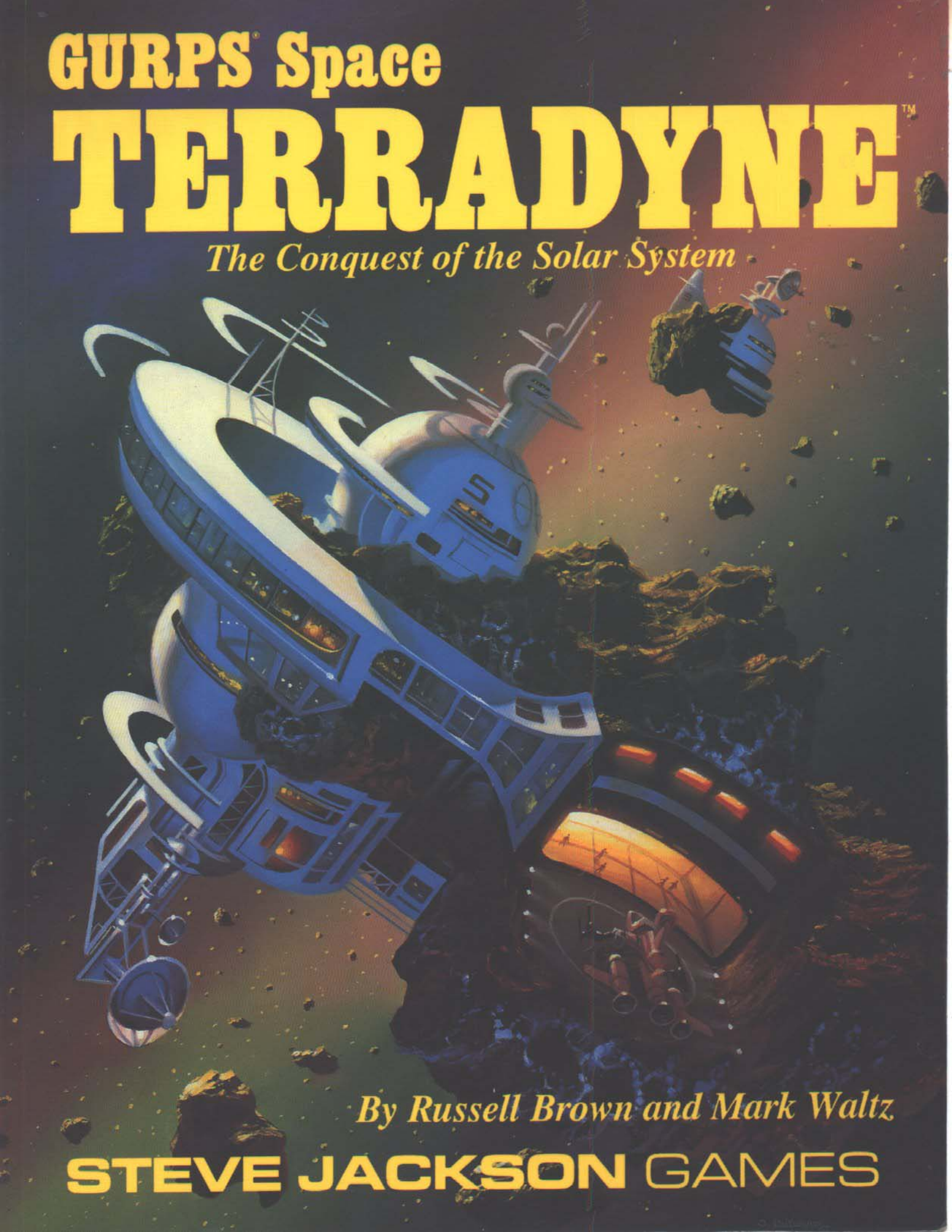
GURPS® Space

TERRADYNE™

The Conquest of the Solar System



By Russell Brown and Mark Waltz

STEVE JACKSON GAMES

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INTRODUCTION

Many science fiction authors, like Ben Bova, Gregory Benford and William Gibson, have based their work in the near future. Their worlds are socially and scientifically plausible. They anchor their stories in the real world by using real places, familiar objects, and well-known institutions. We can relate to their characters easily because they could be *us*, or our children, or maybe our grandchildren.

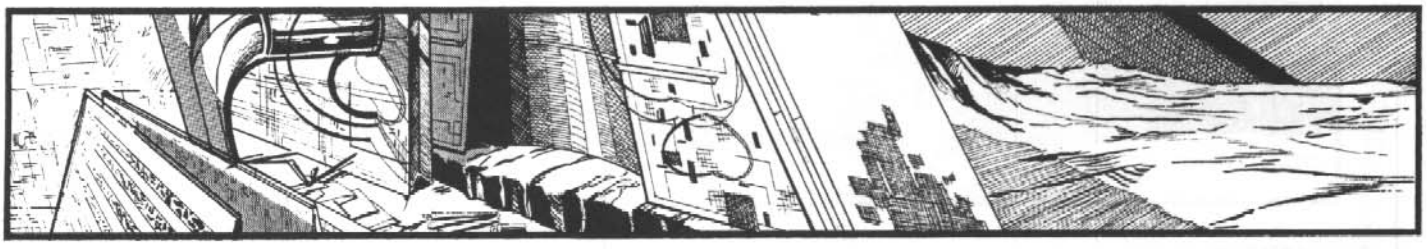
GURPS Terradyne is a sourcebook for such a near future. It's hard science fiction — there are no known alien races, no dogfights in space, and only a handful of humans have ventured outside of the Solar system. Interplanetary travel is inconvenient at best, and the speed of light is as formidable a barrier as ever.

Contemporary adventure themes like espionage, organized crime, mercenary missions and murder mysteries work well in ***Terradyne.*** The setting makes these adventures more exciting — picture them on a partially terraformed Mars, or the Moon, or an orbital station with the deadly vacuum of space just on the other side of the airlock. Now add wonder drugs, genetic engineering, worldwide data networks, video displays worn like contact lenses, and powerful computers so small they can be surgically implanted in the brain.

It is the dawn of the 22nd century. The human race has begun to populate the Solar system. There are more people on the Moon than in some nations back on Earth. Mars is a partially terraformed frontier world with strange similarities to the early days of the American West. There are mining operations on the moons of Saturn and a solar observatory on Mercury.

On Earth, most people struggle to survive, and the environmental damage of past centuries seems irreversible. As Mars blooms with new life, humanity's mother world is withering.

The heavens are controlled by Terradyne, a corporate state with monopolies on most technology, including interplanetary travel. The Earth is governed by the United Peoples of Earth, a powerful federation of nations which is more authoritarian than it needs to be. Like other periods in Earth history when two great powers reigned, there is conflict — a conflict ready to be exploited for fame, glory, money and adventure.



About GURPS

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Page References

Rules and statistics in this book are specifically for the ***GURPS Basic Set,*** Third Edition. Any page reference that begins with a B refers to a page in the ***Basic Set*** — e.g., p. B102 means p. 102 of the ***Basic Set,*** Third Edition.

Page references beginning with an S refer to pages in ***GURPS Space,*** Second Edition.

About the Authors

Russ Brown is a software engineer at GE Medical Systems in Milwaukee. He has also worked on flight simulators as an Air Force officer. He helps his wife, Pam, raise their two sons, Andy and Alex, and their cat, Bob. Most of his writing occurs when he should be sleeping.

Mark Waltz is a systems analyst with Andersen Consulting's practice in Milwaukee, where he lives with his beautiful wife and daughter. In his spare time (which there is precious little of), he tries to lead a normal family life, feed his news-junkie habit and stay abreast of current activities in science and technology. Mark's brain is overcrowded with trivia, which he relentlessly shares with his co-workers and friends.

HISTORY 1

Peace and Prosperity

In the last years of the twentieth century, the United States and Union of Soviet Socialist Republics were forced to re-evaluate their attitudes toward the world and each other. The two countries' collapsing economies made keeping massive armies and trying to be "the world's policemen" impossible.

Both countries looked to expanded world trade as the way to recovery. The Soviet Union overhauled its manufacturing capabilities with the goal of producing the best consumer goods in the world. The United States turned to high technology — primarily computers, space technology, communications and agricultural research. Both economies

Zhukov Base

In May of 2005, seven cosmonauts were stationed at Zhukov Base, a seismic testing station located in the Moon's *Mare Imbrium*, or Sea of Rains. Their mission was to search for underground rock formations and mineral deposits.

Three of the cosmonauts were several miles out on the lunar surface, checking an array of seismic detectors, when the detectors' needles went off the scale. They simultaneously lost radio contact with Zhukov Base. Monitoring stations in the Soviet Union confirmed the loss of transmission and advised the field crew to return to the base immediately.

A U.S. intelligence satellite detected a large infrared source at Zhukov when contact was lost, so the surviving crew was partially prepared for what they found at the site. The base had undergone complete decompression and most of the debris was badly scorched. Only three bodies were found; one was burned beyond recognition and the others were stiff, dry and pale blue from suffocation in the open vacuum.

The four who died in the explosion appeared fortunate in comparison with the three who survived. The Soviet Union would not be able to provide a rescue ship for eight days, and the cosmonauts' primary life support center was gone. With only enough oxygen left for 36 hours, the survivors waited for death.

The United States had monitored the Zhukov crew from the beginning, and when word of the Soviets' helplessness spread, U.S. space scientists scrambled to reprogram a robotic resupply ship headed for Tranquility Station. The cargo ship was diverted to Zhukov base, where it picked up the cosmonauts. They were then transferred to Tranquility Station, where they stayed until the Soviet rescue ship arrived.

rebounded in the first half of the 21st century, although never to the heights of before.

The two nations began to cooperate in a variety of endeavors, including space exploration. The Spacelab/Mir joint missions of the 1990s led to the establishment of Diomede Station on the Moon, jointly manned by the Americans and Soviets. The station was not intended to be permanent, and the joint missions ended with the establishment of an American base in 2002, but the spirit of cooperation and friendship remained, peaking in 2005 when the Americans rescued the survivors of the Zhukov Base disaster (see sidebar).

At the same time, Japan retained its position as the world's major builder and exporter of ships, automobiles and consumer goods. The Economic Community of Europe became the world's second-largest food exporter. Recovery seemed well on the way.

Rise of the Third World

As the focus of international relations shifted from giving economic aid to becoming trading partners, the third world nations scrambled to keep up. Many began to find niches where they could successfully compete with the developed countries. South American countries raised cattle. Korea put its shipbuilding industry into high gear, eclipsing the Japanese by the year 2010. Mexico successfully positioned itself as a tourist attraction. China stepped up its imports of consumer goods. India offered electronics manufacturers a ready supply of cheap, highly-skilled labor.

Standards of living increased as national debts fell. Tax incentives and appeals to nationalism kept many bright young people in their homelands, though most countries were still dependent on the more developed nations for education and technical information.

These nations gained their technological independence in the 2010s with the introduction of two world-wide data networks. The first, GeoComm, was originally based in the western United States. Tax and other incentives convinced GeoComm to move their operations to the African nation of Guinea-Bissau in 2019. The second, Reseau Mondial d'Information (RMI), was based in France. It was primarily designed to serve the European community, but was open to the entire world as well.

As the third world nations developed their technology, their requirements for electricity and raw materials increased. Japan began producing commercial fusion reactors in 2015, but few small nations could afford the initial investment. Fossil fuel power plants were still cheaper to build and operate, and the least expensive manufacturing process was often the most toxic. Developing nations became the scapegoat for the environmental problems of the industrialized world.

Decline of the Superpowers

As the number of economically independent nations rose, the number of markets for U.S. and Soviet-made goods declined. Both countries watched their standards of living slowly erode.

With weak economies forcing still further cuts in their military budgets, neither nation was able to do much about the sporadic fighting breaking out all over the globe. Brushfire wars sprang up in Central America, Eastern Africa, the Middle East and Central Asia. The United Nations attempted to send peacekeeping forces to several of these areas, but the member states were for the most part too busy with their own domestic affairs to be able to participate.

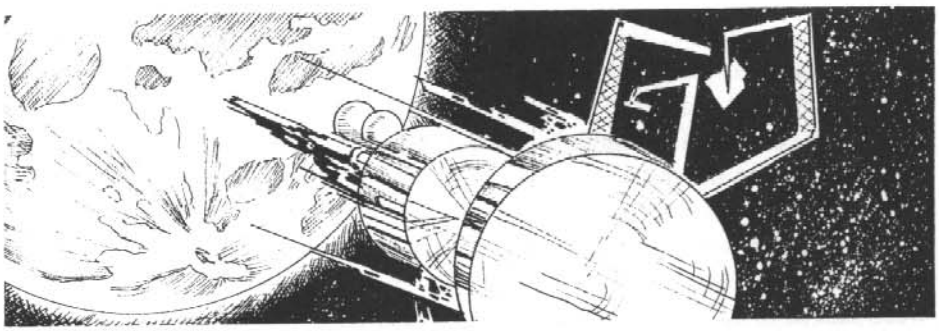
Then on the morning of April 18, 2027, the unthinkable happened. As a

Syrian armored battalion massed near the town of Fiq, east of the Israeli-occupied Golan Heights, a nuclear device exploded overhead. No one ever claimed responsibility for the blast; although it was widely assumed that Israel was responsible, the Israeli government denied involvement. The world was outraged, not only that nuclear weapons had apparently been used in anger, but also that the United Nations had been powerless to stop it.

Formation of UPOE

Later that year, the nations of India, Germany and South Africa used a UN forum to propose a new world organization, which they called the United Peoples of Earth. UPOE would be a bicameral organization, similar to the American Congress. In the Peoples' Assembly, each nation would have representatives in proportion to its population. In the Nations' Assembly, each country would have one representative and one vote. Resolutions could be passed by a ¾ majority in either house, or by majority vote in both. There would be no equivalent of the Security Council, and no veto power.

Six months later, 57 nations met in Brasilia, Brazil to draw up the charter and work out organizational details. On December 26, 2028, the United Peoples of Earth held its first meeting. At first the United States, Great Britain and the Soviet Union boycotted the meeting, but each joined within two years. The United Nations found itself steadily losing power and attention to the UPOE; in 2038 it voted to move its headquarters to Nairobi, but the move never took place and the adjourned body never reconvened.



Formation of Terradyne

In early 2027, several large aerospace and research firms formed a holding company called *Terradyne*. Terradyne's stated goal was to bring space technology to bear on Earth's problems. By developing solar power technology and moving manufacturing into space, Terradyne planned to cut pollution and dependence on fossil fuels. By building colonies on Mars and the Moon, Terradyne hoped to ease Earth's overcrowding and to build recycling technology to help conserve its resources. The United States government jumped wholeheartedly behind Terradyne, giving it special tax status and immunity from antitrust regulation. It also limited foreign investment, a move which many countries around the world saw as an attempt by the U.S. to maintain a stranglehold on space technology.

One of Terradyne's first major projects was the building of solar power satellites. These satellites were designed to turn solar energy into microwaves, beaming the power to collection and distribution stations on Earth. Building these satellites required a significant mining operation on the Moon, and in order to protect its investment Terradyne laid claim to exclusive settlement rights on a small area of the Lunar surface. The Soviet Union protested, saying that the

Recent History Timeline

1998 Frontier I Mars probe launched
2001 Tranquility Station established on Moon
2005 Zhukov Base disaster
2006 Soviet landing on Mars
2012 U.S. landing on Mars
2015 First commercial fusion reactor
2019 Data nets go into service
2027 Nuclear attack on Golan Heights
2028 Incorporation of Terradyne
UN Claims Control Committee formed
Formation of UPOE
2036 UN dissolved
Solar power satellite operational
2037 First ice ships leave Earth orbit
2038 Martian claims debate ends
Last sleeper ships leave for Tau Ceti
2041 Luna City founded
2042 First extra-terrestrial birth
2045 Intense study of Mars by Terradyne begins
2051 Terradyne moves its headquarters to the Moon
UPOE charter expansion establishes corporate structure
Artemis engine fires on Phoebe
2053 World-wide flooding begins
2055 Lunar University established
2064 Terradyne restructured into a single corporation
Evacuation of Mars
Phoebe collides with Mars
2075 French government forms Spatiale
2083 Anti-Terradyne demonstrations in India and China
2084 VOMS in operation around Venus
2086 Jodo San becomes CEO of Terradyne
2087 Terradyne buys Spatiale
2088 Terradyne requests independent UPOE representation
Humans reclaim Martian surface
2090 Terradyne employees renounce Earth citizenships
2091 Mercury Solar Weather Station in operation
2092 Hurricane Fidel
2093 Interplanetary Security Forces established
World trade war begins
2094 U.S. interest in Terradyne sold to UPOE
World Economic Collapse
2095 UPOE begins World Economic Plan
UPOE Standard currency introduced
2098 Regulatory Monitoring Agency formed
Passage of Free Space Act
2101 Free Trade League formed
2104 Terradyne begins paying employees in company scrip
2115 Construction fleet leaves for Titan
2120 Present

claim violated the Outer Space Treaty of 1967 (see sidebar). Terradyne countered with the claim that it was not subject to the treaty, since it was a corporation and not a nation.

Eventually, Portugal called for a compromise in the form of a UN Claims Control Committee (UNCCC), which would have the power to monitor exploitation and settlement of the Solar system and to settle claims at a level lower than the full UN General Assembly. The resolution passed by an overwhelming vote, with the United States and Japan (which had begun to invest heavily in Terradyne) abstaining.

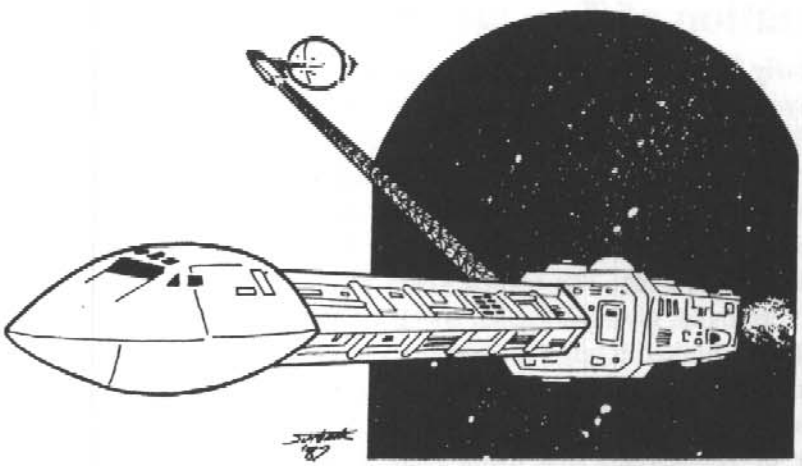
A Vision of the Future

The greatest problem faced by the new world government was the environment. The UPOE assemblies passed resolution after resolution to control dangerous substances, limit human expansion, and protect endangered species..

Terradyne took a different approach. The company's leaders decided that they could not save Earth's environment unless they understood it better. And the best way to understand the complexities of a planetary ecosystem was to build one on Mars. They presented the Space Claims Committee of the UPOE (a direct descendant of the UNCCC) with an extensive terraforming plan, and argued that the only way the plan could be implemented was for the SCC to grant them exclusive colonization rights to Mars.

The plan involved gathering large chunks of water ice from Saturn and its moons and propelling them to Mars. Once there, the ice would be melted, forming oceans and lakes. These bodies of water would be seeded, first with genetically engineered bacteria and single-celled organisms which would help to create an atmosphere, then with successively more complex organisms. Terradyne estimated that humans could walk unprotected on the surface of Mars within a hundred years.

Using computerized models and the testimony of respected non-Terradyne scientists during the three-year debate, Terradyne finally convinced the SCC to grant its request. It then made its detailed terraforming schedule public; a minor scandal erupted when it was discovered that Terradyne ships had left Earth orbit for Saturn in 2037, a year before SCC approval. Several Terradyne officials were sacked to appease public opinion; all immediately gained high-paid jobs as consultants with Terradyne contractors.



Project Phoebe

Almost before the furor over the "ice ships" had died down, Terradyne researchers made an amazing discovery. In 2051, Saturn, Mars, Jupiter and several of Saturn's moons would be in a unique alignment which would allow Phoebe, Saturn's outermost moon, to be propelled into a collision course with

Outer Space Treaty of 1967

In 1963, a committee sponsored by the United Nations ended five years of discussions and produced a declaration governing "the Activities of States in the Exploration and Use of Outer Space."

The basic idea was that celestial bodies should be explored and used to benefit all mankind, not just individual countries. Space would not be "subject to national appropriation by claim of sovereignty, by means or use of occupation, or by any other means." The declaration also prohibited the stationing of nuclear weapons or establishing of military bases on celestial bodies or in space.

The contents of the declaration were incorporated into the Outer Space Treaty, which was signed by representatives of 63 nations in 1967. The articles of this treaty were upheld by the UN and became the foundation of space law under UPOE.

Articles II and IV of the treaty are particularly interesting. Article II repeats the original declaration's denial of national claims to celestial bodies. It was the basis of UPOE's refusal to grant the Terradyne colonists independent representation in the Assemblies.

On the other hand, Terradyne has used Article IV, which prohibits military bases in space, as the basis of its opposition to UPOE's Interplanetary Security Forces.

Sleeper Ships

The debates over the terraforming of Mars and the vision of a pure new world may have been the inspiration for Aegis Carver and the members of his Sleeper Society. Over a four-year period, Carver convinced thousands that the only hope for mankind was the colonization of other planets and star systems.

His converts sold everything they owned to finance the construction, by Terradyne, of seven cryogenic sleeper ships. Three of the ships left Earth orbit near the end of 2037, carrying over 1,200 colonists toward Alpha Centauri. Carver and the remaining 1,500 members left for Tau Ceti a year later.

Each ship was equipped with an automatic tracking signal, which were tracked by various groups over the next decades.

The signal from the Alpha Centauri-bound ships faded and disappeared in the 2060s. The signal from the other fleet was monitored until 2094, when the monitoring stations gave up for economic reasons.

A group of Terradyne scientists attempted to reestablish contact in 2098, but could not detect the signal.

If the missions succeeded, the first fleet should have reached Alpha Centauri around 2090, and the second fleet should have reached Tau Ceti around 2115.

Mars! A small change in Phoebe's velocity would send it on its way; Saturn's and Jupiter's gravity would accelerate and guide it.

The project supervisors presented the plan in a secret session at Terradyne's headquarters. Top management approved the plan, and began work on it at once.

Engineers were set to work to design the propellant system that would take Phoebe out of its orbit. Computer models were established to determine the exact time and duration of the "burn." Resources and profits were diverted to pay for the operation, and perhaps most importantly, plans were made to move Terradyne's headquarters.

Terradyne Expansion

Work continued on other Terradyne projects as well. The network of solar power satellites was expanded and followed by a series of manned observation stations in Earth orbit. Factories, hospitals (cardiovascular care facilities, for instance) and settlements began to appear, and Terradyne offered to buy equipment already in space. By the year 2050, most of Earth's satellites and orbital stations were owned by Terradyne.

The moon wasn't far behind, either. Terradyne built Luna City on the site of its mining claim granted by the CCC. By 2042 there was a permanent population; on September 5, 2043, the first baby was born on the Moon, and by 2050 its population topped 50,000. A population explosion followed shortly after when Terradyne announced that it would be moving its headquarters to Luna City.

Most of Terradyne's research and development of the '40s and '50s went into preparation for the colonization and terraforming of Mars. The stations in orbit spearheaded research on interplanetary drive systems and were a source of data on the effects of extended existence without gravity. The Moon bases provided the technology for survival on a lifeless planet, and Luna City provided colonists accustomed to life in enclosed ecosystems with low gravity.

Phoebe's Arrival

On a clear evening in 2051, just months after Terradyne had moved its operations to Luna City, an amateur astronomer in California noticed what he thought was a supernova near the planet Saturn. Professional astronomers were puzzled, however — not only was there no known star in the area which could go supernova, but the supernova appeared to be moving!

It took about a week for astronomers to find that Phoebe, one of the smallest of Saturn's moons, had disappeared, and to connect the brilliant object with Phoebe. A Soviet-owned telescope was pressed into service, and showed that Phoebe had indeed been in effect turned into a guided missile. Computer projections showed that the moon was on a collision course with Mars. Terradyne, as the only entity with the resources and motive to do this, was denounced. The UPOE passed a resolution demanding Terradyne once again change the course of Phoebe to avoid missing Mars.

Terradyne's response was — no response at all. All questions were met with either stony silence or a terse " no comment" for several years. In fact, Terradyne had been preparing for this event for several years, stockpiling resources and money against an anticipated boycott of Terradyne products. The boycott had little effect, however; the world had become so dependent on Terradyne technology that it could not afford to turn away from it. An international labor union called for a general strike to protest Terradyne's actions. The day before the strike was to take place, Terradyne shut down its solar power satellites for a

Jodo San

In 2043, a son was born to a Japanese father and an American mother in Luna City — the first extraterrestrial human birth. Jodo was one of the first *moonbabies* — children born and raised in gravity lower than Earth's. His weak bones and underdeveloped muscles prevented him from ever living on Earth; even the short descent down the gravity well might kill him.

