from the film *Earth Girls Are Easy* (1988), dir. Julien Temple.

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Art Index

Software used included *PaintShop Pro 4*, *Corel Photo-Paint* and *Microsoft Picture It!* for bit-mapped images, *Micrografyx Draw* and *Corel Draw 12* for vector-mapped images, *Caligari TrueSpace 3.2* for 3D modelling, and *Planets* by Larry Puhl (with DosBox MS-DOS emulator) for orbital calculations and initial orbital tracks. *Celestia*, an excellent free solar system modelling program, was used for some images.

All of the pictures from this PDF can be accessed on line as separate images via the HTML version of this file. In many cases they are somewhat larger than the versions in the PDF.

Front cover	MLR, TrueSpace model with various photo edits. NASA – Moon, star fields.
2	Copyright-expired photograph, source Wikimedia Commons, photographer unknown.
13, 23 *(lower)*	MLR, after diagrams by Stephen Oxley. All errors are mine.
22 *(map)*	Source Wikimedia Commons – Schiaparelli's 1886 map of Mars showing the locations of events in *A Martian Odyssey*. Edited by Johnny Pez; released to public domain
22 *(picture)*	MLR, 3D models, Schiaparelli's Mars based on 19th century globe, NASA star field
23 *(upper)*	NASA, modified for this version of the Solar System.
25	NASA
26	NASA, modified (firefighter's headgear substituted for helmet, new background and colour)
27	MLR, 3D model, star field NASA
28-30	MLR
32	MLR, based on map by Vardion released via Wikimedia Commons
34, 35, 99, 103	Stills from *Just Imagine*, Fox, 1930 – believed to be out of copyright.
37 *(upper)*	Schiaparelli's map of Mars, 1896.
37 *(lower)*, 39, 40	MLR
45 *(upper)*	MLR, based on orbits plotted by *Planets* by Larry Puhl
45 *(lower)*	MLR, Moon photo Nikon D50, 500mm mirror lens, asteroid images TrueSpace 3D models.
47	NASA

49	Celestia image, manipulated for watercolour effect, edited to add moon sizes.
50	NASA, manipulated to add jungle etc.
51	Edited illustration (originally a dinosaur with rider) by Lawson Wood, from *Pre-Historic Tittle-Tattle* by Fox Russell, 1903. For the original see the *Forgotten Futures CD-ROM*.
52	MLR, manipulation based on rat and bat illustrations from copyright-expired sources.
54	Edited illustration (originally a lizard-like monster) by Warwick Goble, from *How Will The World End* by H.C.Fyfe, 1900. The article is included with *Forgotten Futures V*
55	NASA, Europa adding satellite imagery of Alaskan mountains etc.
56	MLR, composite from various sources, Jupiter image NASA
57 *(upper)*	NASA, Ganymede image, edited to add seas, *(middle)* MLR, *(bottom)* MLR
58	MLR
61	NASA, minor edits
62, 63 *(upper)*	Celestia images, minor edits.
63 *(lower)*	MLR, crystals photographed using Intelplay QX-3 microscope, colours edited
64, 65, 68	MLR, composites from various sources.
67, 69	NASA images
70	Celestia, image manipulated to add texture and surface features
71	MLR, TrueSpace model with various photo edits. Pluto image as above modified for "line drawing" effect.
73	MLR, Corel Draw image, Celestia background.
74 *(main text)*	NASA, V2 missile, colorised and manipulated.
74 *(sidebar)*	MLR, TrueSpace model with various photo edits. NASA – Moon, star fields.
75	NASA, NERVA atomic engine – source Wikimedia Commons
78	MLR, composite from various sources.
84 *(upper)*	MLR, Truespace 3D model with photo edits.
84 *(lower)*	MLR
92	Peress 'Tritonia' diving suit 1925, desert background, colorised, etc.
93, 94	MLR, Composites from various sources.
95	MLR, Corel Draw image
96 *(upper)*	MLR, TrueSpace 3D model
96 *(lower)*, 97	MLR, Composites from various sources.
105-7, 108 *(lower)*	Screen shots from various copyright-expired 1920s-1930s films, some face transplants, editing etc.
108 *(upper)*	MLR, 1930s airport buildings, Corel Draw model, various edits and effect filters.
109	MLR, Corel Draw image based on orbits plotted by *Planets* by Larry Puhl
111	MLR, Corel Draw images
112	Controls of Douglas DC3, NASA star field
113	British Gas, obsolete boiler room equipment
114, 117, 122	Screen shots from various copyright-expired 1920s-1930s films, some editing etc.
116	Copyright-expired from Wikimedia Commons, edited to show whole plant only.
118, 120, 123	MLR, composites from various sources.
121	MLR, Corel Draw image
124, 134 *(logo)*	Public domain images, Wikimedia Commons
125	MLR, composite from various sources.
127	Alvis Stalwart amphibious truck, some edits.
129 *(upper)*	MLR, from Corel Draw original
129 *(lower)*, 130	MLR
134, 138, 139	MLR, from Corel Draw original
135	MLR, fractal generated by Fractint software.
136	MLR, modified NASA image, source Wikimedia Commons.
140-148	MLR
151	NASA and US Geological Service images (Saturn over Mount Erebus, Antarctica)