While working on his Ph.D. at Lunar University in the 2060s, Jodo San joined a pseudo-secret group of young visionaries called the Universal Circle. He rapidly became the leader of the group, and has appointed several Universal Circle members to leadership positions in Terradyne.

He joined Terradyne directly out of school and rose quickly through the ranks, becoming Chief Executive Officer at 42.

Jodo San has the emaciated looks of a moonbaby. His features favor his Japanese father, but his American heritage shows around his deep blue eyes.

ST 6, DX 13, IQ 15, HT 7
Speed 5, Move 5, Dodge 5.
Height 7' 4"; Weight 180 lbs.

Advantages: Alertness (+2); Language Talent (+2); Patron (Terradyne Security, 15 or less); Reputation (+2); Status (+7); Wealth (Filthy Rich);

Disadvantages: Moonbaby; Skinny (-1 reaction); Duty (to Terradyne).

Home Gravity: 0.2 G

Quirks: Quotes Buddhist scriptures; seldom seen in public; disdains high-tech personal equipment.

Skills: Administration-17; Bard-16; Detect Lies-15; Free Fall-16; Geology-16; Karate-14; Leadership-16; Meteorology/TL8-17; Theology-15.

Languages: Chinese (Mandarin)-15; English-17; French-16; German-15; Janglish-18; Japanese-18.

Hurricane Fidel

Deforestation and greenhouse warming during the 21st century caused serious changes in the Earth's weather patterns, including the frequency and severity of tropical storms. As the atmosphere warmed, so did the seas. The northward movement of the warm waters increased the spawning grounds of tropical storms and allowed them to gain strength from the powerful coriolis effects in the higher latitudes. Hurricanes began to form and persist farther north than ever before.

In September of 2092, weather satellites spotted a tropical storm forming far out in the Atlantic. It quickly built to hurricane strength and moved northwest toward Cuba and the West Indies.

Before it reached the islands, the hurricane (designated "Fidel") had become the most powerful hurricane on record — and was still growing. As its leading edge struck Puerto Rico, the storm curved north. It followed the gradual curve of the Bahamas and looked as if it might hit the mainland in South Carolina and sweep right up the East Coast.

The U.S. president asked Terradyne for help. Terradyne had successfully weakened and changed the course of smaller storms in the South Pacific by using microwave energy beamed from its solar power satellites to heat the atmosphere near the water's surface, creating a low pressure zone.

Terradyne succeeded in diverting Fidel from the population centers of the Northeast — straight into Mexico. Thousands were injured or killed. Images of a church, full of Mexican refugees, being ripped apart were spread all over the data nets.

Mexico blamed Terradyne for the entire disaster, denouncing its obvious disregard for the welfare of developing nations.

day "for routine maintenance" — maintenance they had never before required. In the resulting chaos, the strike never took place.

Of course, much of the reason Terradyne had moved its headquarters to Luna City was to remove itself from the jurisdiction of the UPOE. A few Terradyne offices were targets for mob violence on Earth, but on the Moon Terradyne was safe from UPOE interference. They could fume all they wanted, but they could do nothing about it.

The Big Splash

Earth's reaction to Project Phoebe died down when the UPOE realized there was nothing they could do about it and that Terradyne *would* do nothing. Calls for sanctions against Terradyne continued in the twelve years it took Phoebe to approach Mars orbit, but nothing came of them. The world watched and waited for what the press had begun to term "the Big Splash."

On a July afternoon in 2051, observers saw Phoebe explode. A shaped charge inside the moon blew it into several fragments. Some scientists saw this as a Terradyne attempt to abort the project, but it quickly became clear that the fragments were still on their way to Mars.

The world's data nets were watching pictures from a Soviet orbital platform on September 23, 2051 when they saw the calm surface of Mars explode as a fragment of Phoebe hit, then another, then another. Dust and smoke obscured the later explosions. Spectroscopic telescopes confirmed that the thin Martian atmosphere had been blown away. Old, long-dormant volcanoes erupted, and new ones joined them. The surface of Mars became covered with lava.

Over twenty years would pass before the surface of Mars cooled enough for humans to set foot on it again.

The Growing Breach

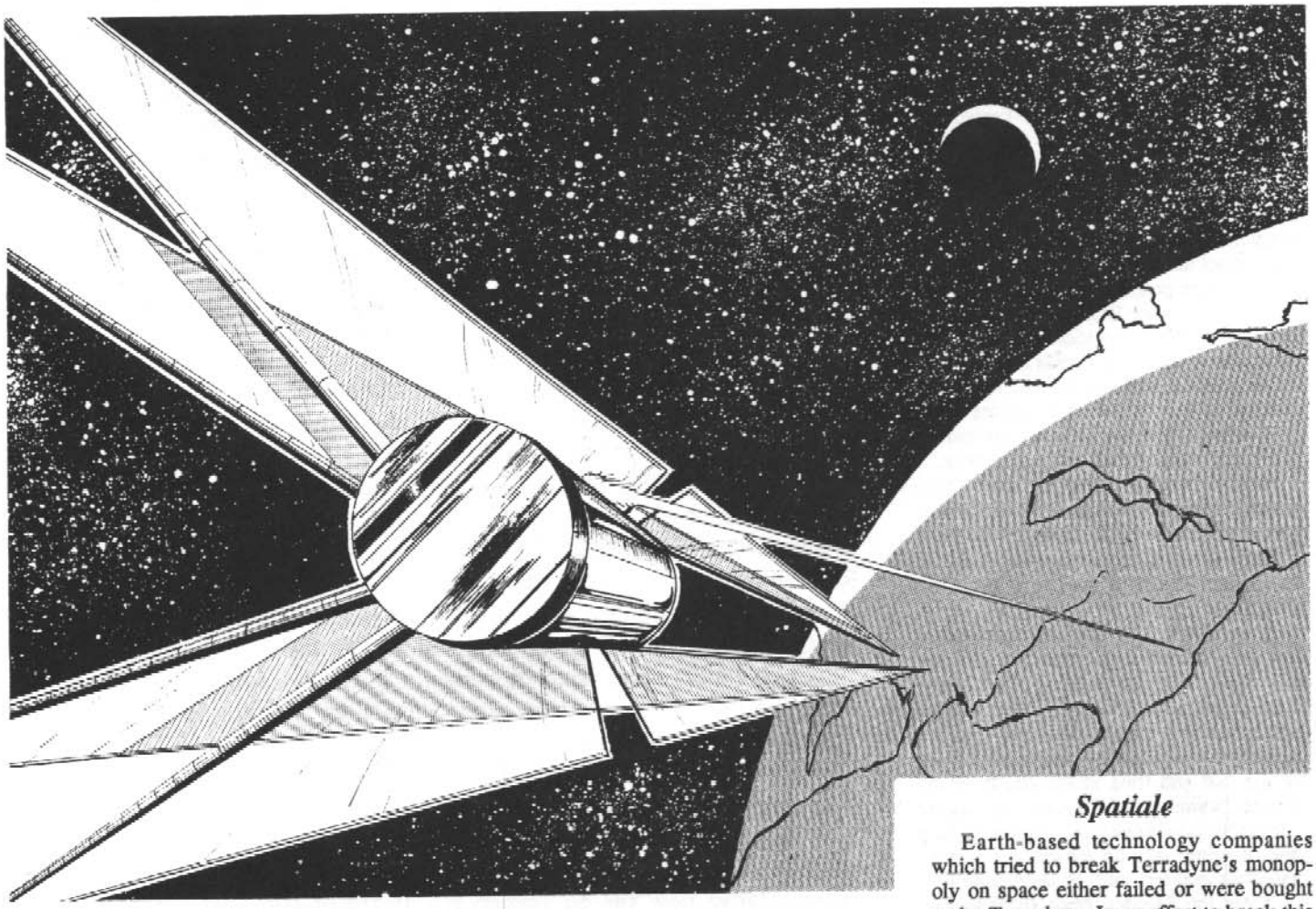
Resentment over Project Phoebe intensified in the latter half of the twentieth century. Terradyne began to be increasingly seen as a blind giant, crushing everything in its path. It had a near-monopoly on high technology, and within a year of its founding Terradyne's Lunar University was receiving more international patents than any other corporation or university. Competitors were either bought out or undercut and forced out of business.

Terradyne became more independent as its space technology improved and more of its operations moved off of the Earth. It had not required energy from Earth since the '40s, when the solar power satellites were built. Dependence on other Earth resources, like carbon, nitrogen and heavy metals, decreased as new sources were found.

Terradyne's political ties with the U.S. and Japan were weakened by disputes over taxes and tariffs on Terradyne goods.

In September of 2088, Terradyne requested independent representation in UPOE. Terradyne personnel already had representation of sorts, since each was included in the population count of his home country. But off-worlders had very different concerns from their countrymen on Earth. Most felt closer to fellow Terradyne employees, regardless of heritage.

The UPOE General Secretary refused to even bring the request for independence before the Assemblies. She claimed that, while colonization of the Solar System by an international corporation did not violate UPOE space law, recognition of that corporation as an independent nation would. Several nations, led by France and India, demanded that a vote be taken; these nations wanted Terradyne accountable to the UPOE. The motion for Terradyne's admission was voted down.



Terradyne responded by withholding all nationality data on its 200,000 employees. In a company-wide address, Terradyne president Jodo San asked all Terradyne employees to renounce their national citizenships. "We are left without representation in the communities of Earth," he said. "Let us therefore band together as citizens of Terradyne." While a few employees left the company rather than renounce their citizenships, most enthusiastically joined the secession from their homeworld.

UPOE leaders were surprised by the off-worlders' unity, but were unable to agree on an economic or military response, so they did nothing. Terradyne had become a *de facto* state, outside the jurisdiction of the UPOE.

The Collapse

But Terradyne was still a corporation, and still in theory accountable to its shareholders — the largest two of which were the United States and Japan. France wanted badly to bring Terradyne into the UPOE and thereby make it accountable for its actions, so it put forward a plan to the Americans and Japanese — if they sold all of their Terradyne holdings to the UPOE, it would become Terradyne's largest stockholder and could place people on the board of directors. On February 23, 2094, the U.S. did so, and the UPOE requested a meeting of Terradyne stockholders.

Panic ensued. Terradyne, already chafing from the UPOE vote, considered its ties to the United States severed. Trading in Terradyne stock reached an all-time high, with most of the shares being purchased by the company and its employees. This fueled a stock market sell-off and a run on American bank

Spatiale

Earth-based technology companies which tried to break Terradyne's monopoly on space either failed or were bought up by Terradyne. In an effort to break this stranglehold, the French government nationalized a number of space and technology firms, including the developer of the RMI data net, in 2075 and combined them to form Spatiale.

Spatiale was competitive with Terradyne in some areas of orbital space travel and orbital research, but it was never profitable. The French received very little support from other nations, and, after 13 years of losses, gave up. Earth's best chance to stay in the technology race was sold to Terradyne in 2087.

Free Space

A number of public works projects were created after the Crash to get UPOE Standards into circulation and to stimulate recovery. One such project is *Free Space.*

Under this program, UPOE subsidizes several space technology companies by providing low cost loans and wage subsidies. These subsidies have allowed Free Space to break the Terradyne monopoly in travel to low Earth orbit.

Besides breaking the space monopoly, UPOE has also gained power over Terradyne by taking advantage of the political turmoil of the period to impose production and trade regulations.

UPOE Philosophy and Mission

To the average person on Earth, the most visible and important aspect of UPOE's mission is control of Terradyne. The media loves it when a corrupt Terradyne official is captured by the ISF, or a Terradyne spy is exposed. But UPOE's mission is much broader; its charter dedicates it to "peace, prosperity and justice throughout the world."

To insure peace, international disputes are resolved in the World Court or the assemblies. UPOE provides mediation services and, if necessary, sends in ISF troops or conscripted national forces. Assembly representatives of member nations often prepare peace treaties in cooperation before presenting them to their national leaders.

UPOE tries to bring the world economic prosperity through a number of programs. It has led the Earth beyond the collapse of two decades ago with its World Economic Plan and special efforts like Free Space (p. 11).

The Justice Department, assemblies, and the ISF work together to promote justice. The assemblies establish International Law for nations and World Law for individual criminals. Violators of World Law are arrested by local law enforcement agencies or the ISF and tried in the courts of the Justice Department. Offending nations are tried in the presence of their representatives and, if guilty, may be subject to economic sanctions or direct military intervention.

Over the decades since its founding, UPOE has been true to its original mission. It has had its share of corrupt and greedy people, especially during the Collapse, when many nations and groups were vulnerable and desperate for help — but there seem to be no lasting scars from these incidents.

Equitable Clean Energy Distribution Act

UPOE's legislative power occasionally backfires. In 2038, when the startup costs of fusion power were still beyond the means of all but the richest nations, representative Vladko Valvosec of Serbia proposed the Equitable Clean Energy Distribution Act. It failed in the Assembly of Nations but got enough votes in the Peoples' Assembly to become law, imposing a tax of U.S. $20 on every megawatt-hour of energy generated by a fusion power plant.

The tax was supposed to provide revenues to help developing nations build fusion plants, but it had the opposite effect. With the price of fusion energy artificially inflated, energy from the solar power satellites became more competitive. Many nations turned to Terradyne for energy and dropped their plans for new fusion plants.

reserves. On February 26, the first small banks folded. Two days later, major banks followed. Japan, which had been about to sell its own Terradyne stock, quickly reconsidered.

By April, the world's economy had collapsed. Inflation in most countries reached 500% or more; the Japanese economy fared better but was still hurt. Paper money became worthless. Most privately-run communications and transportation facilities stopped. The UPOE had to step in as best it could to restore order.

Recovery

Under UPOE direction, the world's economy has slowly recovered. UPOE economists had already planned a more stable world economy, but before the Collapse the changes seemed too drastic to put in place. Afterward, the people of Earth were more willing to accept UPOE's leadership.

In 2095, the UPOE began exchanging most national currencies for a gold-backed, stable currency, the UPOE Standard. (All prices in this book are given in Standards — abbreviated $). They have also expanded the World Economic Reserve by taxing member nations and selling UPOE bonds. UPOE's World Economic Regulation Council existed before the collapse, but had little power; its strength has now increased along with its monetary reserves.

Earth's most effective intelligence force was also formed after the collapse under the non-threatening title of the Regulatory Monitoring Agency (RMA). The RMA was initially used only to verify compliance with UPOE regulations. It now monitors all high-level government communications and develops expert systems to eavesdrop on the public communication networks.

Terradyne — still partially dependent on the Earth for organic chemicals and other basic needs — has peacefully accepted the new order of things. A UPOE representative now sits on Terradyne's Board of Directors; Terradyne, however, still has no representation in the UPOE. It's possible that in the future, when it can safely do so without jeopardizing its access to Earth's resources, Terradyne will reassert its independence. Only time will tell.

ORGANIZATIONS

The developments in technology over the last century are unmistakable, but power still belongs to those who can lead and organize *people*. The East/West struggle of the 20th century has been replaced by a terrestrial/extraterrestrial struggle between the United Peoples of Earth and Terradyne, complicated by the independent goals of world nations and non-aligned power groups.

United Peoples of Earth

The nations of the world met in 2028 to create an organization which could replace the outdated United Nations. Their aim was to create a new union of nations with legislative and judicial powers far beyond those of the UN, allowing it to deal with growing international problems like the environment, trade, the world economy, and control of international waters and space. It would provide representation not only for national governments, but also for the people of the world.

The UPOE headquarters compound in Sao Paolo, Brazil is the permanent home of the Prime Minister, the Assemblies and the Justice Department. These establish and enforce International Law and punish those who fail to comply.

The Prime Minister

The focus of much of UPOE's power is the Prime Minister. A new Prime Minister is elected every five years. A candidate must be nominated by at least three members of the Assembly of Nations and then win a general election in the People's Assembly.

The Prime Minister proposes new laws and regulations to the assemblies as he sees fit and has executive control of most of the agencies within UPOE. The Prime Minister is also the official UPOE ambassador to non-member nations and member nations which require special attention. The current UPOE prime minister is Tekeda Larakutnum, of Sri Lanka.

The Assemblies

To fairly represent the sovereign nations of the world and their people, UPOE's founders settled on a bicameral legislative system similar to the U.S. Congress.

The Assembly of Nations consists of one representative from each of the 163 member nations. Some are chosen through elections; others are appointed by their national leaders. Each member of the Assembly gets one vote on each issue, so coalitions of a large number of relatively small nations like the Trans-Atlantic Alliance exercise a great deal of power when they work together. In general, laws and resolutions are passed by the vote of a three-fourths majority in either assembly, or a simple majority in both.

Representation in the People's Assembly is based upon population. Each nation is allowed one voting representative for every 20 million people, or part thereof. Nearly 11 billion people are represented by the 535 members of this assembly. While small nations are on an equal footing in the Assembly of Nations, here they have a single vote to cast against the populous nations like India, with 158 members, and China, with 141.

Members of the People's Assembly *must* be selected through national elections to be accredited. This sometimes results in conflicts between the voting record of a country's elected people's representatives and that of its *appointed* national representative.

The terms of office for assembly representatives are set by member nations, a privilege which is sometimes used to remove members who have not pleased their home government.

Assembly members live in the UPOE headquarters complex. They are in constant communication with their home nations through the datanets and often

Interplanetary Trade Commission

Because monitoring and voting on every aspect of world trade would be impossible, the assemblies included the creation of the ITC as part of the UPOE Charter Expansion of 2051. Since then, the assemblies have only concerned themselves with broad trade issues or items of specific interest; the day-to-day control of international tariffs and off-world input quotas is the job of the ITC.

This agency makes recommendations to the assemblies, and is the source of almost all of UPOE's trade-related legislation.

The ITC employs economists, statisticians, diplomats and lawyers. Most employees work at the head office in Sao Paulo, compiling trade figures, meeting with assembly members and running computer models of proposed tariff and quota changes. Some are field agents, sent around the world — even into space — to gather first-hand information and discuss trade policies with the leaders of affected nations. Others are port inspectors and tax assessors. ITC field agents also work with RMA investigators to get information which is not openly available.

This is a small agency which might escape notice in the larger scheme of UPOE activities, were it not for its history of corruption. To most people on Earth, the ITC *means* corruption — many ITC officials accept bribes and misuse confidential information. In 2088, the assemblies formed a special subcommittee to monitor the ITC and clean it up, but it hasn't helped. Since the collapse, the ITC has been the subject of six major investigations by the RMA, four of which exposed serious violations at the agency's highest levels.

The Postal Authority

UPOE's Postal Authority was formed in 2034 as a successor to the Universal Postal Union. It originally handled only international deliveries, but began contracting for national mail service in the '50s. It now handles all of the mail for 24 nations, including Spain, Korea, and Australia.

The Postal Authority also expanded to provide efficient orbital and interplanetary service as the off-world populations grew. The current rate is $8 per pound from Earth to Luna City.

Internally, the Postal Authority is free of corruption and the mail is seldom tampered with. Ironically, this makes it a favorite avenue for smuggling small items to Earth from the colonies; delivery is assured and the price is hard to beat. The ISF knows this happens and has suggested the Postal Authority use chemsniffers to scan the mail coming in from the colonies. Terradyne's lobbyists have convinced assembly members that such a move would not be fair unless all international mail was also scanned, which the Postal Authority cannot afford.

Abuse of the mail system is a very serious crime. Smugglers who are caught at it face much stiffer sentences than those who are only charged with trade violations.

The Postal Authority employs crews and ground support personnel for its transports. Its Earth orbit shuttles are mostly the latest Free Space technology, but the transports which run from the Earth stations to the Moon and Mars are modified Terradyne OTVs (with non-critical hardware removed to make room for more mail). The Postal Authority charters Terradyne L-shots for lunar delivery and Jet Shuttles for its Mars route.

return home at least once a year — at least when they are in favor with their constituents. UPOE quarters are available on a long-term basis to assemblymen (present and former) who are *persona non grata* in their home countries — usually because of their votes in the Assembly.

Justice Department

This department is made up of one International Law court, with five judges, and three World Courts, each with a single judge and jury of ten. The former hears cases of international law against entire nations or groups, and the latter tries crimes committed in international waters, space, or across national borders.

Most Justice Department employees are lawyers or legal assistants, but experts on specific subjects are sometimes hired for the duration of a trial. Judges must be nominated by the Assembly of Nations and approved by the People's Assembly.

UPOE Agencies

Interplanetary Security Forces

One of the factors which triggered the economic collapse of 2094 was U.S. and Japanese resistance to the ISF. The ISF was established in 2093 to enforce international law in the colonies and ensure that UPOE trade regulations were being obeyed. After the collapse, UPOE gained enough political and economic muscle to expand the operations of the ISF and create permanent facilities for them in the colonies. Today the agency deals mainly with black market privateers smuggling Terradyne products to Earth. They also cooperate with the RMA to expose white-collar crime within Terradyne, but they ignore most other crimes that involve only Terradyne colonists. The ISF is the only permanent military force under UPOE control, so it is also called upon to assist in crisis situations on Earth which are too big for the RMA's paramilitary forces and too sensitive for common mercenaries or conscripted national forces.

Control of the ISF

Four force commanders (Earth, LEO, Moon, Mars) plus the seven fleet commanders under their control make up the ISF Command Council, which is under direct control of the Prime Minister. An assembly subcommittee must approve any major redeployment of ISF forces. The Assembly controls the ISF budget, so no long-term operations can be maintained without their full approval.

Office of Colonial Affairs

The OCA was originally a very small agency, created by a subsection of the 2051 charter expansion. Its founders saw the OCA as an advocacy group which could present the special concerns of the off-world colonists (only 17,000 at the time) to assembly members and the Prime Minister.

Over the years its role has changed. It is now primarily an advocate of non-Terradyne colonists in their disputes with Terradyne.

The OCA is under direct control of the Prime Minister, who often calls upon it for advice on colony issues. It also advises Space Claims Committee members on issues like the Terradyne squatters on Mars.

The OCA's primary goal is to weaken Terradyne's control over the colonies. It encourages other corporations to colonize by providing training for the colonists and acting as a buffer between them and the bureaucracy of Terradyne.

The OCA debriefs all outbound Terradyne colonists. They are interrogated to keep UPOE's data on colonists up to date, and shown propaganda to undermine their loyalty to Terradyne.

Most OCA employees are counselors, interrogators, lawyers, or technical instructors. But this agency is always interested in dissatisfied Terradyne colonists who may want to return to Earth and become lobbyists. All employees work on Earth, though extended trips to the colonies are common.

Department of Environmental Sciences

The DES is one of UPOE's oldest independent agencies, formed in 2034. Its mission is to study the environment of Earth to identify and understand its problems. It is responsible for developing solutions and presenting them to the assemblies for implementation.

Besides its main office at UPOE headquarters, the DES has over 2,000 field researchers assigned around the world and 75 in Earth monitoring stations (who get along fine with Terradyne's Environmental Research people). In addition, they has strong working relationships with hundreds of university researchers.

Researchers transmit their data and recommendations back to headquarters staff, who evaluate it, prioritize it, and combine it into formal recommendations to present to the Prime Minister and the Assemblies. These recommendations usually call for new environmental regulations or more money to fund further DES research.

In addition to being the caretaker of the Earth, the DES has recently taken it upon itself to become Terradyne's conscience in the terraforming of Mars. Transport of new species from Earth to the colonies is strictly controlled, and there are 20 DES researchers in the Martian colony. They sample the atmosphere, map geographic features, and test new life forms before they are introduced into the Martian ecosystem. Their presence is tolerated, and some of their data is even used by Terradyne. None of their recommendations and restrictions have yet been a threat to Terradyne's plans.

The DES employs meteorologists, agronomists, botanists, zoologists, planetologists, geologists, civil engineers, and lawyers. Staff members spend most of their time in the office writing reports.

Field agents lead a more exciting life; they find themselves in remote locations, doing environmental studies which the local government does not approve of, or isn't even aware of.

Gerhardt Oberlehrer

Herr Oberlehrer has been the director of the Regulatory Monitoring Agency (see p. 17) since 2103. He is a heavy man of average height, 55 years old, with black hair, sleepy, dark-rimmed eyes, a round face and no neck to speak of. He doesn't talk unless he really feels it's necessary, and he doesn't mind interrupting whoever's talking at the time.

Oberlehrer brings a special zeal to his job; his parents lost their jobs because of Terradyne expansion, and he has single-mindedly worked to bring about its destruction. He has a son and a daughter, but they mean little to him. His relationship with his daughter is especially bitter; one of her sons works for Terradyne on Mars.

ST 12, DX 10, IQ 16, HT 9
Speed 4.75, Move 4, Dodge 4
Height 5' 11"; Weight 205 lbs.

Advantages: Status +6; Charisma +2; Strong Will +2; Patron (RMA Guards, 15 or less);

Disadvantages: Unattractive (-1 reaction); Overweight; Fanaticism (anti-Terradyne);

Home Gravity: 1.0 G

Quirks: Fond of Indian culture; Doesn't show excitement; Avoids crowds; Prefers female operatives.

Skills: Beam Weapons-12; Writing-16; Shortsword (baton)-11; Survival (Jungle)-16; Accounting-15; Computer Operation/TL8-17; Electronics Operation/TL8 (Security Systems)-15; Electronics Operation/TL8 (Communications)-17; Law (UPOE)-16; History-17; Psychology-14; Acting-16; Administration-17; Leadership-14; Politics-14; Intelligence Analysis-16; Interrogation-15.

Languages: German-17; English-16; Hindi-17; French-15; Tamil-14; Japanese-13; Janglish-14.

Equipment: implant computer plus implant communicator; contact lens display.

Terradyne's Mission

The original Terradyne incorporation documents and the U.S. bill which gave the company special privileges both state that its mission was to "develop space travel technology and space-based technology to study and solve Earth's environmental problems." Many people today do not even realize that the "Terra" in Terradyne stands for the Earth itself — not the process of terraforming. Although the company's activities have clearly expanded beyond the charter, some of its early projects did help the environment.

Both the U.S. government and the original Terradyne executives foresaw the advantages of space-based research, manufacturing and energy production. Reliable systems for flight between Earth and Earth orbit already existed, so Terradyne concentrated on travel from LEO to geosynchronous orbit and the Moon.

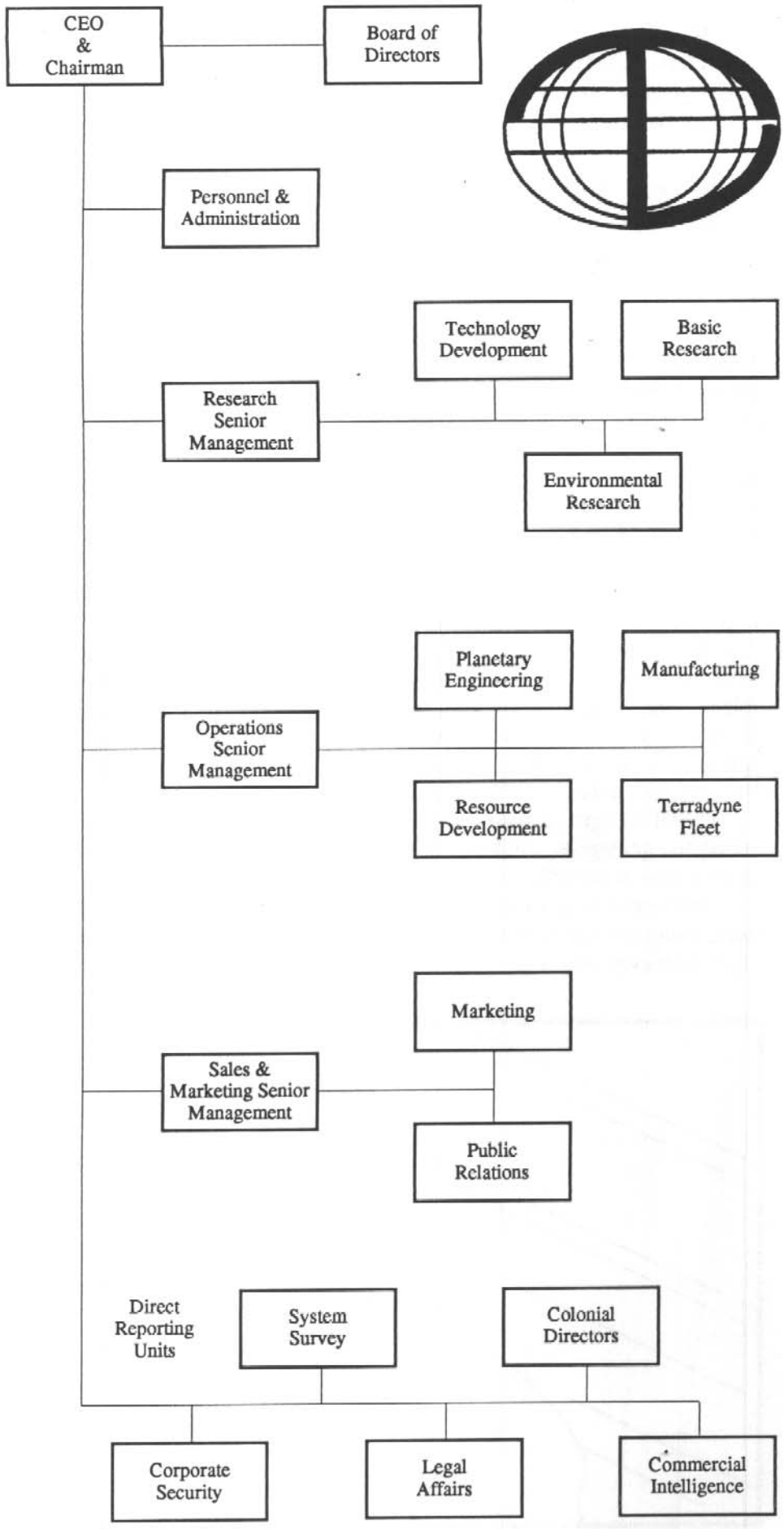
The corporate giant National Space Systems was one of the first firms acquired by Terradyne. It produced the Reusable Lunar Transfer Vehicle (RLTV) in just three years. Continued improvements in lunar transports and the purchase of Orbicon made it possible to begin orbital construction on an amazing scale, using raw materials from the Moon.

The "Orbit Rush" of the 2030s provided a new vantage point from which to study and solve Earth's problems. Earth Monitoring Stations in scattered orbits hosted top environmental scientists and the most sophisticated instruments. Higher up, in geosynchronous orbit, the first huge solar power satellites was pieced together by remotely operated robots. It would supply 60 gigawatts of cheap, clean energy. Even farther out, on the Moon, mining operations were ramping up to supply Earth with valuable lunar minerals.

Whatever Terradyne's motives when it initiated these projects, it soon became obvious that its overriding concerns were profit and independence from Earth — not the environment. Many of the earth stations became laboratories for development of zero-G manufacturing processes. The price of power from the satellites was kept as high as possible without losing business. And the Moon's rich resources were redirected toward orbital construction and the terraforming of Mars.

Terradyne believes it gained its freedom from the original mission statement during the corporate "rebirth" in 2064, when it forfeited its special taxation status. It still studies the Earth's environment, but primarily as a model for the one being constructed on Mars. Corporate scientists understand a great deal about the Earth's problems; it's just no longer profitable to fix them.

Terradyne Organizational Chart



Regulatory Monitoring Agency

As the world government's power increased after the Collapse, the prime minister decided UPOE could no longer rely only on the tidbits of intelligence provided by its member nations. He proposed the formation of an agency which could gather information and take action to insure UPOE laws were followed around the world. The assemblies approved the RMA's formation in 2098. It became UPOE's secret service.

Activities

The RMA operates much like any other intelligence organization of the 22nd century. It has an extensive network of agents and informants throughout the world's national governments and in Terradyne (though the RMA denies any presence in the colonies). Communication channels from field operatives to RMA analysts are often convoluted and sometimes primitive (dead letter boxes and marked newspapers), but they still manage to supply valuable information.

The most valuable source of UPOE's intelligence in the coming decades will be the thousands of AI analysts and expert systems which monitor the data nets and international communication channels. Using these systems, the RMA can find out about the activities of any group or person, even without a serious invasion of privacy. The latest AI systems can combine large amounts of apparently trivial public information and construct an accurate model of underlying events. (Of course, the RMA usually doesn't think twice about invading privacy.)

Not all of the RMA is dedicated to intelligence gathering. There are also a few groups of well-trained, well-equipped (TL8+) agents who carry out paramilitary operations which are too sensitive for conscripted forces. Some of these groups pose as mercenary units and carry out covert operations like sabotage and extrication of criminals from protective nations. These groups are sometimes supported by genuinely independent mercenary units who find themselves temporarily on the UPOE payroll.

Control of the RMA

The RMA is under the control of the Prime Minister, but it is very difficult to control. Many of the RMA's operations are kept secret, even from the Assemblies, and the Prime Minister doesn't have the time (or the courage) to keep track of everything. Agents already in the field and assigned to an operation are difficult to contact, so they usually can't be recalled on short notice. In addition, loose control over the regional directors gives Herr Oberlehrer a handy excuse when the Prime Minister's requests are carried out too slowly.

Terradyne

Terradyne was formed in 2028 as a parent company for U.S. space technology firms. Tax incentives and other support from Congress encouraged investors, who provided the money to buy aerospace corporations. By the '50s, Terradyne controlled all of the major U.S. space companies and had moved its headquarters to the Moon.

Today Terradyne employs nine out of ten adult colonists and has abandoned most of its operations on Earth. It has a monopoly on interplanetary travel and handles 80% of the traffic from Earth to LEO and the Moon. Its solar power satellites provide a third of the world's energy (primarily in less developed nations). Its orbital manufacturing stations are the primary source of superconductors and the only source of some medications. And the ultra-pure silicon circuitry it produces on the Moon and at L4 drives the most powerful computers.

Original Subsidiaries

Before its corporate "rebirth," Terradyne was made up of a number of independent space firms. They worked well together, each concentrating on a specific area of space technology. Their names are known to very few people on Earth, but Terradyne children study them as part of their history and are proud to have ancestors who worked for them.

National Space Systems: This giant produced the world's most efficient heavy-lift boosters and interplanetary transfer vehicles. NSS developed the "Bunyan" payload booster (which performed well despite jokes about its name) and Reusable Lunar Transfer Vehicle for the early stages of lunar colonization. It was also involved in the construction of the Mars VISITORs, especially the shuttles used to reach the transfer orbit for rendezvous.

Otomo-Goji Enterprises: This electronics materials company, based in Osaka, Japan, was very small when purchased by Terradyne, but it was making major breakthroughs in superconductivity. With funding from Terradyne, it grew to dominate the energy storage and electric motors markets. It also produced the huge electronic and photonic storage systems required for the solar power satellites and the solar collectors outside Luna City.

Continued on next page . . .

Original Subsidiaries (Continued)

Orbicon: In the early days of Terradyne, most aerospace firms had modest visions of orbital construction. Terradyne, however, was in the planning stages of its huge solar power satellites and needed a company with a grand vision. They found it in Orbicon, a Houston-based corporation.

Orbicon was ready to be purchased — it was having financial trouble because it specialized in orbital stations, which national space programs could no longer afford.

Terradyne's investment paid off. Hundreds of Orbicon engineers and technicians were in orbit within a year, and construction of the satellites took off at a pace that astounded even Terradyne executives. For years, Orbicon's free-fall technicians, with their Texas twang and rough sense of humor, represented the typical Terradyne employee for people back on Earth.

HASP Inc.: A group of physicists at UC Berkeley formed HASP in 2026 as an ongoing research project. Its goal was to work toward a process which could produce integrated circuits on silicon wafers, with individual electronic element sizes below 100 angstroms, by the year 2050 (hence the acronym: Hundred Angstrom Silicon Process). They received several important patents in the '20s and incorporated just in time to be purchased by Terradyne. The rare vacuum and abundance of silicon on the Moon provided the perfect laboratory. The team (by then a corporation of 800 people) achieved its goal in 2054, later than planned, but soon enough to put Terradyne on top of the electronics market throughout the world.

Success in the technology markets has brought Terradyne power and some degree of independence, but it has also enraged many people on Earth, where Terradyne is seen as an insensitive, greedy corporation which took advantage of its special status.

Corporate Structure

In its early years Terradyne was a group of jointly owned businesses which reported to a core staff of about 300 accountants, lawyers, and business executives in Houston. The number of Terradyne-owned corporations peaked at 23 before internal mergers began, eventually reducing this number to six.

Today, Terradyne is a single corporation. A board of directors appoints and supervises a chief executive officer, who in turn manages business units, colonial directors and headquarters staff. The rest of the company is divided into business units. Each unit handles a specific aspect of the business, such as research, marketing or transport. Colonies and project teams usually include members from many different units.

The board of directors has six members, elected by Terradyne stockholders every two years. Most candidates are Lunar residents who themselves own large numbers of shares, but *anyone* is eligible. UPOE holds the stock once owned by the U.S., so it normally has one seat on the board. Board members meet once a month in Luna City, to review company status, discuss broad policies and let the CEO know how he's doing.

Each unit has a managing director who reports to one of the vice-presidents on headquarters staff. These directors are also given authority over project leaders and colonial directors when appropriate.

Terradyne Units

Basic Research

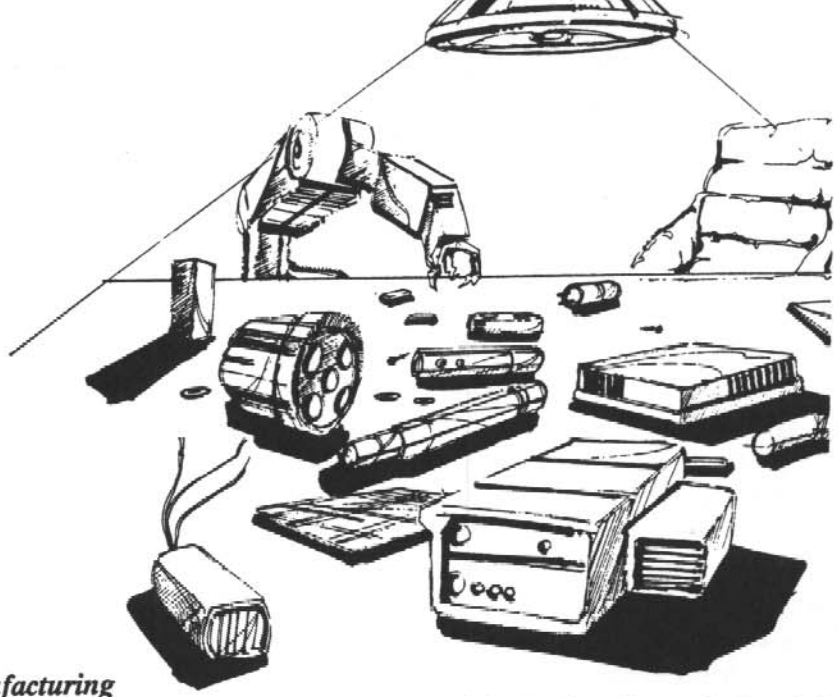
This business unit does fundamental scientific research to lay the groundwork for future Terradyne technology. Some employees mistakenly view their work as "pure" research, but the need to make a profit directs which projects get funding. Basic Research, therefore, concentrates on applications of low or zero gravity, and rare vacuums — areas in which the Terradyne colonies have a competitive advantage.

Its largest operation, and its managing director's office, is on the Moon, in a separate wing of Luna City near Lunar University. There are also researchers from this unit in low Earth orbit, on the Lagrange stations and at remote sites on Mars.

Technology Development

This unit combines market requirements and research results — mostly from the Basic Research unit — to drive the design, development, and testing of new technology. It produces competitive products for the Earth market, as well as special items (like space ships and sensor equipment) for the Environmental Sciences, Resource Development, and Planetary Engineering units.

Current projects include perfecting the portable bioscanner, developing prototypes of a diagnostic medscanner, improving the processing power (complexity) and range of implant computers, testing a robotic system to neutralize toxins in the Martian soil, and designing new ships and equipment for the hydrocarbon mining facility being constructed on Titan.



Manufacturing

The automated factories on the Moon and in Earth orbit are designed, built and maintained by Terradyne's Manufacturing unit. They are usually built by remotely operated robots and their production is automated.

These factories are designed to be run with as few people as possible. Vacuum is intended to be a *clean* environment, and even a few minutes' respiratory waste from a vacc suit could contaminate tons of duralloy, reducing it to the strength of Earth-forged titanium. Operators supervise the robots and machines which do the actual work from offsite control rooms, and technicians make on-site repairs only when necessary. Maintenance robots do most day-to-day repairs.

These remote factories and the unmanned crawlers that transport the finished products to Luna City storage areas are favorite targets of local thieves and smugglers. Manufacturing is unwilling to call on the Corporate Security Forces for protection (and risk site contamination), so its engineers have designed complex security systems into all of its new facilities. These generally involve non-lethal stun attacks and some type of restraint. The Corporate Security officers who have to run out to these factories every few weeks to pick up captured criminals call them the "mouse traps."

The zero gravity manufacturing operations in Earth orbit are also highly automated. Living conditions are cramped, and there are occasional privateer attacks, but the tours are only three to four months long.

Resource Development

The solar power satellites, Lunar oxygen plants and hydrocarbon mines on Titan are all run by the Resource Development unit. Its mission is to exploit the natural resources of the solar system in support of Terradyne objectives.

No new solar power satellites have been built since the economic collapse, but the eleven already in operation are maintained by a team of 30 Resource Development technicians. There is also a crew of five or six at each of the microwave receiving stations on Earth.

Oxygen is removed from the Lunar rocks (regolith) by Resource Development's large, mobile processing plants, which crush the rocks and use hydrogen (imported from Mars) as a catalyst. The extracted oxygen is stored in liquid form and used for life support or as fuel for spacecraft. Some is also sold to non-Terradyne stations in Earth orbit.

Hiring On With Terradyne

Anyone who wants to be a Terradyne employee must meet the skill requirements for a specific job and pass a series of tests. The first is a basic knowledge test. To pass it, an applicant must be literate in his native language and successfully roll against IQ+2.

The next test is a background investigation. Assume that if there's any reason a prospective employee shouldn't be hired, Terradyne will find it unless the employee has worked *hard* to hide it. Even then, a background investigator may find it by making a Computer Operation or Criminology roll, modified by the amount of work the employee has gone to hide his past.

After the background check, applicants are interviewed by a manager from the office they wish to join. This interview is in person if possible; otherwise, it is done using a virtual reality interface or video screen. To see how the interview goes, the GM makes a reaction roll using appropriate modifiers, A Good reaction or better is required to pass the interview. Special skills may be used instead of a reaction roll (see p. B180).

Working Conditions

Terradyne takes care of its loyal employees, even if it means lower profits or damaged public opinion. Its people are well paid and work in pleasant environments with the latest equipment. They also have access to free financial, medical and legal services.

Employees in the colonies are paid very well, but they are paid in company *scrip* (see p. 38, *Terradyne Scrip*). They must also pay for most of their food and water, which can be quite expensive. Living quarters are provided, but are not very large — many colonists return part of their salary to the company to 'rent' larger quarters. Some colonists save large amounts of money by keeping their cramped, standard issue quarters, starving themselves, and conserving water as much as possible.

Earth-based Terradyne employees make more money than their equivalents in other corporations, and are paid in UPOE Standards, but they must obtain their own food and housing. Company medical facilities are generally nearby.

Specific areas of the Moon are set aside for these operations. The processors move along very slowly, systematically covering each area and leaving behind a ten-foot layer of coarse sand. Each has a crew of five to seven (at least one operator and one engineer, the rest prospectors and geologists) who spend two weeks out of six on board. The four "off" weeks are usually spent doing support work at a nearby base or launch site.

Environmental Research

This unit is a leftover from Terradyne's early years. The original corporate mission statement committed the company to studying and solving Earth's environmental problems. Early projects included the Earth Monitoring Stations, as well as new sensors and computer simulations. This legacy of environmental projects stayed with the company and survived the reorganization as the Environmental Research unit. Over the years, it has grown slowly and expanded its operations to include Earth's neighbors, Venus and Mars.

The Environmental Research unit still operates and maintains three Earth Monitoring stations. Few scientists work on the stations, which are now used mainly as space transport terminals, storage areas, and cheap quarters for satellite maintenance crews.

The aging Earth stations are in dramatic contrast with the relatively new Venus Orbital Meteorological Sciences Station. VOMS (see p. 85) is equipped with Terradyne's latest long-range sensor equipment and sophisticated sampling probes.

Over 40 scientists live and work on VOMS, supported by a crew of 12 engineers and technicians. Most of these scientists do not work directly for Terradyne; they are university professors, government scientists, even researchers from rival corporations. Their organizations pay Terradyne millions of Standards for every month spent on the station — and research results must be shared with the host.

Environmental Research scientists are crawling all over the red planet, digging up soil samples, setting up atmospheric tests and measuring water levels. The data they collect is critical to the work of the Planetary Engineering unit, but they tend to follow their own research plans and sometimes get in the way of terraforming activities.

They are appreciated, however, because their work is dangerous. More than one field geologist has been killed in a water burst after taking core samples over melted permafrost. It is also the Environmental Research scientists who die of Red Lung or get buried alive in Martian sandstorms.

Planetary Engineering

Terraforming Mars is the mission of the Planetary Engineering unit, which is responsible for creating Earthlike conditions on Mars. This includes creating and maintaining a thick, breathable atmosphere, abundant liquid water on the surface and introducing new lifeforms.

Detailed activities include design and placement of genetically engineered life forms, directing large-scale surface modification, hydrological studies from orbital platforms, managing microbial nurseries, etc.

Terradyne Fleet

This unit came into existence at least ten years before the corporate reorganization, as Terradyne began to take over the transport operations of its subsidiaries. The fleet now provides all routine transport between the Earth, the Moon, and Mars for the other business units. It also provides most of the space transportation for non-Terradyne organizations, but this is slowly changing because of competition from *Free Space* companies.

Mad Moriyov

Dubro Alexeivich Moriyov is a retired professor of planetology from the University of Moscow. He is best known for the theories about the Cytherean (a preferable term to "Venusian") atmosphere and the radical plans for the terraforming of Venus which he developed during the '60s. Other planetologists openly ridiculed his ideas, and some research library nodes on the data nets would not carry his work. Terradyne officials refused to accept his terraforming proposals; this, more that anything else, earned him the title "Mad Moriyov."

According to Moriyov's calculations, the major stages of terraforming Venus would take less than 50 years; its surface would be habitable within 100. He demonstrated these results on a sophisticated computer model of the entire planet, but no one believed his atmospheric theories, so no one accepted the results of his model.

Fifty years later, at age 94, a less zealous Moriyov is making a comeback. He has spent years analyzing data from VOMS research and has much stronger evidence for his theories. He is still bitter toward Terradyne, so he doesn't involve them in his work. But he has gathered a small following of scientists and engineers, including the science director of Astarte, a growing Free Space corporation which develops space-based robotics and has a number of researchers on VOMS.

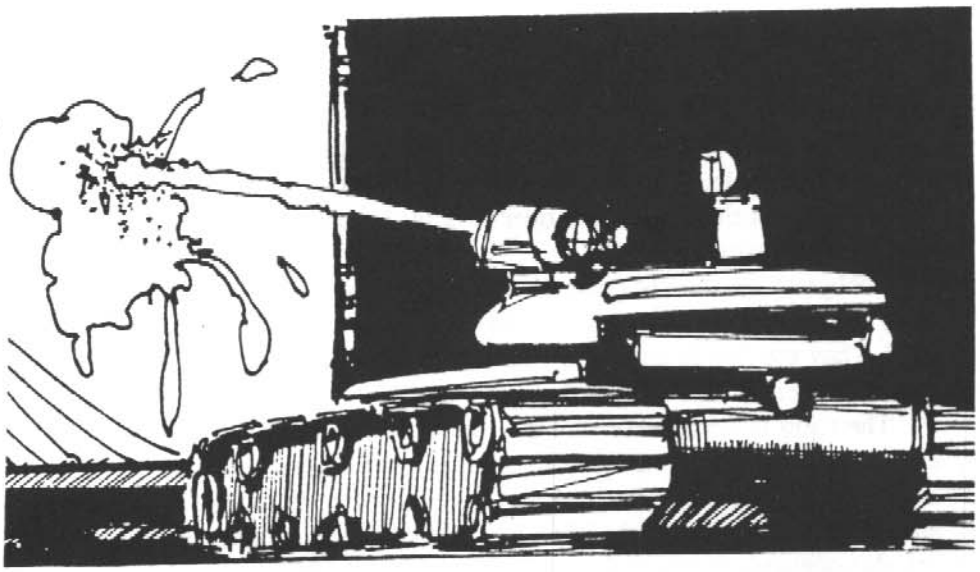
Moriyov doesn't move quickly, but he is obviously very alert. His deep-set blue eyes, disheveled white hair and worn 2070s-style jacket make him look like he might actually *be* mad.

Continued on next page . . .