152	MLR
154-156	Screen shots from various copyright-expired 1920s-1930s films, some editing etc.
158	MLR, composite from various sources.
159	MLR
164	Public domain image, 1920s autopsy instruments
167	Both MLR
170 *(marker)*	MLR
170 *(vehicle)*	Public domain image edited to change logo, source Wikimedia Commons.

Useful Sources

A Step Further Out 2 by Jerry Pournelle; This book includes articles which contain useful information on energy requirements for space travel, which have been ludicrously over-simplified for this setting. Similar information is also available on Wikipedia etc.

XKCD comics has published several strips related to the problems of space travel, the distances of astronomical objects, etc. I particularly recommend

Gravity Wells – http://xkcd.com/681/

The observable universe from top to bottom – http://xkcd.com/482/

Atomic Rocketships of the Space Patrol is a web site that's a useful source on real-world engineering solutions to the problems of space travel. This would be of more use in a more realistic setting, but it's still packed with interesting ideas.

http://www.projectrho.com/rocket/index.html

The Custom of the Sea: The True Story That Changed British Law by Neil Hanson is a fascinating account of the "custom of the sea" that at one time condoned cannibalism and murder under certain circumstances, and of the legal case which finally made it a criminal offence.

http://www.amazon.co.uk/Custom-Sea-Story-Changed-British/dp/0552147605

Wikipedia was an essential secondary source for this game, repeatedly helping me if I couldn't remember the source for a particular idea or event. Its articles on Stanley Weinbaum, on the Planetary series, and on the individual stories of the series were essential resources. The article on the Planetary series includes a more extensive glossary than I could include in the game, an extensive list of characters, etc. There are some differences in the chronology and technological background described in this article; for various reasons it was necessary to make numerous changes to draw all of the stories into a coherent whole suitable for game purposes. Alert readers will notice, for example, that the League and the Patrol are barely mentioned.

http://en.wikipedia.org/wiki/Stanley_G._Weinbaum

http://en.wikipedia.org/wiki/Planetary_series

Coming Attractions

The working title for *Forgotten Futures XII* is *Empire of Earth*. At the moment sources are still being assembled, but they will probably include one of the earliest novels of interstellar warfare, *The Struggle for Empire* by Robert W. Cole, and other important works in this genre.

Writing these games is a lot of work and takes a lot of time, and I can only continue if readers support *Forgotten Futures* by registering and buying the *Forgotten Futures CD-ROM*. If you want to see me continue, please follow the links below and register on line, or contact me for other registration methods.