System Survey

Very little scientific exploration of space — other than the Moon and Mars — occurred between 2030, when most national space programs were being cut, and 2064, when Terradyne added the System Survey unit to its corporate structure. No manned missions went beyond Mars during this period, and the Ice Ships, which went as far as Saturn, carried only basic scientific instruments. The architects of the new Terradyne recognized the benefits of exploration and established System Survey, whose only mission is to study the solar system.

Today, System Survey uses manned and automated ships to map the system and search for resources. They also manage the Solar Weather Station orbiting Mercury and send out teams of engineers and planetologists to "try out" sites for new colonies or bases (Titan, for example).



Corporate Security Force

This unit has existed since 2048, when the Lunar population grew large enough to require its own police force. It was originally under control of the Luna City Council Chairman; now, though it is nominally under control of the Board of Directors, it is generally responsible only to Terradyne's CEO.

Corporate Security became a separate business unit in 2069 and began providing security services on Mars. UPOE opposes the existence of this separate law enforcement group within Terradyne, claiming it is unnecessary because the ISF already provides police services.

The CSF is a relatively small organization (6,000 officers) and is not heavily armed, but it has a good network of informants and the latest forensic equipment, expert system advisors and communication technology.

CSF people spend much of their time tracking down smugglers, black market sources and money laundering operations in the colonies. This is limited to those smugglers who are stealing from Terradyne, and not directed at those who are actually helping Terradyne by buying their products and bypassing Earth's import quotas.

Corporate Research

This unit was created in the reorganization of 2064 to carry out industrial espionage — gathering information about competitors to gain commercial advantage. Its headquarters is on the Moon, but most agents are on Earth.

Corporate Research agents get information about other companies through paid informants or by working undercover. Some break codes and sidestep security on the data nets to gain access to information.

Mad Moriyov (Continued)

ST 7, DX 9, IQ 17, HT 5
Speed 3.5, Move 3, Dodge 3
Height 5' 4"; Weight 125 lbs.

Advantages: Alertness +2; Mathematical Ability (+3 Math or Computer skills, +2 Engineering). Strong Will +3.

Disadvantages: Odious Personal Habits (bad dresser, poor hygiene) -2; Reputation -2.

Home Gravity: 1.0 G

Quirks: Calls his computer "Alex"; Shows off his old jacket ("You just can't find jackets like this anymore!"); Mumbles to himself; Takes Superstim; Reminds people that Venus would already be terraformed if anyone had listened.

Skills: Astronomy-15; Botany-15; Chemistry-15; Computer Operation/TL8-19; Computer Programming/TL8-20; Ecology-16; Electronics Operation (Sensors)/TL8-18; Mathematics-19; Meteorology-21; Physics-19; Planetology-17; Research-17

Languages: Russian-17; English-15; Japanese-14; French-14.

Equipment: Portable Computer (TL8, complexity 4, expert interface, net access software).

Marketing

Terradyne's Marketing unit does most of its work on Earth and in Earth orbit. It promotes consumer products through advertising in the Earth media and deals with other companies who want to do business with Terradyne. Marketing also handles Terradyne's distributors, in Earth orbit and on the surface, and sets prices for many of its products.

In addition to managing existing product lines, Marketing looks ahead to future products. Its connections with customers allow it to anticipate new markets and provide direction to the Technology Development unit. Because it is based on Earth (its headquarters are still in Houston), it is also able to help the Commercial Research unit gather information about competing corporations. Corporate Research agents operating on Earth often pose as Marketing employees.

The Marketing unit generally hires Attractive (+1 or better appearance, Charisma or Sex Appeal), articulate (Merchant, Public Speaking, or Fast-Talk 12+) people who will not stand out in an crowd. A lack of these attributes may be overlooked if the applicant is a lawyer, good at advertising (Writing 13+, Psychology 11+), can manage (Administration 14+), or could serve as a translator (see *Job Table*, p. 121).

Agents also keep an eye on Earth governments and UPOE. Terradyne needs to know about upcoming political changes and new legislation as early as possible so it can direct its lobbyists and avoid any surprises. Terradyne also uses information gained by Corporate Research to prepare for trials in the international and world courts.

Overhead Staff

As with any bureaucracy, Terradyne employs an army of accountants, secretaries, researchers, PR people and other support staff not attached to any particular unit. Most of these employees live in Luna City and work at the Pyramid, but a few are stationed at Terradyne offices on Earth. Some of these are Corporate Research agents under cover.

The Marketing, Public Relations and Legal Affairs units are described in the sidebars on pp. 21 and 22.

Lobbyists

Almost every Terradyne company has lobbyists to persuade politicians to vote and modify laws in the company's favor. Most concentrate on the UPOE Assemblies, but there are a few operating in the capitals of nations which trade heavily with Terradyne.

Lobbyists are loosely controlled. They are generally assigned to a specific piece of legislation and given large expense accounts and any information they need. They are free to approach their assignments however they see fit, as long as they get results and can justify their expenses.

Their job is not as easy, nor as safe, as it sounds. Many politicians, especially from developing nations, are openly hostile toward Terradyne lobbyists. In addition, Corporate Research agents often pose as lobbyists as a cover — attracting the attention of the RMA and national intelligence agencies. Lobbyists are also convenient targets for anti-Terradyne extremists.

World Powers

UPOE is slowly becoming a strong world government, but nations still have a great deal of individual power. Each has a separate government which establishes laws based on *local* culture. Many still have strong military forces and independent intelligence agencies. They all face problems, some global, some local, and they each deal with them in their own way.

Nations still differ socially and culturally. Global travel, communication, and the media have eroded many of the external cultural differences between nations (clothing, pastimes, etc.), but *internal* differences, like values and ideologies, remain. These differences influence local laws and international relations.

United States of America

Many people blame the United States for the trade war and the Collapse. It was also the hardest hit by the disaster. Many private utility and transportation companies were forced into bankruptcy, and most American banks failed. For a few months, the spiraling cost of imported energy threatened to bring the entire economy to a standstill.

The U.S. economy recovered with help from UPOE and the dividends received by Americans who still held Terradyne stock. It has grown steadily over the last two decades.

The United States is still the world's leader in entertainment and in agricultural technology. The Texas and Alaska oil fields still supply modest amounts of

Public Relations

Like the Marketing unit, Public Relations is based in Houston and does most of its work on Earth. Its main job is nurturing good relations with national governments and large organizations. It issues all official Terradyne press releases and addressed any non-criminal accusations against the company. Public Relations also sponsors community events and media programs all over the planet to help Terradyne's poor image.

Legal Affairs

This unit was created in 2030, shortly after Terradyne was incorporated. It originally existed to insure that each of the corporations within Terradyne understood their special legal privileges and did not overstep them. With the reorganization it absorbed the legal offices of these corporations, increasing in size and responsibilities.

Today, Legal Affairs handles all situations which may result in legal action by or against Terradyne. This includes criminal, class action, and international law suits. When they get involved, they tend to take over completely — without regard to schedule or profits. This compels managers throughout Terradyne to cover up their problems for as long as possible.

This unit also has a group of contract lawyers. Company policy requires that managers consult with them before negotiating any major purchases, contracts, or partnership agreements.

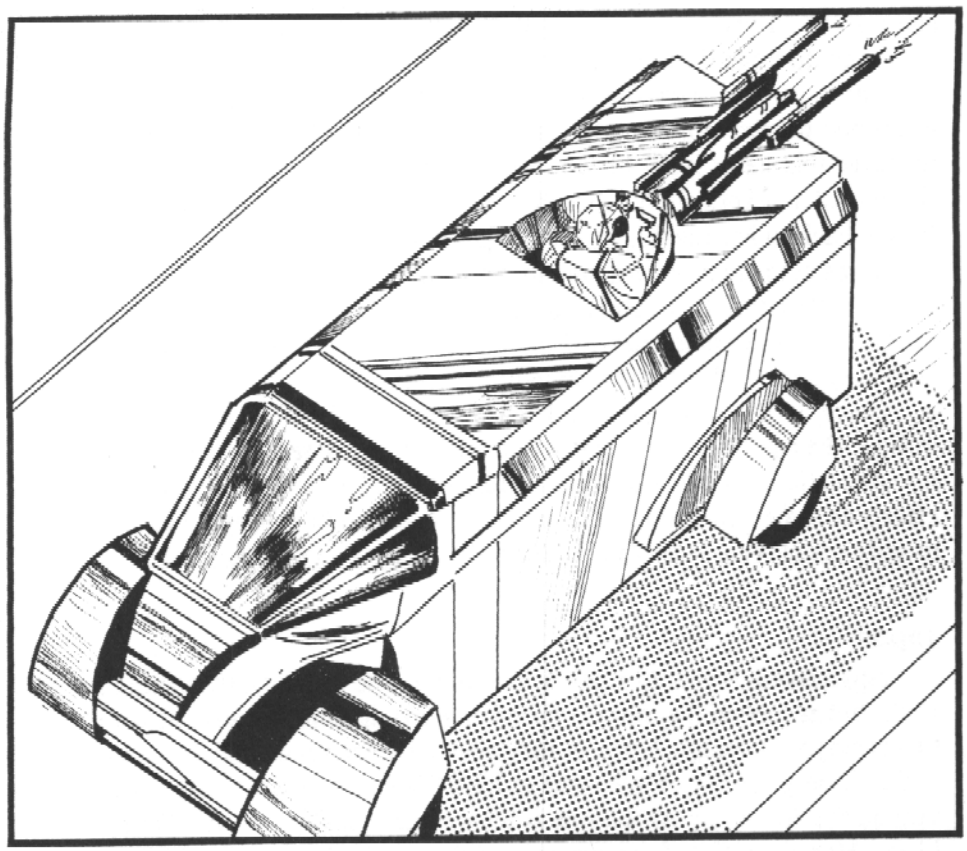
Legal Affairs also handles internal investigations — a distasteful job often assigned to new personnel.

Legal Affairs headquarters is in Luna City, but most of its operations are on Earth. It has representatives at each of Terradyne's Earth facilities, on-site with each important Terradyne customer, and in major national capitals. These smaller offices report to the head "regional" office in Sao Paulo.

Legal Affairs hires lawyers and a limited number of investigators, both as described in the *Job Table*. They also have a few AIs which do research and case preparation.

fossil fuels, which are used locally to produce synthetic materials. It is also still considered to be the home of free enterprise — more than half of the world's millionaires live in the United States.

The government still operates under the Constitution of 1789, and has not followed other nations in their move toward socialism (with housing complexes, for instance). It still maintains the world's largest non-UPOE armed forces, which are used solely for self-defense and anti-terrorist activities, and an intelligence force that rivals UPOE's RMA or Terradyne's Corporate Research Unit.



Union of Soviet Socialist Republics

The Soviet Union is no longer the powerful, tightly bound empire it once was. Many of its former member republics have seceded from the Union. The remainder exist in a very loose federation of semi-sovereign nations, each with separate UPOE representation.

The Soviet economy has never fully recovered from secessions and ethnic unrest of the late 20th and early 21st centuries. Even today, its technological base is no better than many developing nations, and is perhaps 20 years behind the U.S., Japan, Europe, and India.

Global warming has actually been a boon to the Soviet economy — with warmer weather and increased rainfall, the central plains now provide better farmland than the American Midwest, and parts of Siberia are now warm enough to farm year-round. The products of these farms can be shipped out of ports on the Barents and North Siberian Seas, which are no longer blocked by pack ice.

Most of Earth's heavy machinery comes from Soviet factories or from Eastern Europe and the Pacific Rim, where Soviet techniques have been adopted.

The combined population of the five member republics (Georgia, Kazakhstan, the Caucasus, Byelorussia and the Russian Federation) is 460 million, which gives it 25 votes in the People's Assembly and 5 votes in the Assembly of Nations. This is comparable to the voting power of the U.S., but

Terradyne Stockholders

Although most shares of Terradyne stock were bought up by its own employees during the Collapse, nearly a quarter of the company is still owned by governments (notably Japan) and people of Earth.

Terradyne stocks are a mixed blessing for these people. They bring wealth, but stockholders are sometimes seen as traitors to the Earth and become targets for anti-Terradyne aggression. They are blamed for jobs lost to Terradyne competition and increases in the price of Terradyne goods. Environmental extremists blame them for Terradyne's indifference toward the Earth and its exploitation of Mars and the Moon. Threats are made, property gets destroyed, and stockholders are injured or killed.

Stockholders deal with these dangers in different ways. Some try to disassociate themselves from the stock by creating a corporation, or a number of corporations, to hold the stock for them. Wealthier investors may protect themselves with security systems and armed guards. They may even leave the Earth entirely.

Many stockholders manage to keep their holdings secret. Earth governments tax their dividends, but they do not release information about their stocks to the public — that would be a violation of privacy laws (see pp. 39-40). Terradyne does what it can to let them secretly take part in stockholder meetings and elections, usually through Marketing or Corporate Research contacts.

To prevent conflicts of interest, UPOE prohibits RMA, ISF, and ITC employees from owning Terradyne stock.

United States Society

The U.S. is still a wealthy nation by world standards, with a relatively high standard of living. Most of its 460 million people live at TL8, on Average incomes (see *Job Table*, p. 121), in small apartments or suburban homes built before the collapse. About one quarter of Americans are Poor or Struggling (or have *no* income) and are living at TL6 or below — even within the TL8 cities.

The poverty and crime which are confined to complexes in other countries are allowed to fester in the open here. They make the mega-cities, which sprawl up and down the nation's coasts and along the Great Lakes, dangerous and unpleasant places to live.

The U.S. has an overall Control Rating (see p. S122) of 2 in rural areas and 3 in urban areas. It is also one of the few nations which uses capital punishment.

Soviet Society

Most Soviet citizens live at TL7 on Struggling incomes. The wealthy usually have a few TL8 Terradyne items that do not violate government controls. All have access to national health care facilities (barely TL8), disability and unemployment compensation, and a retirement pension ($500 per month). There are also European-style complexes for the very poor in Georgia and southern Russia.

The Soviet Union has a Control Rating of 5 in the Russian Federation and 4 in the other republics. Freedom of speech is guaranteed, but privacy is not. The police and KGB use computers to collect and store amazing amounts of data about each individual citizen. The people of the Soviet Union are remarkably calm about these monitoring activities — the crime rate is low and minor transgressions are usually overlooked, so why complain?

Chinese Society

Except for a few model farms, people in the rural areas of China still live at low TL7, mostly on Struggling incomes. Those in the city have benefited more from modernization and live at TL7 with Average incomes. China has no equivalent of the western complexes, but the hearts of her larger, older cities can be even more confining and just as dangerous.

Overall the country has a Control Rating of 3, but some of the more remote areas are controlled by local strongmen and may be as high as CR 5. Crime is common, especially in the cities. Criminals are tried by the local councils (no judge), so acquittals are rare and punishments are very harsh — sometimes barbaric. Compassion for "criminals" loyal to Terradyne is especially low.

the Soviet Union isn't as well represented on UPOE committees. Its role in world events and world government has diminished steadily over the past century.

China

China developed in the shadow of the Earth's superpowers during the 20th and 21st centuries. The dramatic social programs devised by the old communist regime and continued under the new socialist government solved China's overpopulation problems and closed the technological gap with other developed nations. The desperate, outsider nation has become a calm political powerhouse looked up to by half of the planet.

China has the technology and the people necessary to make her a great economic power, possibly the greatest on Earth. The main reason she has not achieved this status is her blatant opposition to Terradyne. When China goes into the global market, she purposely faces Terradyne head-on, and usually gets beaten back to her loyal (and very large) domestic market.

Some companies do manage to compete. For example, the Chinese government has "nurtured" a number of aerospace companies as part of the Free Space program. These companies led the way in the development of the Payload-90 launch system — the direct competitor to Terradyne's LEO shuttle.

China is the most powerful nation in UPOE. With a population of 2.8 billion, she has 141 representatives in the Peoples Assembly and 3 in the Assembly of Nations (Tibet and Outer Mongolia get separate representation). Her efforts as a mediator in local disputes have gained her many allies, and she can usually count on at least 25% of the votes in the Peoples' Assembly.

Japan

Japan stands virtually alone in the world. She has friendly relations with the U.S., but is looked down upon by other Earth nations because of her closeness to Terradyne. Though Japan is very powerful economically, her population of 175 million gives her only 9 votes in UPOE's People's Assembly, and her single vote in the Assembly of Nations is meaningless against the multi-nation voting blocs. Her alienation from the rest of the world draws her yet closer to Terradyne, raising tensions even more.

Japan is Earth's leader in technology. Her engineers benefit from contact with Terradyne, and in return, are careful not to compete in Terradyne markets. For example, Japan builds most of the world's fusion reactors, power distribution systems and automated factories — heavy items which can be produced more efficiently on Earth. Japan is also the largest importer of Terradyne goods (mostly for export to other nations), and her government is the largest Terradyne stockholder.

Japan's relationship with Terradyne and her national drive and character makes her economy one of the most vibrant in the world. Tokyo and Osaka are the cities of the "big deal." Even in America's venerated Harvard Business School, eager graduates leave their classmates with the optimistic catch-phrase, "See you in Tokyo."

The Japanese political system is the closest to a corporate state the world has ever seen. The political parties are backed by *zaibatsu* — large, multinational corporations. With only one vote in the UPOE Assembly of Nations and nine in the Peoples' Assembly, Japan knows she cannot hope to compete against the large voting blocs, so she conducts much of her diplomacy through the *zaibatsu*. Intelligence efforts are also handled through the *zaibatsu*, coordinated by the powerful Ministry of Trade and Information . . . making them "deniable" in case of an embarrassing slip.

Pacific Rim Nations (PRN)

This is a loose political organization of nations in the Western Pacific and Southeast Asia. Its current members include Korea, Thailand, Vietnam, Laos, Cambodia, the Philippines, Indonesia, Papua New Guinea, Singapore, Malaysia and Myanmar (Burma).

The PRN has little political power in the world. It has 49 representatives in the UPOE People's Assembly, and 25 representatives in the Assembly of Nations, but they seldom vote as a unified group.

The Northernmost PRN nations generally side with China on issues, often in opposition to Terradyne. But the Terradyne spaceport near Palembang, on the island of Sumatra, has been a boost to the economies of Indonesia, Malaysia and Singapore, making them more sympathetic towards the corporate giant.

None of these nations, with the possible exception of Korea, has a strong enough military to project its power outside the region.

European Community (EC)

The EC is a political union of most European countries, excluding those in the USSR. Its capital, including a congress and supreme court, is located in Brussels. The most powerful members are Germany and Poland.

The EC is a strong advocate of environmental regulation and controls on Terradyne activities — even though the EC is the biggest importer of Terradyne products! Its 23 votes in the Assembly of Nations and 50 votes in the People's Assembly are backed up by strong economic ties to other nations and moderate sized, well-equipped and easily deployed military forces.

The general economic trend among EC nations has been toward socialism, including the nationalization of utilities and transportation companies (some under the control of Brussels). But the EC is still the home of many powerful international corporations. Only Japan, with its special Terradyne connection, boasts a larger flow of imports and exports.

Major exports vary from country to country, as they have throughout history. Imports also vary, but always include a large amount of Terradyne goods, purchased after mark-ups from middle-man countries like Japan and Brazil. With so much buying of Terradyne goods and virtually no Terradyne investors in Europe, EC officials have become increasingly worried about the steady flow of wealth from Europe to Luna City.

India

With over three billion people, India is the most populous nation on Earth. It has great political power, especially in UPOE's People's Assembly. It could have even more if it didn't have so many internal problems — its rapid economic growth has left a huge gap between the social classes and led to what has been described as a "chronic state of civil war."

India is a constitutional democracy with a president, a prime minister and a bicameral parliament. At present there are no stable national parties and civil unrest has made reelection a rare occurrence. India's 158 representatives in the

Japanese Society

Japanese society is very urban, high-tech, and expensive. Under the dual influence of Terradyne technology and business deals from around the world, the average citizen of the Tokyo-Osaka megalopolis lives at TL8 on a Comfortable income, and Wealthy incomes are common. Prices for everything but high-tech items are at least three times normal.

Unfortunates who cannot even afford the $2,000 rents on the "cheap" side of town are eventually picked up from the streets and resettled in government-run factory towns in Northern Honshu and Hokkaido. The Hokkaido settlements get many urban troublemakers and petty criminals and can be dangerous, but those on Honshu are reasonably pleasant. The settlements have a control rating of 5 (compared to CR 3 in the rest of the country).

Travel (and immigration) are strictly controlled in Japan. To enter the country, a business traveler must have a respectable (Status 1+) contact within the country. Tourists must present a detailed itinerary and pre-purchase $5,000 worth of credit good only for purchases within Japan. Tourist visas are good for three weeks. Business visas are good for one month, but can be renewed easily.

European Society

The average European citizen can look forward to a life at TL8 on an Average income. Medical care is adequate (TL8, skill level 11) and provided free of charge by the state. Retirement pensions ($500 per month) are also provided at age 75 or in case of disability.

Unemployed or Poor citizens may find themselves in one of Europe's many complexes (see p. 32). Residency is never mandatory, but poor people on the outside receive very little government assistance and are often ridiculed and abused by the working class. Complexes originated in Europe — some have been in use there for nearly a century.

The Islamic Bloc

The Islamic nations of North Africa, the Middle East and Southeast Asia have been an important political force for over a century. The Islamic Bloc's power grew as Muslim nations seceded from the Soviet Union at the beginning of the last century. These nations only stand together on issues dealing with the Muslim faith; on regional issues, they tend to side with local blocs like the Trans-Atlantic Alliance or the Pacific Rim Nations..

Indian Society

The late opening of the Indian market favored those companies and individuals with the cash to compete in a mature global market. The wealthy, and the economy as a whole, did well in the new arena, while many of the poor lost what little they had. The middle class India worked so hard to create in the 20th century is now disappearing as its members slide one way or the other. This polarization of the classes is the major source of India's internal problems.

Most citizens live at TL7 on Poor or Struggling incomes, and TL5/6 communities still exist in poorer areas. About 25% of the population have Comfortable or Wealthy incomes at TL8. Education through college is provided by the state for those who qualify — but poorer areas tend to have poorer schools, so very few of their students score high enough on college entrance tests.

Overall, India has a Control Rating of 3, but areas under martial law have CR 5. The Indian legal system is the most complex in the world, so anyone arrested should have good Law skill or hire a local lawyer. Rolls against Law skill are made at -4, or -2 for those whose legal practice is exclusively Indian. (The +4 for a given specialty, such as "Indian *criminal* law," would still apply.)

News Services

The most important commodity of the 22nd century is information, which has always been the business of the news services. But the day of the impartial network news team is long gone. Most news-gathering services focus on news items of interest to the government or corporation which controls them. Or they seek out only the sensational and the entertaining.

Journalists must be very careful not to violate the growing number of privacy laws (see p. 39), or at least make sure they don't get caught. Many news bureaus have a small group of lawyers whose only job is finding ways to circumvent these laws.

The news gathered by the services is distributed via the data nets. The nets also contain general news nodes which retrieve important stories of general interest into one database (see p. 100).

A fully equipped field reporter running through the streets of a major Earth cities looks more like a combat soldier than a journalist. Normal gear includes protective armor, a wired helmet and a shoulder digicam.

In addition to the normal staff of journalists (see *Job Table*), the news services employ professional investigators and computer scientists to get secure data off the net.

Assembly of Nations have a high turnover rate. The area near the capital of New Delhi remains relatively stable.

India is a major importer of food, primarily from the U.S. and the Soviets. And they are not self-sufficient in energy; nearly 30 percent comes from Terradyne's Solar Power Satellites. Exported items include textiles, personal vehicles, chemicals and electronic goods.

Trans-Atlantic Alliance (TAA)

This is a loose political alliance of South American, African and Middle Eastern nations. It was formed in 2048 to keep the developed nations in UPOE from passing any more environmental regulations which could stunt the growth of the Third World. It was successful at this, and has since tried to form political consensus on other issues.

On the rare occasions when all TAA nations act as a group, they are a formidable power. The 1.2 billion people who live in TAA countries have 119 representatives in the People's Assembly, but more importantly, 73 nations are part of the alliance — nearly half of the 163 represented in the Assembly of Nations.

The TAA is a political organization. It does not provide for economic cooperation. Most TAA economies are weak, still limited in the use of their resources by UPOE environmental regulation and dealing with problems of overpopulation and local wars. Many are still dependent on Terradyne's solar power satellites. Some nations do have economic advantages, however; Brazil has the UPOE headquarters (and the money that generates), and South Africa is one of the world's best sources of precious stones and metals.

TAA nations also control 80% of the world's equatorial lands — the most effective sites for space launch facilities. In many cases, these lands have been exploited by Terradyne and the developed nations with little obvious benefit to the host nations. Popular demonstrations are common outside the Terradyne ports at Quito, Ecuador and Nairobi, Kenya.

Independent Groups

Corporations

Large, multinational corporations have as much power on Earth as small countries. They control key parts of many national governments through economic favors and threats. They have started wars, ended wars, and of course financed wars. They have deposed leaders to set up their own puppet states and virtually enslaved whole populations.

For example, Angeles Enterprises, with the help of some southern PRN nations, overthrew the government of the Philippines in 2072 and began a program of forced labor. With the help of the Chinese navy, rebel guardsmen under deposed General Jose Dagaio landed on the main island of Luzon and liberated Manila from the corporation's private army.

Corporations vary their strategies depending on the nation in which they operate. In free market countries like the U.S., Japan and India, they tend to concentrate their efforts in one product area. This gives them the benefits of a near-monopoly and allows them to focus their political efforts on specific legislation. In China, the Soviet Federation and Central Europe, which are heavily socialist, corporations tend to have very diverse operations. They do not attempt to become a monopoly which would make them likely targets for nationalization.

Most utility companies in the socialist nations, including power, communication and some transportation, have already been nationalized. Nationalization

can be worse than outright bankruptcy and often results in a wave of strikes and terrorism against the government. The fighting over the nationalization of France's transportation firms in the 2050s resembled nothing less than a full-scale civil war.

Corporate strategists must also consider the effects of Terradyne. Few Earth companies compete directly with the extraterrestrial giant, but virtually all must use Terradyne products or services. While they may fight to the death with each other over other issues, every Earth corporation is in agreement in their opposition to Terradyne monopolies. The anti-trust relief and low-interest loans provided by UPOE's Free Space program to Earth companies have begun to pay off — Terradyne's iron grip on the key area of space transportation is loosening.

To the individual, a large corporation can be a comfortable haven. The benefits of a large patron and the security of a stable job are hard to find in smaller companies or the government. In return, employees are expected to be loyal to the company — even to the point of disloyalty to their national government.

Corporations hire specialists in their particular field of endeavor (scientists, engineers, financiers, etc.), plus accountants, corporate executives, computer scientists, corporate spies, lawyers, lobbyists and salespeople.

Astarte

This company makes its money in robotics, an area which is generally dominated by Terradyne. It has survived and grown by concentrating on heavy robots for Earth-based agriculture, mining and construction. It leaves Terradyne the market for lighter, more sophisticated robots.

Recently, however, Astarte has begun a number of small manufacturing operations in Earth orbit and has purchased time for a sizable research staff aboard Terradyne's Venus Orbital Meteorological Station (VOMS). The company's intentions are unclear.

Red Planet Brigade

This activist group is dedicated to stopping the terraforming and exploitation of Mars. It originated as a small group of paramilitary eco-guerrillas who felt the Earth was already beyond help and decided to save Mars from the same fate. They organized sit-ins and sabotage at Terradyne launch facilities, enlisted the help of reputable and highly vocal scientists and recruited new members in earnest.

Today the Red Planet Brigade has *millions* of card-carrying members, respectable lobbying operations in UPOE and other Earth governments and undercover agents inside Terradyne. It has cooperated with the Academy of Earth Sciences to push for UPOE legislation to control shipment of living organisms to colonies and has made heavy contributions to influence representatives on the Space Claims Committee.

It also has close ties to a number of international mercenary groups, one of which was a prime suspect in the destruction of an LEO shuttle at the Palembang, Malaysia launch facility in 2085. These groups are equipped with the latest equipment, possibly obtained through brigade connections with the AES.

Anyone can join the RPB by paying the minimum dues of $100 per year. Members receive a monthly newsletter describing the "rape of Mars" and what is being done about it. It also tells loyal brigade members how to vote in upcoming local and national elections, and contains a list of Terradyne products members should not buy (and an address to which they can send all the money they saved by not buying them).

Terradyne takes the Brigade *very* seriously. It sees them as a serious long-term threat to its operations, and would like to infiltrate them — but so far has been unable to do so effectively.

Mercenary Units

Independent groups of mercenaries exist all over Earth and throughout the colonies. Some are truly independent, selling their services and loyalty to the highest bidder, while others have long-standing relationships with particular power groups. Terradyne, UPOE and most national governments have been accused of hiring mercenaries to do their dirty work.

Mercenary missions include direct physical sabotage, computer sabotage (often involving the data nets), assassinations, kidnappings, terrorism, anti-terrorism, protection and theft. Missions could be as normal as providing escorts for corporate executives, or as strange as smuggling controlled species from Earth to the colonies.

Mercenary lifestyles vary a great deal. Bands of Yellow Crescents, employed by Southeast Asian drug lords to protect their crops, camp out in the jungles, living at TL5 or TL6 and using TL7 weapons. In a very different setting, members of a secret sabotage group called the Asheford Press live normal lives in the large cities of Europe and North America. They use sophisticated TL8 communication and demolition equipment to get their job done.

To join a mercenary group, a character must have the necessary skills (see *Job Table*, p. 121) and get a Good or better reaction from the unit's leader.

Small mercenary bands (less than 20 members) and those with secret memberships are more difficult to join. They generally recruit new members themselves, after studying them for a while, and tend to view anyone who knows enough to ask about joining as a threat to their security.

The Six

This is a group of six of the largest finance banks in the world: Emerson Trust of New York, Sumitoh Shosha of Tokyo, Free Market Bank of Bombay, Rhinebank of Berlin, Handlowy Ruthenia of Warsaw, and the First Bank of Korea. On the surface they all appear to be independent banks, competing with each other. But there are very strong indications that they are "cooperating" on many fronts.

If they ever succeed in a merger (the largest since Terradyne's reorganization in 2064), one financial corporation will hold the lien on nearly half of the world's national debts. Such a move would be met with fierce opposition, probably with UPOE as its leader, but there is evidence that the Six are already making preparations. They are using their political strength to change laws in key nations and their economic strength to gain new political advocates. UPOE representatives don't come cheap, but if these companies can't buy them, who can?

"Beijing Aerospace"

This is a western nickname for the dozen or so Chinese companies cooperating legally under the provisions of UPOE's Free Space act. Their greatest achievement and largest source of gross income is the development and production of the Payload-90 shuttle. The Payload-90 is competing effectively with Terradyne launchers, and China is pushing for a similar effort in the area of low-Earth orbit OTVs.

Legion Defense

Legion is the Earth's largest manufacturer of military technology. Every year its plants in France, India and Mexico turn out armored transports, hoppers, hovercopters and military aircraft by the thousands. Legion spends very little on research and design, preferring instead to "obtain" design information from the smaller, but higher-tech defense firms in the U.S. and Japan.

This company has pioneered the notion of "renting" military equipment. A nation under threat can quickly build up a large military without a severe blow to its budget. Short-term buildups are more frequent than all-out wars, so equipment is seldom destroyed in combat. And if it is, Legion gets a nice tax write-off.

The fact that Legion still *owns* all of this military hardware suggests a frightening scenario; if all of the equipment could be recalled, and the 350,000 Legion employees were trained in its use (and many of them are), Legion would have one of the best-equipped militaries in the world — able to stand up to any single nation on Earth, except perhaps the U.S., China or India.

International Chemical

Otherwise known as I-Chem, this company produces a wide variety of chemicals, including cleaning agents, catalysts, fertilizers, adhesives, composite materials, and food additives. I-Chem headquarters is in Kolhapur, India, just south of Bombay. While most of the company's research takes place in India, most of the production plants are in other countries.

India's growing chemical industry was nearly abandoned after the Bhopal disaster of 1984, and then again after the poisoning of the Brahmani Delta in 2029. After nearly a century, these events have faded and research is permitted (even encouraged), but there is still a collective national fear of poison production.

Kizawa Power and Light

Although it has a deceptively western-sounding name, KP&L is very Japanese. It is the core company of the Kizawa *zaibatsu*, one of the most powerful in

Japan. It is very traditional in its views of employee loyalty and has been accused of overt racism in its hiring practices. Indeed, there are very few non-Japanese in its ranks, even in overseas sales and construction operations.

This nationalism is of concern to the rest of the world because KP&L is the world's largest producer of fusion power plants. It dominates the Third World market by regularly introducing smaller, more economical plants than its competitors can offer.

General Genetics

This U.S.-based corporation dominates the market in new species of food crops and new livestock traits. Since it is the largest *user* of genetic engineering technology on Earth, it has invested heavily in basic genetic engineering research and is becoming a major producer of this technology. G.G. splicers now sit on lab tables in most major U.S. hospitals and genetic disorder clinics, and their use is growing abroad.

Rumors of research into illegal enhancement of humans and non-food species such as monkeys abound, but there is little hard evidence. Auditors have also found an unusual amount of research grants from the U.S. Army, earmarked for "Worldwide Organic Supply Studies."

Academy of Earth Scientists

The AES began as a small group of scientists from universities and research groups around the world who were very vocal in their opposition to much of Terradyne's scientific research. They were viewed as extremists and largely ignored until Earth's scientific community was shocked into action by the "theft" of Phoebe in 2051. Since then, AES membership has exploded. Their rolls now include prominent researchers of UPOE's Department of Environmental Sciences.

The AES is dedicated to Earth-based, morally responsible research. They take what steps they can to uncover dangerous practices and to prevent Earth's talented young scientists from being recruited by Terradyne. There are even rumors that extremists within the group may be responsible for expensive "accidents" at Terradyne launch facilities.

Organized Crime

The successful criminal of the 22nd century is usually part of an organized crime syndicate. These groups operate in urban areas, where they control key local officials to prevent the arrest and prosecution of their members. Some of the larger syndicates span entire mega-cities and operate at the power level of the largest corporations — indeed, some *are* in effect corporations. Most deal in "victimless" crimes like drugs, gambling, prostitution, pornography, weapon smuggling, loan sharking and money laundering — but their tactics for preserving these businesses are seldom victimless.

Ongoing battles between crime groups are common along borders between established "territories," and strikes into the heart of a rival's territory happen occasionally. In many cases, strict codes of revenge can fuel such feuds for decades, even after the reason for the first killing or bombing is forgotten.

Crime syndicates also run legitimate, profitable businesses. For hardened criminal groups these may just be fronts for illicit operations. For others, like the Japanese *yakuza* syndicates, these represent the majority of their income. In either case, these businesses benefit from the group's control of local officials, and illegal tactics are often used to force competitors out of business.

Without the support of a syndicate, the independent criminal faces a well-equipped police force with very effective surveillance and forensics techniques. Those who ply their trade in low CR areas, like the European complexes or the factory towns of Northern Japan, will find that these spots are jealously controlled by the local crime bosses.

Free Trade League

Not all of the trading ships which run between Earth and the colonies are controlled by Terradyne. A growing number of independent, basically honest traders are competing successfully with the huge corporate OTVs, supporting each other through the Free Trade League.

The League is a sort of trader's guild, with offices and meeting halls on many of the older Earth stations. A trader cannot join unless he can pay the dues ($2,000 per month or a $100,000 investment) and is professionally competent. Members who violate space law or default on loans are quickly dropped from the rolls. This gives any member in good standing instant credibility.

The League offers low-interest loans to members and passes the profits on to investing members. It also gets generous, but controversial grants and loans through UPOE's Free Space program.

While every large space trading company has either been taken over by Terradyne or destroyed by price competition, the independent traders manage to survive. There are just too many of them for Terradyne to buy up, and most are privately owned — free from hostile takeover. They deal mainly in small but expensive luxury items which are not carried by Terradyne ships, so there is no direct competition. The manifest of a League member might include jewelry, precious metals, cultural treasures (popular among some wealthy colonists), expensive foods or rare animal species. Many important non-Terradyne colonists will take more expensive League flights just to avoid setting foot on a Terradyne vessel.

Privateers

Privateers are independent traders who work the black market, often selling stolen items. They live their lives aboard their ships, only landing or docking to refuel, buy, sell, steal, siphon power from an SPS, or lie low for a while at a remote Lunar base or abandoned satellite. Many operate independently, looking for the higher profits of contraband like drugs and illegal technology, but some work for Terradyne, smuggling legal products to bypass Earth's import quotas.

Like their Free Trade League brethren, each privateer runs only one leg of the journey between planets, meeting with other traders on old, seedy orbital stations to "sell off" to the next leg. Getting contraband off of a planet, onto a planet, or through an orbital inspection requires contacts inside the system and a fair amount of "persuasion" money.

Many privateers smuggle illegal items like drugs and weapons to the colonies. Terradyne has tried to control this by paying colony employees in company scrip (see p. 38), which is worthless to Earth-bound smugglers, and by increasing landing surveillance and the number of high-speed surface vehicles used for interception. The privateers have responded to the scrip by recruiting illegal money changers among Terradyne employees.

Although it is difficult to prove, it seems obvious that a number of privateers actually work for Terradyne. The demand for Terradyne products on Earth is high, but UPOE import quotas allow only a limited number of items to be shipped down legally — a problem which the privateers can solve. Company agents can either sell products to the smugglers at very low prices, or they can arrange for a staged "theft" from a remote Terradyne factory.

Terradyne Survey Ships

Two large, slow, *Victoria*-class survey craft operate as far out as Jupiter using low-energy transfer orbits. They have a crew of 100 and are packed with the latest sensors, laboratory equipment and shuttles. Some of the crew members sleep during the long transfers between planetary orbits, but most remain awake to continue their research. Because of this, each ship has sufficient recreational facilities and sophisticated virtual reality systems to prevent "cabin fever." Tours on a survey ship can last anywhere from six months to six years.

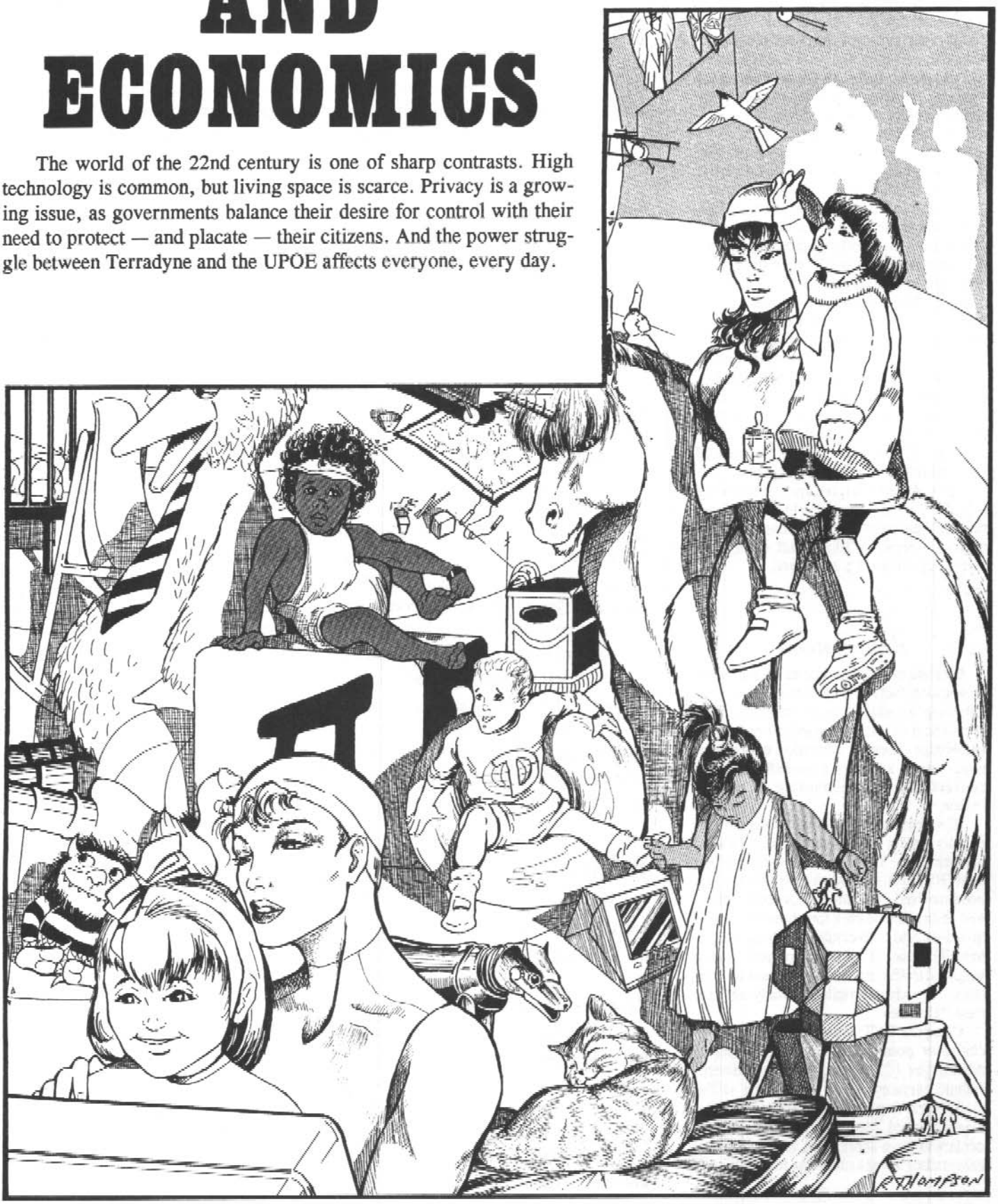
System Survey also has a number of smaller ships which are much faster, but carry a minimum set of instruments. Modified OTVs are used to observe short-lived phenomena (passing comets, collisions in the asteroid belt, etc.) and *quickships* are used for faster missions to the Jovian and Saturnian systems. Survey ships generally carry a crew of six to twelve scientists and technicians.

No manned missions have gone beyond Saturn's orbit. Unmanned missions to Uranus, Neptune and Pluto seem to indicate that they could provide no resources beyond those available from the nearer planets and the asteroid belt.

SOCIETY AND ECONOMICS

2

The world of the 22nd century is one of sharp contrasts. High technology is common, but living space is scarce. Privacy is a growing issue, as governments balance their desire for control with their need to protect — and placate — their citizens. And the power struggle between Terradyne and the UPOE affects everyone, every day.



Complexes

Many of Earth's urban poor live in large, modular shelters called *complexes*. Instead of simply handing out money, many nations encourage the needy to move into a complex, where their basic needs will be met free of charge. Tenants must agree to having their financial accounts monitored (to make sure they are truly needy); some nations sterilize residents for the duration of their stay. Tenants may enter and leave the complex after being scanned by chem-sniffers, and few visitors are allowed.

A typical complex covers multiple city blocks and houses 60,000. Living space is cramped; single living units are 200 square feet and family units are often less than 500.

Most complexes were built before the collapse and are poorly maintained. Human maintenance crews don't enter them, and most automated machinery has broken down or been destroyed by vandals or thieves. Some areas even lack necessities like clean water, filtered air or electricity.

Police never patrol the complexes and only enter to retrieve known criminals. Police response times for calls from inside the complexes range from very slow to never. Drugs, prostitution and violence are commonplace. Youth gangs fight for control of key corridors and public courtyards.

Parts of each complex are controlled by organized crime groups, in loose cooperation with the local gangs. These are often the safest areas — life is still unpleasant there, but at least it's organized.

Examinations

Because the educational emphasis is not on learning facts and each student may be following a unique course of study, it is impractical to test on a standardized set of knowledge. Instead, education expert systems "test" students constantly through conversation and monitoring of performance.

However, universities and potential employers need a way to compare applicants' performance. The Hermanson-Schwelling Test (HST) provides such a standard. It is a computerized evaluation of overall intellectual ability, based on a four-hour session of questions and conversation with an AI system. The end of each school year sees a surge of traffic on the nets caused by millions of graduates futilely "studying" for their "Hermies."

Compute HST scores by adding 80 to character points spent on IQ, IQ-related advantages (Charisma, Common Sense, Eidetic Memory, etc.) and mental skills, then subtracting points gained from mental disadvantages. Average college-age students will have scores less than 100; most universities accept scores as low as 80.

Habitat

In general, the average person's living quarters in the 22nd century are about half the size of his 20th century counterpart's. With overcrowding on Earth and limited room in off-world colonies, city planners and architects have had to learn to use space more efficiently. Communal areas and parks have become very important to create the illusion of open space.

Modern homes and office buildings are not only sturdier and easier to maintain than those built a half-century or a century ago — they are also effective secretaries, accurate accountants and excellent chefs. They'll even clean themselves if shown how. Most homes and offices have a main computer of complexity 4 or higher and dozens of smaller computers with dedicated tasks such as security, door control and waste management.

Any building constructed in the last 50 years or so is also sure to have a good supply of network jacks and a connection to at least one query service (see p. 101). The exceptions to this are very secure buildings which are isolated from the net, and homes of privacy paranoids who fear net services will allow others to monitor their daily life.

Careers

People of the 22nd century still spend a significant portion of their time working to earn money, as people have done for centuries. But there have been some changes.

The rise of computer-controlled factories and world-wide data nets has allowed most people to work out of their homes. *Information* is the world's growth industry — creating, gathering, documenting, storing, processing and selling it to those who need to make decisions based on it. Many of these information processors are end users as well, primarily in the financial markets.

In general, workers change jobs more frequently than in the past. The average employee stays with a company for only three years and changes careers entirely every eight years. Even within a company, jobs are constantly changing; the average worker spends 15 hours per week in continued training. The combination of VR technology and computer simulations can provide very effective on-the-job training, making it much easier to learn a new skill or switch careers.

This is not the case in Terradyne and other companies influenced by Japanese management styles. Employees tend to stay with these companies for life, although they often change careers *within* the company and in fact are encouraged to do so.

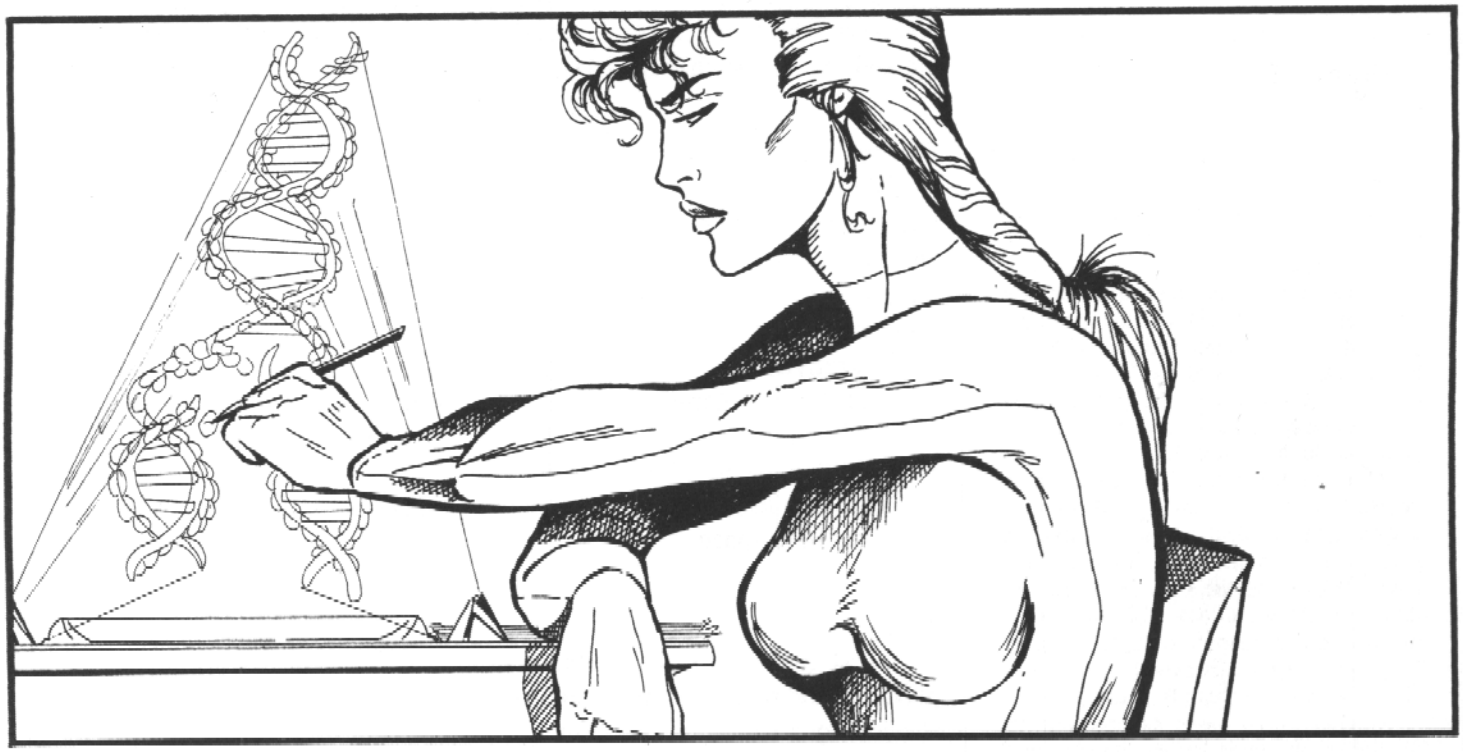
Education

Education is considered essential in an information society. All societies require primary education through age 16; technical and university training is also widely available.