Marcus L. Rowland ~ October 31st 2010

Weapons Summary

Weapon	Shots/Rd (ammo)	Multiple Targets?	Ammunition	Effect	A	B	C	Note
.45 automatic	2 (8)	max 2	Normal	9	I	I	C/K	
			Fragmenting	6	F	I	C/K	1
			Explosive	7+12	F	I	C/K	2
.38 / .380 / 9mm automatic	2 (10)	max 2	Normal	7	I	I	C/K	
			Fragmenting	5	F	I	C/K	1
			Explosive	5+8	F	I	C/K	2
.357 rifle	1 (5)	No	Normal	10	I	I	C/K	
			Explosive	9+12	I	I	C/K	2
40mm machine cannon	5 (belt 400)	full auto	Normal	10	I	I	C/K	
			Explosive	9+14	F	I	C/K	3
Martian pistol	1 (128)	No	Dart	4	F	I	C/K	
			and Toxin	4+1/rd	F	I	C/K	4
Flame Pistol	1/3rd (1)	Cone 300ft x 20ft		30	I	C/K	C/K	5
Flame Cannon	1/2rd (belt 30)	Cone 300ft x 20ft		30	I	C/K	C/K	6
Blaster (grenade)	n/a	Explosion, radius 30ft		25+2D6	I	C/K	K	7
Stunner	1 (n/a)	No	Sound pulse	8	B	KO+B	KO/KO+I	8

Notes

1. Will not penetrate spaceship hulls.
2. Explosion radius 4ft, roll for explosive damage if the bullet hits the target or another object inside the blast radius.
3. Explosion radius 6ft, roll for explosive damage if the bullet hits the target or another object inside the blast radius. Vehicle / Tripod mounted weapon ONLY.
4. Darts can cause wounds by penetration, like any other small projectile, and carry a toxin which affects Martian organisms only – no effect on humans. Roll for toxin damage only if a Martian organism is shot.
5. Range 300ft, Radius 20ft, barrel shatters on 10-11, replacement takes 40 minutes. chamber shatters on 12, not repairable. Ammo cost $10 / shot, Barrel cost $5; barrels cannot be swapped between different models.
6. Range 300ft, Radius 20ft, barrel (swapped out after shot automatically) shatters on 11; replacement takes 10 minutes during reloading. Chamber shatters on 12, not repairable. Ammo cost $10 / shot, Barrel cost $12. Barrels cannot be swapped between different models. Vehicle / Tripod mounted weapon ONLY.
7. A hand-thrown nuclear weapon equivalent to several *tons* of conventional explosives. They cannot be thrown far enough to avoid injury under Earth gravity, but can be used with a timer, trip wire, etc. Detonation takes 2-3 rounds after the pin is pulled.
8. Useless in a vacuum, affects humans only, runs on radium power pack and never needs reloading. Injuries can include epileptic fits, concussion, nosebleeds, etc. It would probably be possible to design a stunner that affected alien species but none are commercially available. Any multi-species design will probably only be able to affect one species at a time, e.g. on the Venusian setting humans would be unaffected, and vice versa. Martians have their brains in their bodies, not the head, and should be assumed to be more resistant to stunning than humans.

Martian Pistol

Flame Pistol

Stunner

Forgotten Futures XI - Spaceship Design Record

Blast type	
Emergency acceleration	
Cruising acceleration	
Horizontal landing, wings & underjets?	
Military or weapons permit?	
Supply endurance, weeks	
Racing engine?	

Game Data	
BODY	
Armour Rating	
Engineering Difficulty	
Piloting Difficulty	

	Tons	Cost	Quantity	Total tons	Total cost
Cramped / shared cabins, etc.	0.30	$500			
Individual cabins, moderate comfort	0.60	$1,200			
Luxurious accommodation	1.50	$2,500			
Head (shower and lavatory)	0.50	$4,200			
Galley (variable cost and tonnage)					
Cargo hold (per ton of cargo)	1.10	$250			
Fuel (hold or tank including mass of fuel)	1.10	$250			
Life support equipment (per passenger)	0.20	$150			
Algae "farm" (variable cost and tonnage)					
Supplies storage per person per week	*0.30*	*$250.00*			
Controls, per pilot	0.50	$1,200.00			
Radio (short range)	0.10	$500.00			
Radio (interplanetary range)	1.50	$15,000.00			
Meteor warning device	0.10	$1,200.00			
Electric "plumb" altimeter	0.10	$1,200.00			
Multi-function meteor warning / plumb	0.10	$1,800.00			
Air lock	0.50	$2,500.00			
Space suit recharge point	0.10	$1,100.00			
Fixed or turret-mounted machine gun	0.20	$750.00			
Fixed or turret-mounted flame gun	0.20	$3,000.00			
Turret for weapons	0.50	$5,500.00			

Payload & Fuel			
Engines			
Totals			

Engine maintenance per annum				
Life support per flight				
Cruising fuel consumption & Endurance		Tons / day		Days
Full thrust fuel consumption & Endurance		Tons / hr		Hours

A spaceship design spreadsheet template (Excel format) can be downloaded from the author's web site.