Primary Education

Educators have long recognized the need for children to learn to interact with their peers, so most children age 16 or under attend formal schools. Most schools on Earth are run by local governments; Terradyne sponsors most schools in the colonies. Religious and private schools are available as well, and parents can in some cases educate their children at home through the data nets.

Schooling consists of developing students' analytical, cognitive and creative abilities. Rote learning is de-emphasized. There are no textbooks as such, and no



grades; students are led through their courses by expert systems capable of answering their questions, and by teachers. They are encouraged to learn at their own pace, and when a student finishes a course, he moves on to the next.

Universities

Most universities are very specialized, training students in four to eight years for specific careers. Few schools still offer the more "general" college programs in liberal arts. Even at the high school level, students are prepared for college by computerized instruction tailored to the specific career areas of their choice.

Universities are often associated with a single corporation, union, special interest group or government body which pays a large percentage of the bills and employs most of the graduates. Compared to the universities of a century ago, they do less basic theoretical research, studying practical applications instead (and getting patents for the corporate sponsor). They have effectively become the recruiting, training, and basic research sections of many large corporations.

Socially, universities have changed very little. They are still most people's first taste of real personal freedom (and responsibility). They are also a source of social protest, though the opinions professed in rallies and demonstrations rarely conflict with those of the sponsoring institution.

Family

The family is still the basic unit of society and the institution responsible for raising children. "Traditional" families, however — with a husband who works outside the home and a wife who stays home and takes care of the children — are rare.

Family Partnerships

Throughout the colonies and much of the Earth, two or more individuals may declare themselves to be joined in a family partnership, similar to a business partnership. The traditional version of this is a man and a woman joined in

Computers in the Home

Every modern home has one main computer which can communicate verbally with the occupants. These systems commonly have personal names to let them know when they are being addressed; they may even run personality simulations and expect to be treated as part of the family. A conversation with Felix, a complexity 4 home computer with a variety of software and a line to a good query service, might go like this:

"Excuse me, Carl, but you should be getting up soon."

"Huh . . . What? Felix, it's only 6:45. I usually sleep until 8:00 on Wednesdays."

"Carl, you have a 7:30 VR meeting with Osako-san, and you usually schedule 40 minutes to get your files together and suit up."

"Oh. Thanks, Felix. How'd you know I had a meeting this morning?"

"You told Janet about it yesterday during dinner. I was monitoring."

"I thought I told you to nix the eavesdropping for a while."

"No. You didn't."

"Well, stop monitoring as of now. The codeword to resume will be 'Blueberry Waffles'."

"I understand. The codeword is 'Blueberry Waffles.' Anything else, Carl?"

"Yes, forget everything you've heard about Osako Shuzo and Kukeso corporation. And run diags on my suit."

Religion

Though restrictions on religious practices have been nearly eliminated, most large religious groups have seen their followings decrease dramatically over the past century. There are as many theories to explain this as there are sociologists to formulate them — perhaps more.

The exception is Islam, which has flourished; the Islamic revival of the late 20th and early 21st centuries increased the political clout of Islamic nations and began healing old wounds with the West. Americans were so taken with Islam, in fact, that today Sunni Islam has well over 15 million adherents in the United States.

As traditional religions decline, many people have begun studying and reviving ancient and classical religions. Egyptian mysticism, Zoroastrianism, Taoism, Druidism, Wicca and the various Greek and Roman mysteries all have followers. One wealthy (and eccentric, some would say) Terradyne stockholder even funded a temple of Dionysus in Quad B of Luna City.

Another group bases its practices on Australian aborigine nature worship and totemism, making frequent pilgrimages to learn from the few aboriginal groups still surviving in the Australian outback.

Terradyne employees bring their religions with them to the colonies, so there are Christian, Jewish, Buddhist and Islamic groups on Mars and the Moon. There is even a small Shinto shrine among the living quarters of Luna City.

Entertainment

The most important entertainment development in modern times is, indisputably, the computer. Computers drive the Virtual Reality technology which truly brings the experiences to life.

VRs are described in more detail on p. 103. They can be stories which the viewer passively watches or interactive worlds. Live-broadcast VRs allow the user to attend sports events and talk shows. Interactive stories and VR games are often so detailed and realistic that they become an escape from daily life and can be addictive (see p. 118).

Music has also been heavily influenced by computers. It is recorded, mixed and played back by computer. In concert, very few musical groups can produce anything approaching their recorded material without the help of computers. Live performers on non-computerized instruments are rare and considered somewhat snobbish.

Despite rumors that "print is dead," it is alive and well on the data nets. It is not often recognizable because it is usually read and processed by computer and presented verbally. Novels seem to be the last stronghold of non-interactive entertainment; some provide alternatives for the listener, but most are straight text.

marriage, but same-sex and multi-party families are accepted and nearly as common. Children become part of the family partnership of their primary guardian and regard the children of other partners as brothers and sisters.

Bearing Children

Many of Earth's nations have stringent reproduction laws, and offer incentives (larger living quarters, cash bonuses, etc.) to those who voluntarily sterilize themselves. These people are free to adopt children, and in fact there is a waiting list for adoptions. Most people, however, still prefer to have children the old-fashioned way.

Terradyne, however, is anxious to raise populations and increase the number of natural-born colonists. It encourages families by providing free fertility drugs and artificial insemination. Terradyne employees receive a $2,000 bonus for each child up to the fifth.

Freedom to bear children is one of the benefits which constantly draws new colonists in to space.

Raising Children

Most guardians take advantage of the variety of child-care services offered privately and by governments and corporations. A child who is always cared for at home by a parent or guardian is part of a small minority. Most spend a large part of their time in child care centers or under the watchful eyes of a nanny.

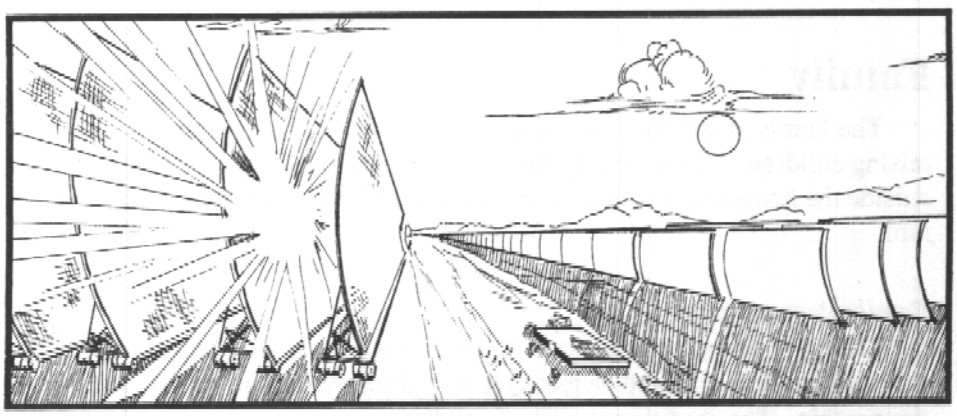
Many children do not live with even one natural parent. So many, in fact, that the term "parent" has been dropped in official references, as well as everyday speech, and has been replaced by "guardian." In many nations, guardians must satisfy a local official that they will be competent, even if they are a child's natural parent — in effect, all children must be adopted, but their natural parents get the first chance.

Economics

Effects of the Collapse

The economic collapse of 2094 allowed UPOE, which had been slowly gathering political power, to control the world's economy as well. UPOE was the driving force behind the recovery, issuing a world currency and establishing a world economic reserve.

UPOE also stimulated growth in the world economy by providing economic support for "public works" projects worldwide. Many of these, like the Free Space program (see p. 11), were intended to pave the way for Earth-based companies which could compete with Terradyne.



For Terradyne, the collapse brought the end of its special relationships with the U.S. and, to a lesser extent, Japan. The giant corporation was now in direct confrontation with UPOE yet had no intermediaries to represent it in the assemblies. As an added frustration, UPOE controlled the company stocks once owned by the U.S. government, which means they held one of the six seats on the Board of Directors.

UPOE took advantage of this situation by increasing taxation and tariffs on Terradyne products and decreasing import quotas. The result was a surge in the number of smugglers and black market dealers. UPOE was forced to respond by increasing the number of ISF officers in the colonies.

The UPOE Standard and World Economic Reserve

The people of Earth gladly exchanged their rapidly sinking national currencies for the more stable UPOE Standards. Such exchanges brought further confidence in the world government and decreased the stability of local currencies, adding to the incentive for others to make the switch. By 2098, most of the world's economic assets were measured in Standards.

To control the supply of Standards and their value, UPOE has established the World Economic Reserve, providing a single, central deposit reserve for other banks. Using this reserve, UPOE's World Economic Regulation Council controls the money supply, inflation and economic activity by setting interest rates and purchasing securities on the open world market. It also sets the minimum reserve deposit ratio (available currency to deposits) for each of 144 Regional Reserve Banks and closely monitors their activities.

The council can encourage savings by raising its prime lending rate, or increase world-wide spending by decreasing it. It can also influence inflation by

The Media

The term *media* has historically referred to the public's three most important sources of information — radio, television, and newspapers. Today's source of information (and communication, and entertainment, and software, etc.) is the data nets — so the data nets are the media.

The super networks which existed during the early years of radio and television are gone. They've been replaced by millions of separate information sources, each with specific interests and definite biases.

Anyone with write access to a database node can sell information over the net. Legal restrictions about what can be posted are the same as those for any publishing industry — the information posted need not be true, but legal action could result if it is false, malicious and damaging (e.g., libelous).

Advertising

In the early days of television, it was easy to get the public to watch a commercial for a product — it was wedged it into the most exciting parts of a program.

Things are tougher for today's advertisers. Commercial interruptions still work during live, interactive VR programs, but net "viewers" can instruct their interface computer to filter obvious advertising out of any recorded material. Commercials are now fully integrated with the programs — VR stars are seen using particular products and news programs include stories about the merits of each sponsor. Many database nodes claim to be "commercial free," but few are.

Finance

Throughout the world, and in the colonies, people live out most of their lives in debt to banks and corporations. Most of this debt is secured by collateral, but some is based only on personal credit ratings (see *Jobs and Wealth*, p. 119). The typical interest rate for personal loans with reasonable collateral is 6% over inflation, while unsecured loans are 10% over inflation.

To get a loan, a character must provide proof of sufficient credit rating (or collateral) and ability to make regular payments. Privacy laws forbid credit agencies to keep permanent records of a borrower's financial situation after the loan decision is made. This makes cross-checking of information on the application difficult, so interviews with potential borrowers are *very* important. Applicants will be interviewed for any loan of $1,000 or more, and must get a Neutral or better reaction.

Investment

The most common forms of investment are still stocks, bonds, and bank deposits. The return on each of these varies, as does the risk involved.

Stocks represent partial ownership of a corporation's assets, while bonds represent loans made to the corporation. A stockholder is allowed to vote on corporate policies in proportion to the number of shares he holds. Ownership of a corporate bond does not confer voting rights. If a corporation goes bankrupt or is liquidated, however, bondholders have first claim on the corporation's assets.

Stock and bond transactions require the services of a trained broker or a Broker Expert System. Using the Broker services available on the net, a single transaction (any amount of a single type of stock or bond) costs $50 plus a 1% commission.

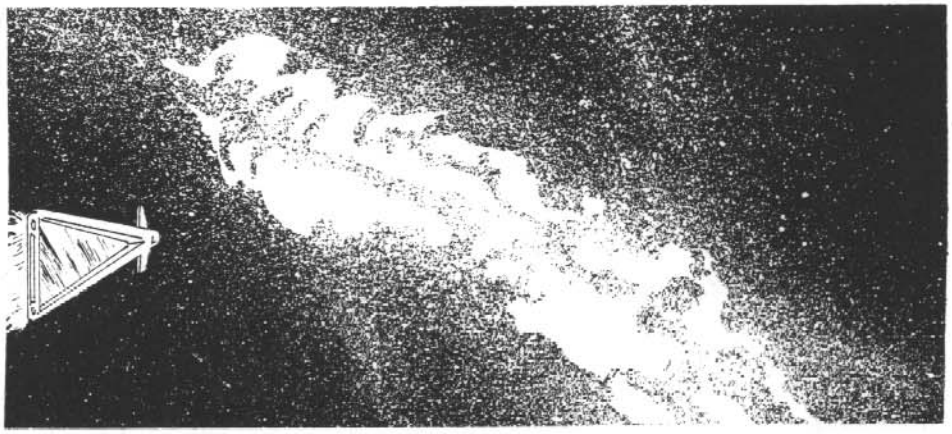
Banks which belong to the world reserve system can offer very low risk, highly liquid investments in the form of common deposits. Money deposited in a bank may be loaned out on risky ventures, but the loans which go bad can easily be covered by the bank's UPOE mandated reserves.

Transaction Cards

These are small keypads which fit nicely in a pocket and weigh only one ounce. When making a purchase, the owner keys in the amount of the purchase and inserts the card into a slot so the store's computer can read out the access code. Most stores immediately verify the transaction with the customer's financial institution over the net (which takes 3 seconds). A standard transaction card costs $50, and banks charge $10 to "burn in" an ACG. A machine which can burn in ACGs costs $250.

When a person wants to give money to someone, but doesn't have immediate access to the data net, he can just punch up the transaction on his card and read off the access code (a string of 10 to 12 numbers and letters). The other person can use this value to make the transfer some other time.

For security, transaction cards require the user to enter a 4- or 5-digit password before each transaction; the user can change this password at will if he knows the current one. With a multi-password card, the user can define different passwords for different amounts, or totally disable transactions over a certain amount. A card could have one password for transactions up to $100, another for transactions between $100 and $500, and transactions over $500 could be prohibited. A multi-password card costs $300.



adjusting the minimum reserve ratio for its regional banks. The council can even set separate reserve and interest rates for each individual bank, allowing it to adjust for regional problems without affecting the whole world. Critics argue that rates tailored for a specific region allow the council to discriminate and undercut the worldwide stability the Standard was intended to provide.

Trade Between Earth and Space

Nearly 500 tons of goods and materials are launched into orbit every day on shuttles, and 1,500 tons drop to Earth on expendable Mayflies and returning shuttles. Cargo from Earth is mostly heavy metals, luxury items and personal belongings of new colonists. Items shipped to Earth include high-tech electronic gadgets manufactured at L4 or in clean factories on the moon. Mars plays only a secondary role in this trade arrangement; its main product, hydrogen, is not shipped to Earth, but it is vital to the operation of the transport ships.

Most of the cargo is carried by ships of the large Terradyne Fleet, but they do have competition. The members of the Free Trade League, a growing "guild" of sorts for independent traders, have taken most of the non-Terradyne passenger business.

Import Restrictions

Since the collapse, UPOE tariffs on off-world goods have reached 20% of the market value, and tariffs imposed by individual nations are almost as high. Most items are also subject to import quotas, generally far below Terradyne's production potential. These quotas were intended to restrict Terradyne's high-tech monopoly, but their usefulness has been eroded by a lack of public support and the increased activities of smugglers and Terradyne privateers.

In addition to the tariffs on imported goods, *anything* of value brought back from the colonies, including personal belongings and money, is subject to a tax of 25% of its value. (Colonists returning to Earth need only declare money and goods gained while off-planet.) The intent of these laws was to make up for UPOE's inability to monitor and tax off-world transfers of money; the effect has been to encourage Terradyne employees to stay with the company and keep their money in scrip.

The Black Market

These laws also encouraged the formation of a black market in Terradyne goods, especially since legally-imported goods tend to end up in the hands of the wealthy and privileged. Smugglers can freely buy Terradyne products at wholesale prices in the colonies, but because they take risks and have to sell their products through indirect channels, the end prices for blank market goods are 50% higher than regular listed prices.

Smuggling also goes the other direction. Most illegal traffic from Earth to the colonies consists of drugs, weapons, banned VRs and similar contraband. Approximately 15% of Terradyne's Corporate Security efforts go toward investigating and stopping smuggling.

Black market operations in the colonies are on a much smaller scale than on Earth and are well concealed because import inspections are more thorough and there aren't many secret storage locations. The owner of a legitimate shop might sell a few illegal items a week, and only to well-known customers. The only full-time black marketeers are the so-called "outside" dealers who buy up large cargoes at remote landing sites on the Moon and Mars, then store it and sell it at some secret location on the planet's surface.

To find a black market dealer in a large city or settlement, a character must make a successful Streetwise roll (-3 to find an outside dealer), then get a Neutral or better reaction in order to be able to buy anything.

Import Inspections

All cargo landing on a planetary surface or being transferred to an orbital station is checked out by import inspectors. The thoroughness of these inspections varies from location to location, as does the susceptibility of inspectors to bribes.

Earth-bound cargo is inspected at the landing sites, usually by local officials, most of whom can be bribed. The GM should make a reaction roll based on the size of the bribe as compared to the official's salary, with modifiers for the size and legality of the item. On a reaction of Neutral or better, the official will let the cargo pass unreported. A worse reaction means the bribe attempt failed; critical failure means the official *immediately* calls the local police or the ISF.

Occasionally, if the ITC suspects that local inspectors are accepting bribes and passing cargo through unreported, it will place one or more of its own inspectors at the port. The only effect is that the smuggler must now pay off the UPOE official instead of the locals. RMA agents occasionally go undercover as local inspectors to check up on ITC officials. Most RMA agents will not accept bribes.

Goods bound for the colonies are inspected by Terradyne officials. There are no import taxes, tariffs or quotas in the colonies, so they just search for illegal items. Terradyne's inspectors cannot usually be bribed, so most smugglers bypass them by landing at remote sites. This is a rare occurrence on the Moon, but is relatively common in the frontier areas of Mars. It is also easy to unload illegal goods at older Earth stations, many of which have no inspectors.

Laws

UPOE laws deal with interactions between nations as well as areas beyond normal jurisdiction (such as space and the high seas). National, local and municipal governments also implement laws reflecting their own local values.

Terradyne and other large corporations have their own corporate policies which can have the force of law within the corporation. In theory, Terradyne employees are subject to UPOE and natural laws; in practice, however, the UPOE often lacks the means to enforce its laws in the colonies.

UPOE Law

UPOE Assemblies establish two different classes of laws: *International Law* and *World Law*.

International Law protects the sovereignty and resources of nations and the rights of their citizens. It includes laws regarding military action, use of space,

Electronic Transfers

Most financial transactions happen electronically, with no need for paper currency. Businesses transfer wages directly into each employee's account, bills are paid by computers with the proper account access codes, and purchases are made using calculator size transaction cards.

Anyone opening a financial account is given a customized Access Code Generator (ACG) program (complexity 1) which generates a unique password for each money transfer based on the time and amount. The financial institution keeps a copy of the program which must generate a matching access code for the transaction to succeed. Most people run these programs on their home computers, allowing their financial management software to pay bills and make transfers for them.

Hacking into one of these accounts requires access to a copy of the ACG program. This may require breaking through security software or gaining physical access to a specific computer. Many ACGs, especially in businesses, will also be protected by voice-print analyzers or other security devices. If the trespasser cannot gain direct access, it is possible to write a matching program by monitoring thousands of separate transfers to determine how the access codes are generated (Cryptography-4, Computer Programming-4), but banks change these programs every few months.

No access codes are required to transfer money *into* another person's account, but the financial institution can be instructed to notify the recipient of deposits over a given amount.

Yankee Traders

There are many items that Terradyne either will not import for its employees in the colonies, or doesn't have the time to bother with. This has left a void which is filled by *Yankee traders*, named for the peddlers who traveled door-to-door in the 18th and 19th centuries in North America.

These traders move from settlement to settlement, usually in ramshackle space ships, selling their wares and picking up items to sell in the next colony. In smaller camps they are heartily welcomed as a fresh source of news and gossip from the outside. Their stock in trade varies widely, from beef jerky and dried fruit to "spicy" VRs and print publications.

There are occasional rumors that some of the Yankee traders are actually RMA spies. If so, colonists in general tend to feel that the visits are worth being spied on.

Terradyne Scrip

All Terradyne employees in the colonies are paid in company scrip instead of Standards. One scrip "credit" is equivalent in value to a Standard, but is not accepted by anyone but Terradyne, which will not exchange them for Standards *except* for retiring employees returning to Earth. This forces employees to buy from the company store and save at the company "bank." Prices at the company stores are usually fair, but selection is somewhat limited.

Scrip is used instead of UPOE currency to indirectly control trade from Earth. Independent traders are at the company's mercy, and black marketeers have to find corrupt money-changers for the scrip they get from the colonists. Independent traders, including black marketeers, love real UPOE Standards because they eliminate the considerable problems of exchange; many will not even accept scrip. They usually add 25% or more to an item's cost if it is purchased with scrip.

For this reason, a Standard is actually worth 25% more than a scrip credit in areas where colonists routinely buy from independent traders and black marketeers.

Even with Terradyne controls, colonists still manage to get Standards. The easiest way is through non-Terradyne colonists who are paid in Standards. Terradyne employees buy items at the company stores with their scrip and sell them to independent colonists for Standards.

Standards also come into the colonies when black marketeers use them to purchase Terradyne products from colonists for sale on Earth.

Earth-bound retirees are also a source of Standards in the Terradyne economy. Shortly before they leave for Earth, they take out large loans in UPOE Standards on the black market, paying them off when they exchange their life's savings. The retiree can set up his own exchange operation, taking out loans at 10 or 15% and getting a 25% markup in exchanges with other colonists. The company is well aware of this scheme and routinely watches the company bank accounts of likely suspects, looking for a sudden rise near retirement.

economic and environmental responsibility, and fundamental individual rights. Any nation that violates International Law will be tried by UPOE's Justice Department and, if found guilty, will be reprimanded by the Assemblies through economic sanctions or military intervention.

World law governs the activities of individuals and groups in places where national laws cannot touch them — in international waters and space. It also handles crimes which involve more than one nation. These laws deal only with crimes which are recognized as illegal worldwide — such as murder, theft, assault and other violations of human rights.

National Laws

In general, national laws complement UPOE laws to form a complete legal system. They are heavily influenced by local values, reflecting local religion and social ideals. Capitalist nations have fewer laws limiting the activities of businesses. Islamic nations have strict criminal laws with severe, non-negotiable punishments. The Indian legal system has a large category of laws governing the creation and interpretation of laws, making it the most complex system in the world. Some nations have many laws which are never enforced, existing only to present the proper face to the rest of the world.

Visitors to a nation are still subject to its laws. If an action would not be a crime in the suspect's home nation, government agencies may intervene and make a deal to bring the accused home — but the aggrieved nation is well within its rights to imprison the suspect, so it's a good idea to make sure of local laws and customs before traveling abroad.

Law in the Colonies

In theory, the colonies are subject to the laws and regulations of UPOE, but there aren't enough ISF officers to enforce them. So ISF officers concentrate on tracking Earth-bound smugglers and data pirates. Most World Law crimes go unchecked.

In the absence of World Law or a national legal system, laws in the colonies consist mainly of Terradyne corporate policies. In addition to crimes committed directly against another individual, any activity which could seriously lower company profits or damage its reputation is illegal. On Earth, for example, an employee who passes proprietary company information to a competitor will be fired and may be sued for financial damages. In the colonies he would automatically be deported to Earth.

The status of non-Terradyne colonists is uncertain. Terradyne claims they should be subject to its policies while inside its facilities. UPOE doesn't recognize this claim — because Terradyne is not a nation, it cannot apply its legal system to visitors. The UPOE Office of Colonial Affairs has led efforts to convince Terradyne that it is in its interests to simply deny convicted violators access to the colonies.

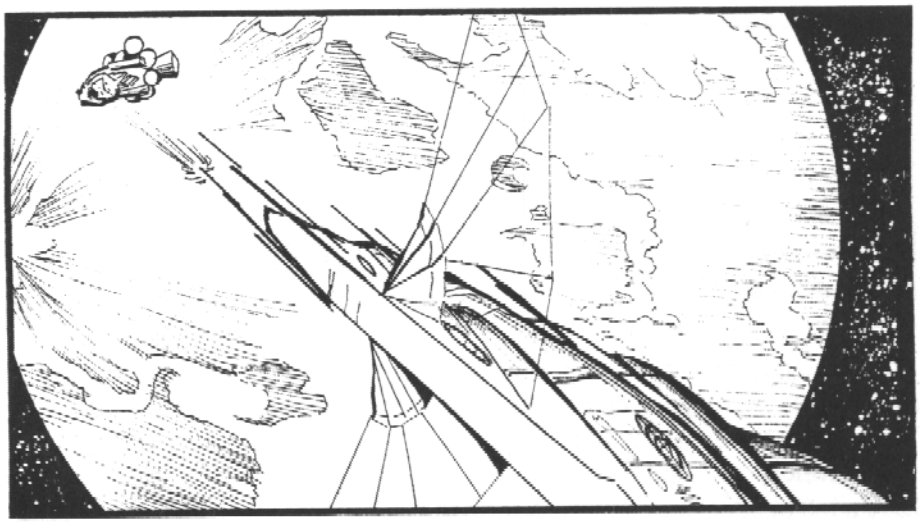
Space Law

UPOE space law regulates the activities of all man-made objects which reach an altitude of 100 km or more above a planetary surface. It addresses prime orbits, controls some forms of travel, defines the proper behavior for ships meeting in space and establishes the rights of individuals aboard space vessels. Most of space law consists of regulations which can be modified by the Space Claims Committee or the Interplanetary Trade Commission without formal approval of the Assemblies.

Following the principles of the Outer Space Treaty of 1967, individual Earth nations have no sovereignty in space (see p. 8). They cannot claim any area of

space or the surface of any other planet. They are also prohibited from stationing offensive weapons in space or establishing military bases there, a restriction which is stretched to the limit by dozens of orbiting Defense Management Stations (see p. 53).

Space law is enforced by UPOE's ISF (see p. 14) with the help of local spaceport officials. Terradyne's Corporate Security Forces also help, but only when it is to the corporation's advantage.



Launch and Landing

Earth nations still control their own airspace below 300,000 feet. They can place any restrictions on space launches and landings within their territory. Not all nations have spaceport areas, especially not those far from the equator. Those that have launch sites restrict the types of spacecraft which can operate from them by limiting noise and radiation levels.

Both UPOE and Terradyne own and operate spaceports around the world. They are generally larger and better equipped than national spaceports.

At least ten Earth launch sites can handle typical space vehicles like the LEO Shuttle and the Payload-90, and there are even more sites where these glide-return vehicles are allowed to land.

There are no Earth sites where a fusion drive or fusion ramjet spacecraft is allowed to launch — the levels of radiation would violate local ordinances, as well as UPOE's environmental laws. Fusion drives may not operate anywhere within Earth's atmosphere. There is no such restriction on Mars or the Moon.

Orbit Control

Satellites and debris in the relatively narrow band or Earth's geostationary orbit already form a dim man-made ring, and hundreds more satellites are squeezed in every year.

UPOE's Space Claims Committee monitors all orbiting satellites of the Earth, Moon and Mars. It must also be consulted before inserting any object into controlled orbit zones. Examples of controlled orbits include the geosynchronous orbits around Earth and Mars and very low, surface-skimming orbits around the Moon.

Travel and Trade Restrictions

Any ships taking off or landing from a planet's surface or transferring to a different orbit must file a flight plan with the ISF at least one Earth day in advance. It must include the registry and serial number of the ship, the pilot's

Privacy Laws

The increasing storage and processing capacities of computers, coupled with the quality of information which can be gathered by modern surveillance equipment and the speed with which it can be distributed over the net, threaten to destroy the privacy of individuals. To prevent this, the UPOE Assemblies have created a number of separate restrictions referred to collectively as the *Privacy Laws*. Interpretations of these laws differ from nation to nation, and in the colonies, but the basic principles are as follows:

Data Storage and Distribution

Organizations can only store and distribute personal information if they are given explicit permission by the subject, including a list of approved uses and a maximum duration of storage. The Privacy Laws also insure that each individual has access to all personal information organizations keep on them. Permission to store personal data is commonly granted for things like data net directories, medical records and insurance policies.

An organization's computer system must provide appropriate protection for the type of data being stored; names and net addresses are only level S1 (-1 modifier), but medical history and VR viewing habits could be as high as S3. (See p. 104 for access levels.)

Surveillance, Search and Seizure

Before doing any organized surveillance of a suspect, searching a private location or seizing private property, law enforcement officials must get permission from all affected persons or obtain a court order. The court order must contain specifics, including the alleged criminal activity, location to be watched or searched, and the types of items to be seized. It must also give the maximum length of time the information or confiscated physical evidence can be held by officials. These time limits can be extended by another court order.

Evidence held beyond the times listed in the court order or gained in violation of these procedures cannot be used in UPOE courts and most national courts. Illegal surveillance, search or seizure may also result in legal action against the officials involved. Items found during the course of a legal search which are not listed on the court order *are* admissible in court, as is evidence about unsuspected criminal activity gained during authorized surveillance.

Continued on next page . . .

Privacy Laws (Continued)

Violations

Organizations, including law enforcement agencies, which violate privacy laws may have to defend their actions in court. Cases against law officers are difficult to win in most Earth courts — too many rulings against them could make them too hesitant to take action and reduce their effectiveness.

Plaintiffs often win, however, in privacy suits against other organizations, and settlements can be large, depending on the violation. To protect themselves, organizations which store personal information on their computer systems frequently purge their systems of unneeded files. In some cases this is done automatically by an AI or a sophisticated expert system.

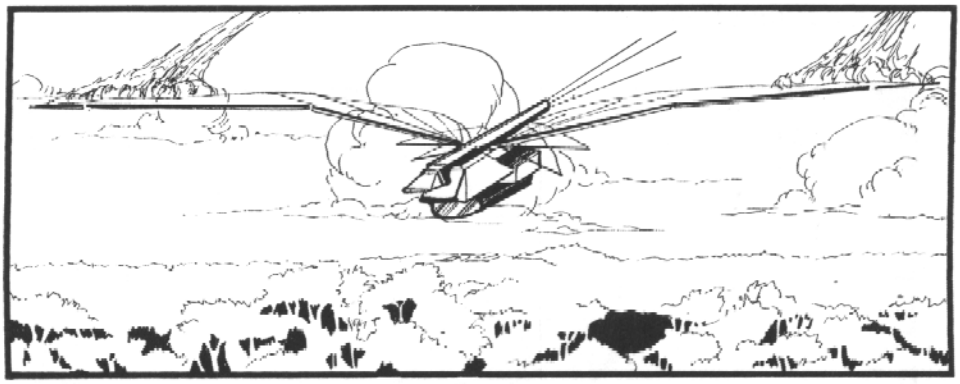
Privacy in the Colonies

Terradyne employees have much less privacy than independent colonists or the people of Earth. The company claims it needs detailed personal information to understand its employees and provide for their day-to-day needs. It has no trouble getting permission to store this data — those who don't grant it must return to Earth or struggle along as independent colonists.

It is also much easier to get a court order in the colonies. Court orders are normally approved by the local judicial system — a job filled by Terradyne in most of the off-world settlements. Company approval for surveillance search or seizure is given when there is enough evidence of criminal activity *or* if the strength and profitability of the corporation is being threatened.

Personal data files, and Terradyne computers in general, are well protected from outsiders (level S3+), but employees with authorized access to the systems have little trouble retrieving information about fellow employees — unless they are caught.

name and qualifications, a passenger list, and a brief description of the flight's purpose and cargo. They are submitted through computers, interpreted by computers and stored on a computer. Few are seen by humans. Flight plans are covered under the privacy laws, so the ISF deletes them after confirmation of a successful flight.



Cargo is subject to an import inspection at its destination. These inspections exist to detect smuggled contraband like weapons, drugs and illegal technology. They are also used on Earth to monitor quotas on Terradyne goods.

Travelers planning for an extended period in the colonies must prove they have a job or adequate support to survive there. Before leaving Earth, they must also endure an "exit interview" conducted by the OCA, during which they must declare official residency in an Earth nation. The interview is also a propaganda tool used to build loyalty to Mother Earth and to recruit spies for UPOE.

Pilots who do not file flight plans face fines of up to $1,000 per ton. Space travelers who are not on the passenger list and have not informed the ISF of their trip face fines of up to $100,000.

Law Enforcement

Any institution which creates laws must have some means of enforcing them. Earth nations do this through local police forces or by imposing martial law and using their military. At the international level, UPOE laws are enforced by a poorly coordinated combination of ISF officers, conscripted peacekeeping forces, and national agencies like the KGB and the U.S. Combined Intelligence Bureau.

Law enforcement in the colonies is the job of Terradyne's Corporate Security Forces and UPOE's ISF. There are also colonial militias — small groups of vigilantes who patrol the wild frontier settlements of Mars.

Jurisdictions

Local Police

Throughout most of the Earth, routine law enforcement is the job of the local police force. Some are dedicated crime fighters; others are completely corrupt, only doing what's advantageous for them. Local police generally have the power to arrest or detain anyone they suspect has committed a crime or has information about a crime. They cannot make arrests in other nations.

Military

The military takes over the role of local police when an area is placed under martial law, gaining temporary legal enforcement powers. They are not as concerned about individual rights and proper procedures as local police and are

more likely to use violent force. There are usually ten or more nations of the world under martial law, either because the current leader is losing power, a military coup is in progress, or social conditions have deteriorated into violent demonstrations and looting.

Outside of areas under martial law, a soldier has no legal enforcement powers.

ISF

Officers of UPOE's Interplanetary Security Force have full enforcement powers in the colonies. According to their original charter, they are *the* police force in the colonies. They can arrest or detain anyone in connection with a violation of World Law, International Law, or UPOE regulations. In practice, the ISF only concerns itself with regulatory violations, leaving criminal cases to Terradyne's CSF. They can still use their enforcement powers when necessary.

RMA

UPOE's Regulatory Monitoring Agency has no official law enforcement power anywhere. They are primarily an intelligence gathering agency, with a small sideshow of covert activities. They only get involved in criminal cases which threaten UPOE's power base; when they want someone arrested, they go to the ISF or to mercenaries on their payroll. A case has to be big for the RMA to get involved.

CSF

Terradyne's Corporate Security Forces have the power to enforce corporate policies in the colonies and aboard Terradyne ships. They act as security guards and fill the role of local police, patrolling the larger settlements and dealing with all levels of crime. They also spend a lot of time tracking down colony-bound smugglers. Power over non-Terradyne colonists is limited to arrest and expulsion from Terradyne settlements; more severe punishments would result in expensive interference by UPOE's Office of Colonial Affairs. Independent settlers can do as they please in their own settlements, which are not patrolled by the CSF or the ISF.

Colonial Militias

In the smaller frontier settlements of Mars, where the CSF does not patrol, the black market does very well and unauthorized settlers make their own laws. Years ago, Terradyne employees in these areas began forming small groups of part-time police. These groups have grown and united into a well-structured "colonial militia." Terradyne has officially recognized it and granted its members the same enforcement powers as the CSF. But all attempts to incorporate the militia into the CSF have met with strong opposition from frontier settlers afraid their protectors would soon be off chasing smugglers.

Conscripted National Forces

The Conscription Agreement of 2031 gives UPOE the authority to "draft" peacekeeping forces from the 57 signatory nations. These forces are sometimes called up to stabilize a crumbling government or keep the peace in an area which has lost its government. In this role, they have the same authority as the military during martial law.

Tracer Implants

On Earth, many prisoners are given *tracer implants*. These are small transmitters surgically implanted in the skull. They transmit an identification signal unique to the wearer, allowing directional radio trackers to locate them. This not only makes it easy to keep track of inmates *inside* the prison — it is virtually impossible for an implanted prisoner to escape undetected. Local authorities around the world know the tracer frequencies and monitor them continuously. Tracers are also used to keep track of prisoners on parole.

Tracer implants can be disabled by removal, shielding, jamming or a strong blow to the head. The tracer can be removed by a successful Surgery roll if the proper medical equipment is available. It can be shielded by enclosing the entire head with metal — wearing a metal helmet or riding in an enclosed vehicle (no glass windows) is sufficient.

Tracer jammers scramble the tracer's coded signal, making it impossible to detect among all the background radio noise of civilization. They must be adjusted for a specific tracer with a successful Electronics Operation (Security Systems) roll. Some tracers detect when they are being jammed or shielded and inflict pain on the wearer; this is usually a moderate headache (DX-related skills at -3).

If the wearer receives a *brain* hit at the location of the implant, it will be destroyed if 3 or more points of damage penetrate before the skull's DR 2 is taken into account. See p. B203 for further effects of brain hits.

Tracer implants are TL8, cost $200, and the surgical process costs $500. Their AA cell power supply lasts ten years. Directional receivers (for locating tracers) are described on p. 102.

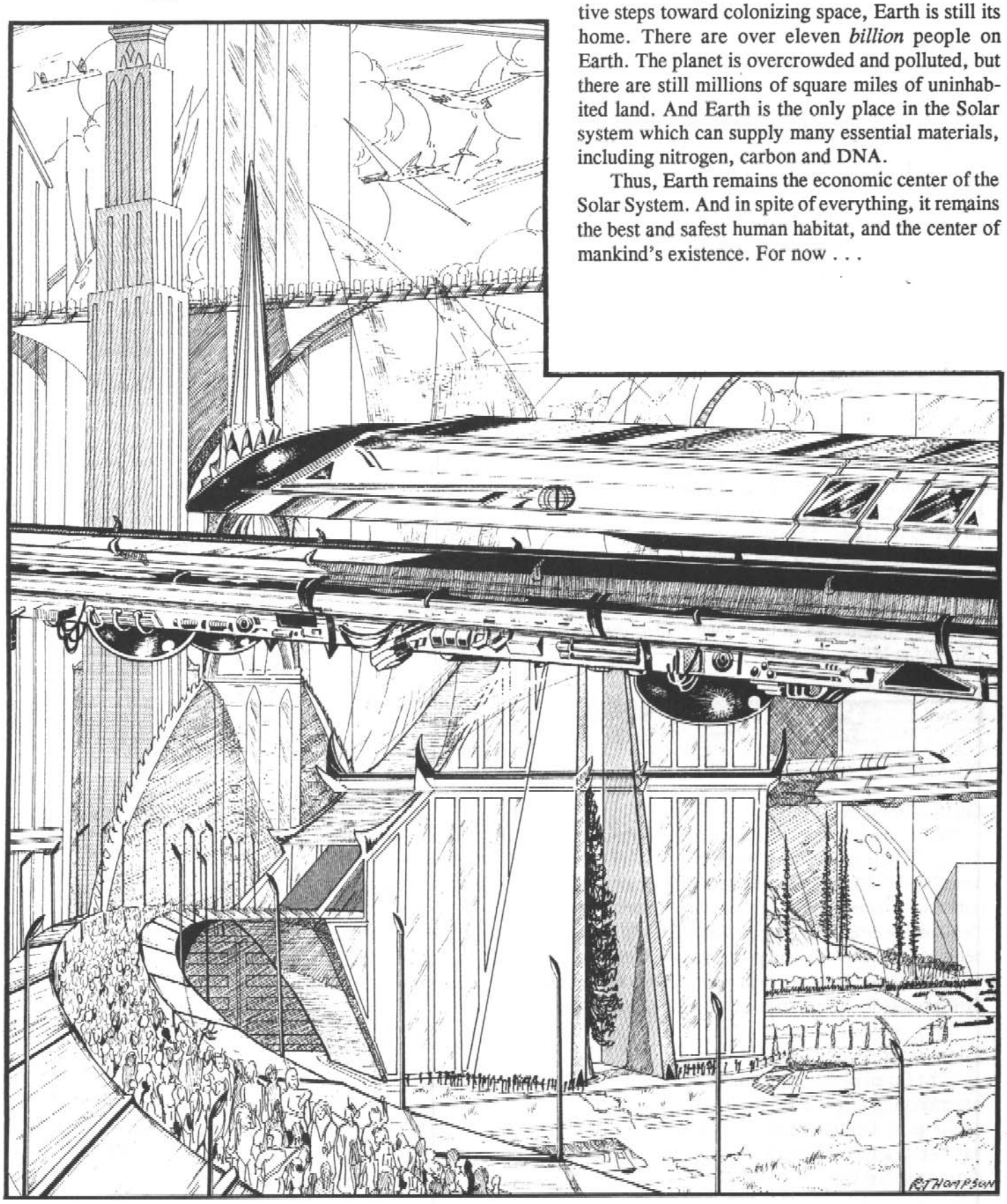
Tracer jammers are TL8, cost $1,000, weigh 1 pound, and operate on an A cell for 24 hours. They must be within 2 yards of the tracer to be effective. Tracers which detect shielding and jamming cost $500 plus $1,000 for implant surgery.

3

EARTH

Even though mankind has taken its first tentative steps toward colonizing space, Earth is still its home. There are over eleven *billion* people on Earth. The planet is overcrowded and polluted, but there are still millions of square miles of uninhabited land. And Earth is the only place in the Solar system which can supply many essential materials, including nitrogen, carbon and DNA.

Thus, Earth remains the economic center of the Solar System. And in spite of everything, it remains the best and safest human habitat, and the center of mankind's existence. For now . . .



The Cities

Today's cities are more decentralized than those of a century ago. VR, data nets and other advances in communication have reduced the need for a concentrated "downtown" area and allowed many more people to work from home. Many cities still have downtowns, but they are mostly holdovers from earlier times — primarily composed of older office buildings and housing complexes.

The newer areas are mainly apartments and communal housing built since the Collapse. A single-family house is a status symbol, highly sought after — and very expensive.

Administration and Services

The local government is responsible for a city's law enforcement, transportation, basic education and utilities. These services may be run by private organizations, but usually through a franchise granted by the city.

The city has some autonomy, but it is heavily influenced by provincial, state and national governments.

Crime

Today's cities are relatively safe, especially in developed nations. Violent crime has been reduced through improved law enforcement techniques. The only dangerous places are older urban areas and the housing complexes.

The United States is a notable exception. The crime confined to complexes in other parts of the world is spread through the streets of U.S. cities.

Urban Transportation

The most densely populated areas of modern cities are served by slidewalks. They do not pass every building in the city, but there is generally a step-off point within a quarter-mile of any major destination. Access to slidewalks is free in most socialist nations; where they are privately owned or not subsidized, there may be a nominal fee (usually $1). Outlying areas are served by public transportation systems; hydrogel-powered automobiles are available, but they are expensive and must be equipped to tie into a centralized traffic control network.

Maglev trains provide high-speed transportation over relatively long distances within a single megalopolis. Trains leave often — as often as one every 10 minutes on the high-volume corridors. Private maglev cars may also be used on these routes if they link into the line's traffic controller. The Northeast Corridor Line (linking Boston with Richmond, Virginia), the DDC Line (Dacca-Delhi-Calcutta) and the Rhine Express are good examples.

Rural Areas

The rural areas of Earth are dominated by large robotic farms (see pp. 99-100). The technicians and agronomists who work on these farms live in small

The Poor Side of Town

The older parts of some towns are areas of architectural historical interest. The downtown areas of Prague, for instance, date back almost a millennium, and there's still a certain amount of prestige attached to many of the older skyscrapers on the southern end of Manhattan.

Most of the older areas of large cities, however, have fallen into disuse and neglect. A few have been taken over by artists and other bohemians looking for inexpensive places to live; some have been converted into housing complexes. Many have just been abandoned to the elements; some of these have been taken over by otherwise homeless people desperate for any kind of shelter so they don't have to go to the housing complexes.

Traditional Farms

Some less developed nations still rely on traditional farms for most of their production. A few small farms even survive in Europe and North America, but in general these fall into two categories: traditionalists (including small pockets of Amish and Mennonites) and opportunists (setting up their farms as tourist attractions). Both groups refuse to use robots, though for different reasons, and the opportunists don't mind using maglev lines to get their produce to market.

Some traditional farm families feel threatened by the new robotic farms; a few even attempt to sabotage the field equipment or break into the central complexes.

Unstable Regions

Most of the world has been at peace for 20 years or more, but there are a few regions where warfare is common.

In northern India, for instance, continued disputes with Pakistan over Punjab and Kashmir often flare into border wars, and the growing chasm between social classes has thrown the states of Punjab, Himachal, Jammu and Kashmiro into a constant state of civil war. China has an army of 600,000 stationed in western Tibet to insure that the unrest does not spread north.

The Middle East also has problems. Its main resource — oil — is not nearly as valuable as it once was. Solar power satellites and fusion energy destroyed many Middle Eastern economies during the last century. These Arab nations have recovered, however, and have joined together to form a solid Islamic bloc.

towns scattered along the maglev lines that fan out from the local storage and distribution centers to the central complexes of the farms.

The newest robot farms are completely automated, requiring no intervention by humans, even for maintenance. Areas of highly productive farmland in the American Midwest and central Europe have no human residents. Old farm towns in the middle of these super-farms have been tilled under or become ghost towns. Someone who finds himself in one of these areas may travel 20 or 30 miles and pass many farm complexes before finding another human being.

Rural counties that were once covered by a solid pattern of cash crops are now mottled with sections of land allowed to go fallow.

Some land is also used for *prairie farming*, a method of mixed-crop agriculture which allows a variety of indigenous prairie grasses to grow together in a miniature ecosystem. The tops of the grasses are harvested year-round, and the fields are only tilled once every 5 to 10 years. Nutritional yields are similar to single-grain farms.

The Environment

The last 200 years of human progress have caused serious changes in the Earth's environment. Population pressure led to irresponsible farming techniques which in turn lead to desertification, causing famine. Rising world mean temperatures have melted polar ice and raised sea levels dramatically. Short-sighted exploitation of water resources has led to drought in some areas and dangerous levels of contaminants in others.

The solutions to these problems are long-term, difficult and expensive. Environmental scientists and activists have had a hard time convincing Earth's people to make sacrifices which may not have a noticeable effect for generations.

But there has been some progress. Fusion power has replaced most fuel-burning sources, greatly reducing production of greenhouse gases. Large tracts of rain forest in South America and Africa have been set aside as preserves, and more are being added. Modern recycling technologies — borrowed from offworld colonies, where recycling is a necessity — have reduced waste.

Population Pressure

The world population growth rate has fallen steadily since the mid-20th century, but Earth still holds 11 billion people. Per capita food production has actually increased during this period, so starvation and malnutrition are not major problems. Some studies indicate that the Earth's croplands, if farmed with the modern techniques, could keep as many as 60 billion people well fed.

But overcrowding — not hunger — is the problem. Over 80 percent of the people on Earth live in cities with populations of 500,000 or more. The streets are crowded, mass transit capacities are too low and housing prices are inflated.

Ozone Depletion

During peak solar activity, so much ultraviolet radiation reaches the Earth that without the protection of the ozone layer, an exposed person would receive a lethal dose in a matter of hours. The dose is considerably less during normal solar activity, but it can still have long-term effects.

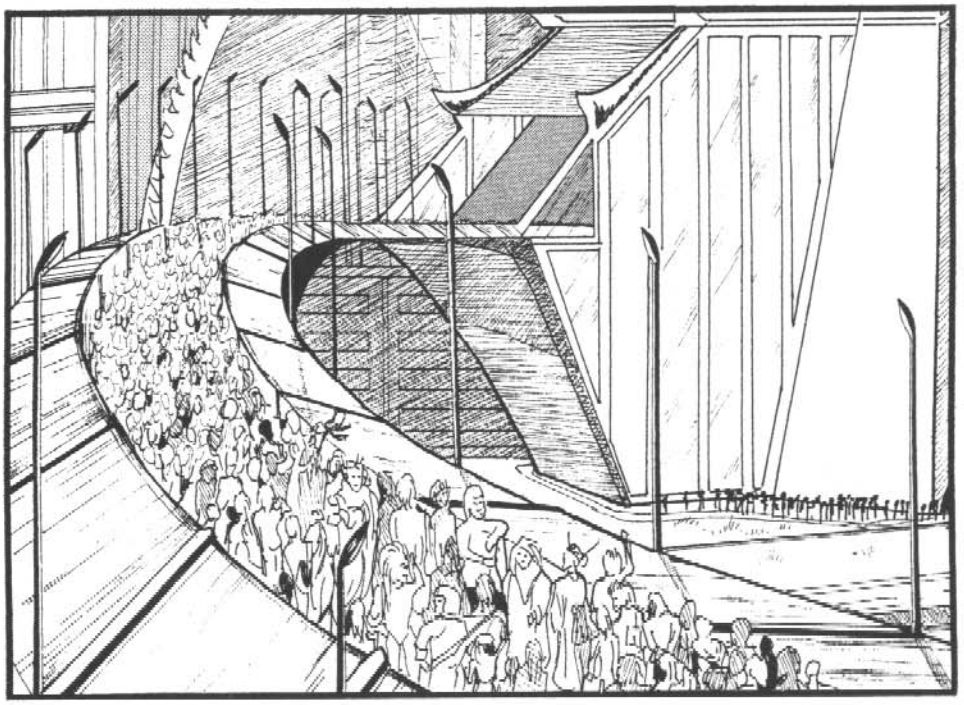
The ozone layer is a thin shell of atmosphere about 30 miles above the Earth's surface, near the boundary between the *stratosphere* and the *mesosphere*. It has a relatively high concentration of ozone (O_3) and atomic oxygen which work together to absorb the dangerous ultraviolet rays.