Remember how the future used to be?

When vast fleets of flying ships blackened the sky...

When psychic investigators used electric pentacles...

When Venus was a paradise, never fallen from grace...

When the government's main job was to make the airships run on time...

When a gentleman could build his own spaceship and still have change of a million pounds...

When there were still dinosaurs and monsters in the unexplored corners of the Earth...

When you could find a complete role playing game with eleven supplements on line...

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Illustration by Fred T. Jane for *Olga Romanoff or The Syren of the Skies* by George Griffith, one of the books accompanying Forgotten Futures

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By Marcus L. Rowland

Illustrated by Aaron Williams

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BY MARCUS L ROWLAND

ADDITIONAL MATERIAL BY T. CRAIG DRAKE & MATTHEW HARTLEY

BASED ON AND INCLUDING

FLATLAND BY EDWIN A. ABBOTT

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ALL OF THE AUTHOR'S INCOME FROM THIS GAME IS DONATED TO MÉDECINS SANS FRONTIÈRES (DOCTORS WITHOUT BORDERS)

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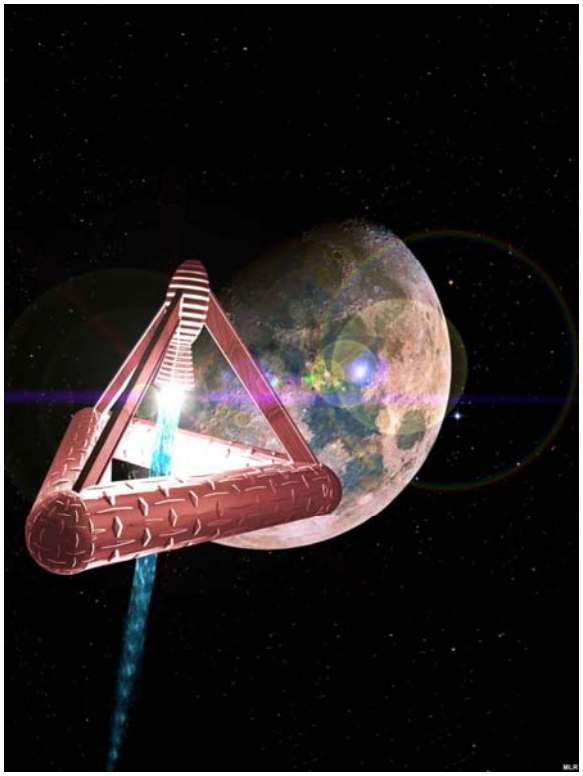
And don't miss the free *Forgotten Futures Compendium*, which includes a *Forgotten Futures / Flatland* crossover adventure, The *League of Extraordinary Geometers*



Forgotten Futures XI:

Planets of Peril

Role-Playing in the Worlds of Stanley G. Weinbaum's 1930s Science Fiction

By Marcus L. Rowland

Adventures across a Solar System where every world has life and many secrets:

- Venus, where the fungi and spores will eat you if the plants and natives don't!
- Mars, home of cryptic friendly natives at least as intelligent as mankind!
- Io, the jungle moon, where tiny natives view humans with hostile eyes!
- Europa, an unspoiled Eden where mankind may be the serpent!
- Ganymede, the tidal moon, where you either swim or die!
- Titan, Eskimo hell, source of the most beautiful gems in the solar system!
- Uranus, the great enigma, a huge habitable world that's still almost unexplored!
- Pluto, lair of the pirate queen Red Peri, and home to strange and deadly living crystals!

Includes full details of all nine worlds and the asteroids and major moons, complete spaceship operation and construction rules, a detailed adventure campaign, three long adventures and eighteen adventure outlines, twelve ready-to-use characters, and much more!

Forgotten Futures XI is supported by online downloads including deck plans, spreadsheet templates, and a selection of Stanley G. Weinbaum's science fiction stories.

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