Ozone forms in the upper atmosphere, where some of the incoming UV radiation splits oxygen molecules (O_2) into two separate oxygen atoms, which then combine with other oxygen molecules to form ozone (O_3). Over time, the ozone molecules combine with other ozone molecules or atomic oxygen and again become more stable oxygen molecules. Newly formed ozone is constantly replacing the "decaying" ozone, so a balance is maintained.

The ozone layer has been seriously depleted by chlorofluorocarbons (CFCs) and other gases produced by the human race. These chemicals act as catalysts, converting ozone back to oxygen prematurely, thus upsetting the balance and depleting the ozone layer. The use of CFCs, primarily as aerosol propellants and refrigerants, was limited by law in the late 20th century, and completely banned in the early 21st when suitable substitutes were developed. But as soon as one such ozone-depleter was identified and its use stopped, another one was developed.

Ozone depletion has been slowed, but the damage has already been done. The rates of cancer and other radiation-related diseases have increased steadily since 1950, especially in the arctic regions where depletion is the worst. Westerners have had to end their love-affair with sun tans and only the uninformed wear no protective cream or clothing when exposed to the sun.

The colonies have played a key role in Earth's adaptation to this problem. Researchers on Mars, where there is *no* ozone layer, have been the source of new protection techniques, and when the Solar Weather Station at Mercury issues flare warnings, *billions* of people on Earth head for cover.



This forces the poor to live in housing complexes, abandoned buildings or improvised structures.

A growing world population also aggravates other environmental problems. More people need more energy, use more water, burn more fuel and produce more waste. They also need more room, so valuable forests are destroyed to accommodate them.

The Greenhouse Effect

During the last 200 years, humanity's use of fossil fuels has more than doubled the percentage of greenhouse gases in the Earth's atmosphere. Greenhouse gases, including carbon dioxide and water vapor, trap the sun's energy. They let sunlight pass to the surface of the Earth, where it is absorbed and re-emitted as infrared energy, which becomes trapped in the atmosphere.

Fusion and solar power have greatly reduced carbon dioxide emissions. But people still burn down forests and fossil fuels are still used in less developed areas, so the level of carbon dioxide in the atmosphere is still slowly increasing.

The buildup of these gases has raised the Earth's average temperatures 8 degrees Fahrenheit. The most dramatic warming has occurred at the poles, where temperatures are up as much as 12 degrees.

Rising Oceans

The warming of the poles has caused serious problems. During the early 2040s, major sections of the Ronne Ice Shelf in Antarctica began to break away, drifting north and melting in the warmer waters off the coast of Argentina. By the end of the decade, the Ronne Ice Shelf was nearly gone and the Ross Ice Shelf began a similar demise. By 2055, the melting ice had raised the world's oceans by 16 feet.

In the U.S., New Orleans and southern Louisiana were completely flooded, and the southern half of Florida disappeared. Miami was temporarily saved by a system of sea walls and a 100-mile causeway to the mainland, but it too was abandoned by 2060.

Other low-lying areas around the world have also been destroyed. Coastlines everywhere have retreated. Improvements to the Netherlands' sea wall system kept most of the country dry, but the expense bankrupted them; they are now working off the debt by exporting land-reclamation technology to other countries.

Attitudes Toward Terradyne

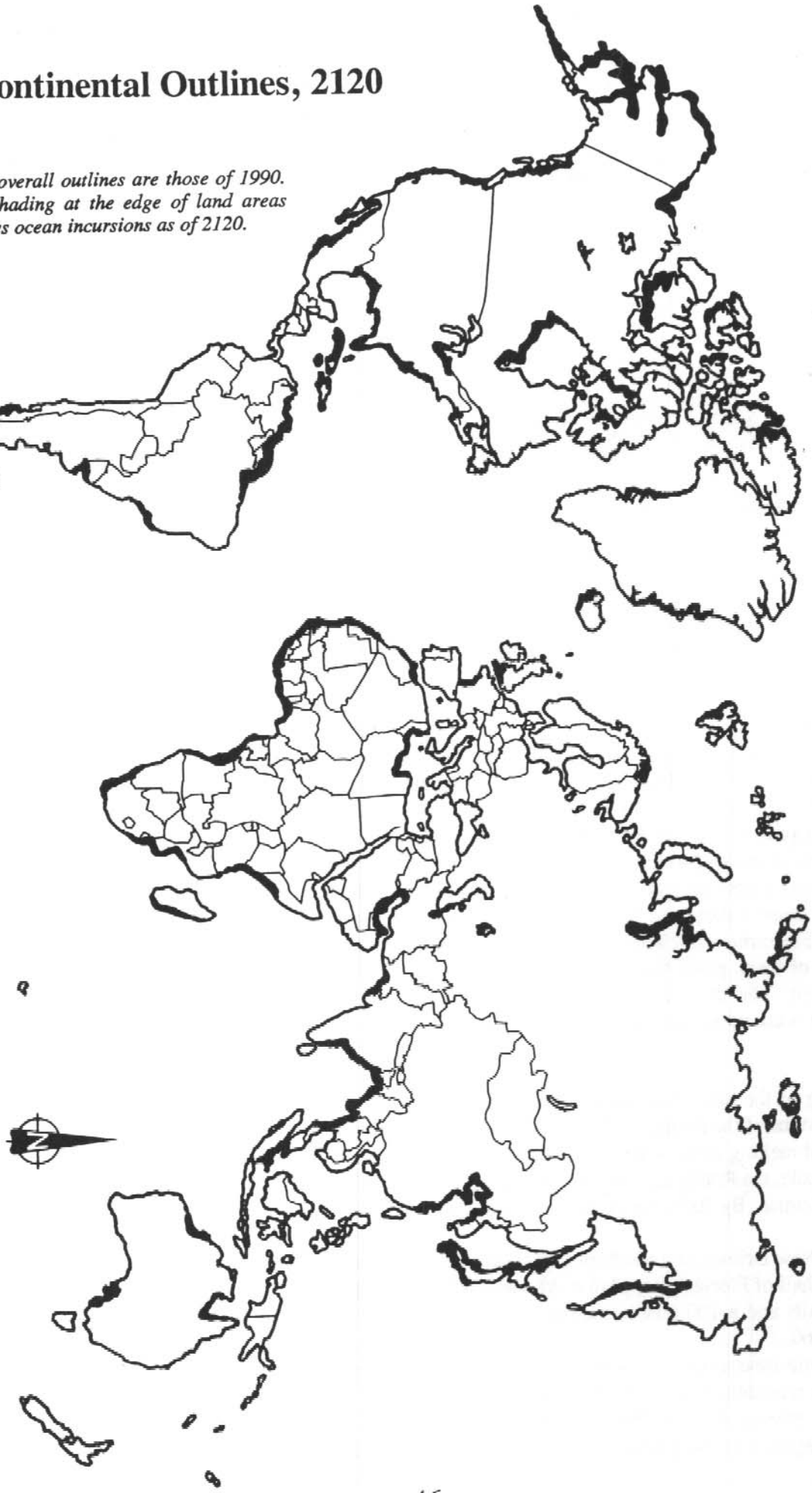
In general, the general population of Earth is afraid of Terradyne and distrusts the company's motives. They see Terradyne and its employees as an elitist organization purposely trying to control Earth's economy. This doesn't stop them from buying Terradyne products, however — which just fuels the hatred. The GM should apply a -2 modifier when rolling for the reaction of an average Terran toward a known Terradyne stockholder or employee.

Some people go beyond distrust of Terradyne to form hate groups. They may have lost a job to Terradyne competition, or they may be modern Luddites, rebelling against a world they no longer understand. They harass Terradyne stockholders, destroy shipments of Terradyne products and use anti-Terradyne propaganda to increase their ranks. The GM should use a -6 modifier when rolling their reactions toward a Terradyne employee or stockholder.

But there are many people on Earth who want to see Terradyne prosper. They believe that the human race is on the verge of a great expansion, with Terradyne and the colonies as its vehicle. *These* people react at +2 toward Terradyne employees and stockholders, and may in fact even be trying to hire on with the company.

Continental Outlines, 2120

The overall outlines are those of 1990. Black shading at the edge of land areas indicates ocean incursions as of 2120.



The oceans have now risen a total of nearly 30 feet, shrinking the continents and totally consuming a few small islands. Coastal cities everywhere have migrated inland as people became reluctant to build near the coast.

The Mall in Washington, D.C. is flooded and the government has moved to higher ground. Tourists can visit the Oval Office and the second floor of the old Capitol Building by boat.

New York City was also hit hard. About 20% of Manhattan is under the Atlantic, including the Upper West Side to Amsterdam Avenue, and nearly all of the East Village.

Other Effects

Global warming has also changed the Earth's weather patterns. Northern areas now receive more rain and equatorial regions get less. Less rain and scorching temperatures in the American Midwest have cut crop yields. Decreased rainfall has also brought drought to most of Central Africa; the Sahara has spread into the savannas of Ethiopia, Nigeria and the Ivory Coast nations.

Increased rainfall farther north has increased the severity and regularity of Indian monsoons. The rain and warmer temperatures have transformed millions of square miles in Siberia into productive farmland.

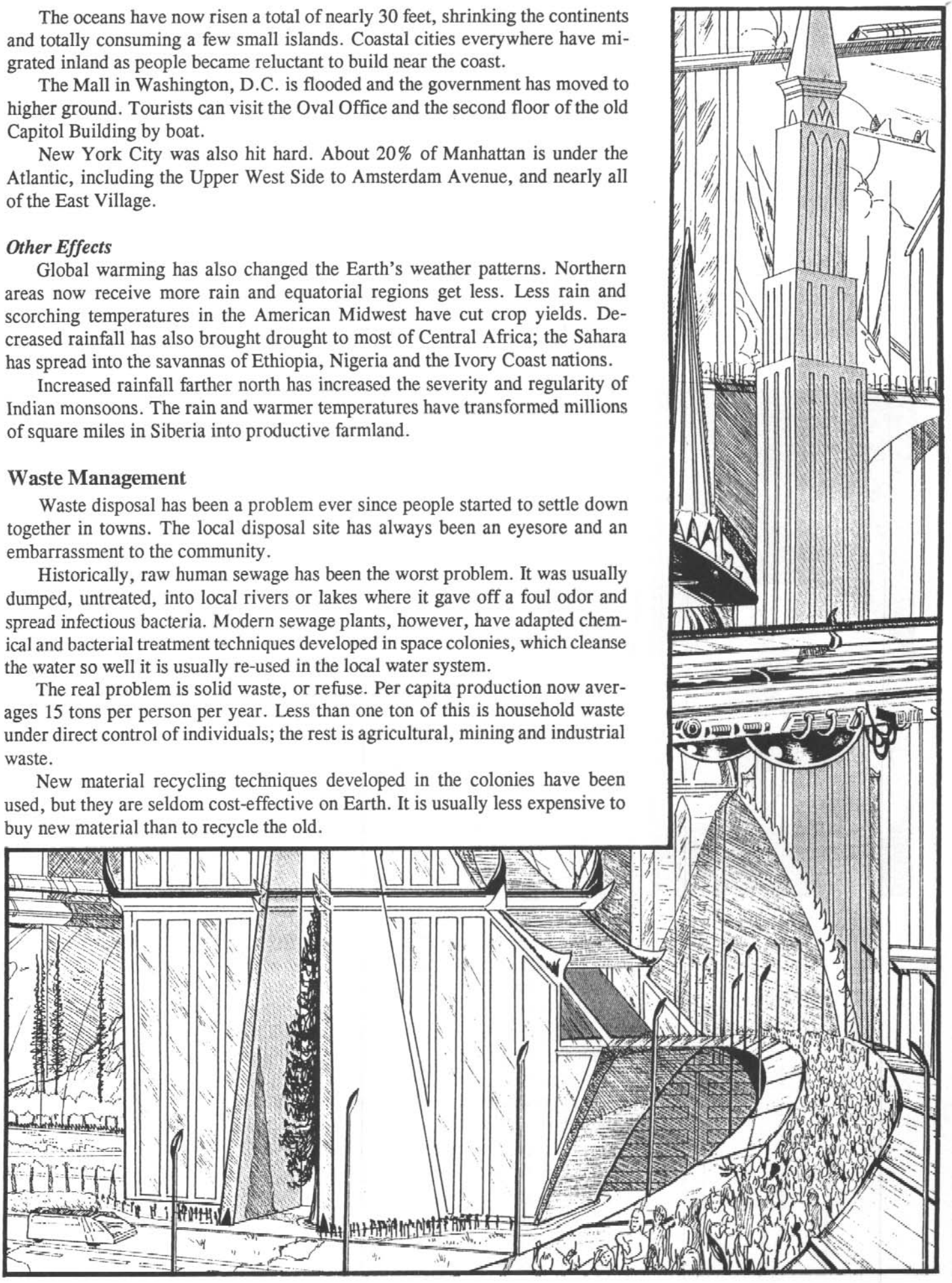
Waste Management

Waste disposal has been a problem ever since people started to settle down together in towns. The local disposal site has always been an eyesore and an embarrassment to the community.

Historically, raw human sewage has been the worst problem. It was usually dumped, untreated, into local rivers or lakes where it gave off a foul odor and spread infectious bacteria. Modern sewage plants, however, have adapted chemical and bacterial treatment techniques developed in space colonies, which cleanse the water so well it is usually re-used in the local water system.

The real problem is solid waste, or refuse. Per capita production now averages 15 tons per person per year. Less than one ton of this is household waste under direct control of individuals; the rest is agricultural, mining and industrial waste.

New material recycling techniques developed in the colonies have been used, but they are seldom cost-effective on Earth. It is usually less expensive to buy new material than to recycle the old.



Incineration of garbage is not permitted, so most of it goes into landfills. But landfill space is very scarce and expensive in large urban areas, so urban refuse is sometimes transported by truck or ship to more remote, less expensive disposal sites — including the oceans. Ocean dumping is stringently regulated by UPOE regulations, which means much of it is done illegally, although Japan has created a few small islands in this way.

Diminishing Resources

Supplies of many of Earth's natural resources are being depleted by irresponsible use. The most important of these are fresh water and arable topsoil.

Fresh Water

Fresh water is a renewable resource, but people use it faster than nature can replenish it. At one time, it took 15,000 gallons to grow one bushel of wheat, 60,000 gallons to mill a ton of steel, and 120 gallons to produce one chicken egg. Modern methods are much more efficient, but there still isn't enough water to go around.

The American Midwest reached its water crisis in the 2040s, when the Great Plains underwater reservoir nearly ran dry. Harvests were poor and many farms went under during those years. The drought spurred construction projects such as the Rocky Mountain Trench, designed to deliver Yukon melt-off to the western United States, and the Superior Canal System, designed to deliver Great Lakes water into the Mississippi River.

Topsoil

Shortsighted farming techniques, pollution and poor land management have destroyed much of the Earth's arable topsoil. In the late 18th century, there was an average of 18 inches of topsoil in North America. In the 1980s, the average was 8 inches, and by 2120 this had diminished to 4 inches.

Farmers of the past two centuries have had very effective mechanized techniques for getting the maximum return from the soil, but these techniques returned nothing to the soil. They used fertilizers to replace fallow time and nitrogen-enriching crops. Soil used this way eventually lost its richness. Overused soil became dry and dusty and was easily eroded by wind and rain.

Irrigation has also destroyed topsoil. The water used contained small amounts of salt, which eventually built up in the irrigated soil, making agriculture impossible. The salt fields of California are good examples.

Improvements in farming practices and farmer education over the past century have nearly eliminated these erosion and salinification problems. But the Earth's expanding populations are always looking for more land to settle.

In tropical areas, the traditional way to get more land is to cut down a patch of the jungle and burn it. "Slash and burn" farming worked well when the populations of these lands were small and nomadic. But the farmers of today are settlers. They seldom leave land once they have it, and if they do, the land they leave behind is too poor for the jungle to reclaim.

Deforestation

The world's forests are being destroyed by industrial expansion, "slash and burn" farming and large civil engineering projects. The forests are *the* major producers of oxygen on Earth. As the human race burns fuels and destroys the forests which can restore the oxygen used, it is measurably reducing the level of oxygen in the atmosphere.

Forests are also the home of most of the world's plant and animal species. Many species live in confined areas, where conditions are just right for them, so destruction of even a small patch of forest can destroy entire species. The loss of a species is not an unnatural event; millions of species have been lost over the course of pre-human history. But the loss of thousands, perhaps millions of species over a period of only a few hundred years can only be compared to the environmental disasters which destroyed the dinosaurs 65 million years ago and the Permian extinction which destroyed 95% of all living species 230 million years ago.

There has been progress to slow deforestation. Many tropical nations have laws to restrict land use, though they are not effectively enforced, and many international organizations and private citizens have purchased rain forest to preserve it. Nearly a million acres of Brazilian rain forest has been set aside in the UPOE Preserve.

Sea Farming

The human race is just beginning to understand the critical role the continental shelves play in maintaining the Earth's atmosphere. The fields of kelp and algae which cover these relatively thin boundaries between land and deep ocean rival the rain forests in their capacity to produce oxygen. But they may also be the *only* source of trace elements in the atmosphere which are necessary for human existence.

Even as some scientists begin to understand the sea and how critical its preservation might be, other scientists look toward its exploitation. Japan and the U.S. have large operational sea farms, but these are only prototypes for massive robotic farms currently being designed.

Demonstrations at sea farm launch facilities have been large and sometimes violent. Activists have equipped themselves with modern diving equipment and sabotaged robotic equipment on the sea floor. Some have died in the attempt.

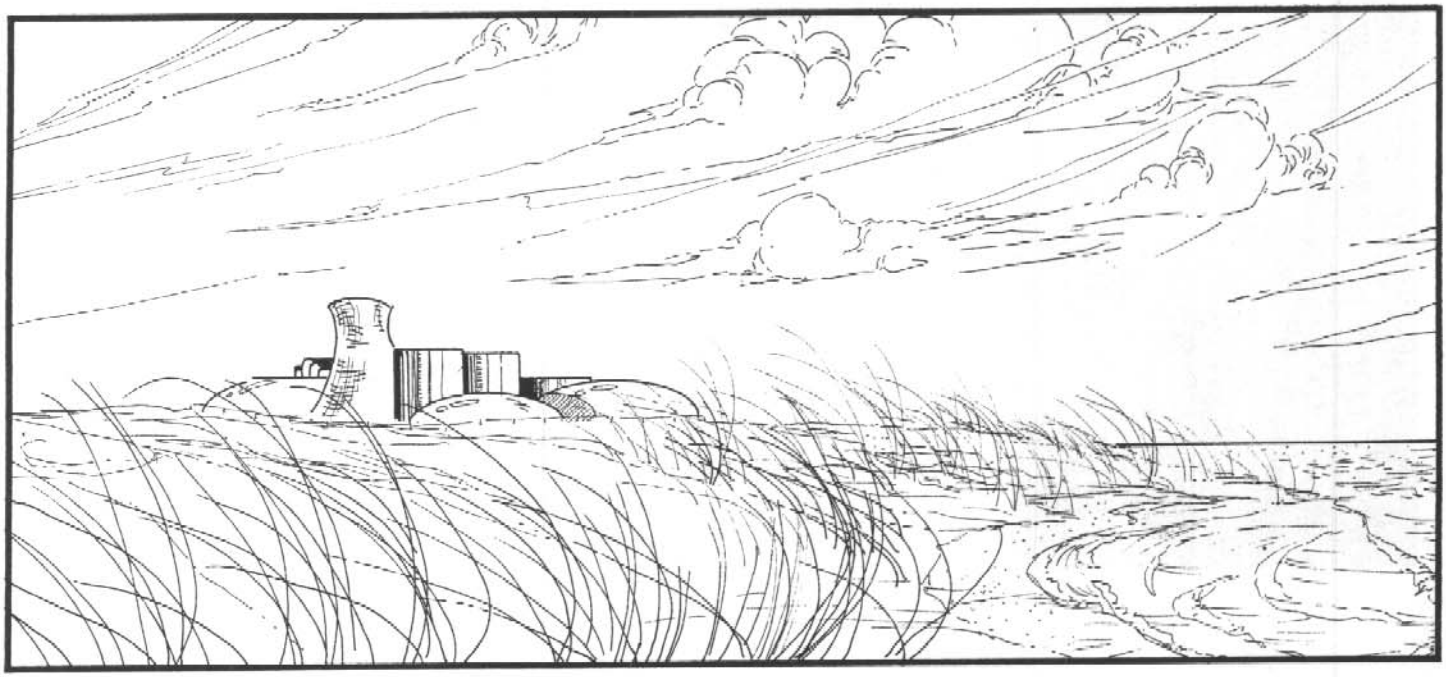
Radiation Hazards

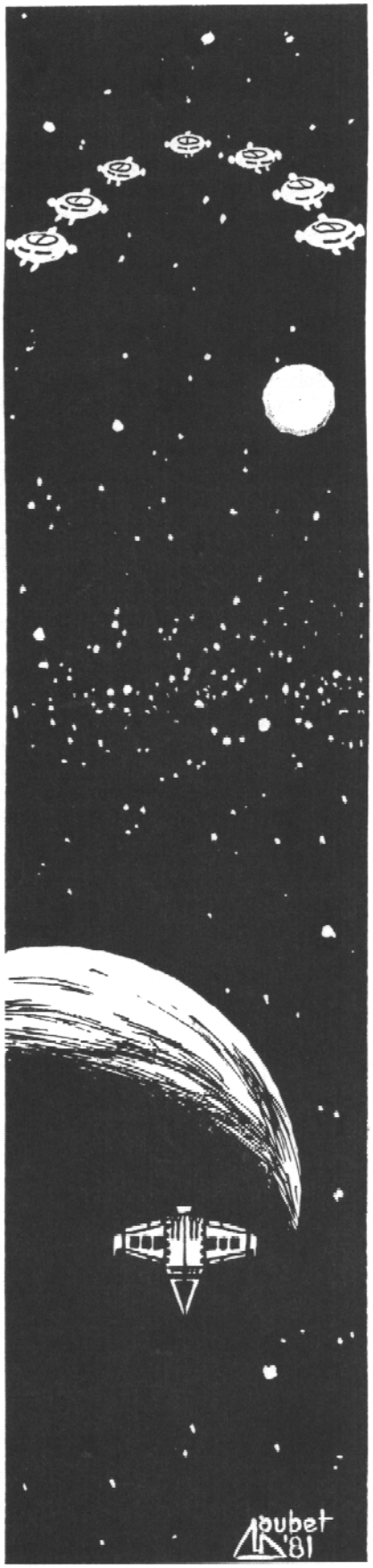
Two main radiation hazards face Earth station residents: The Van Allen radiation belts and solar flares. There are no occupied Earth stations within the inner Van Allen belt, where the radiation level is 5 rads/day.

The outer Van Allen belt has much lower radiation levels (less than .1 rad/day). There are many stations orbiting inside it, including all those in geosynchronous orbits (23,000 miles).

Solar flares are the most serious radiation hazard for Earth station residents. The Van Allen belts offer some protection by deflecting charged particles, but radiation levels still reach 200 rads/hour below the inner belt, and 500 rads/hour or more in orbits farther out. The deadliest radiation from solar flares takes 30 minutes to reach the Earth-Moon system. The Solar Weather Station on Mercury can usually get a message to Earth within 10 minutes, so even though it sends out warnings immediately, Earth station residents have only minutes to cease any outside activities and move into shielded areas of the station which have protection factors of 5,000 or more (see p. S77).

Well-run stations have one or two flare drills every month just to keep the occupants ready and to train new arrivals.





All the attention has worked in the environmentalists' favor. The United States government now monitors the sea farming activities and imposes some of the restrictions suggested by environmental scientists. Japan's government may be close to similar action, but has done nothing.

Local Politics

The United Peoples of Earth (UPOE) is Earth's representative world government. It legislates and enforces international law as well as globally acceptable criminal law. It also controls the World Economic Reserve, which gives it power over the money supply and interest rates. UPOE has the support and participation of 163 nations.

There are no formal political parties in the UPOE Assemblies, but nations occasionally form voting blocs to coordinate their votes and lobbying activities. There is a definite division in voting patterns between developing nations and the industrialized world.

Nations still have a great deal of individual power. They have their own military, their own legal systems and in some cases, their own economic reserves. They also have some control in the world government through their assembly representatives.

Local Economics

The basic currency of the Earth's economy is the UPOE standard, so UPOE controls the money supply and interest rates. Yet economic prosperity and power still varies widely from region to region, and the economy is still affected by the policies of major national governments and the colonies.

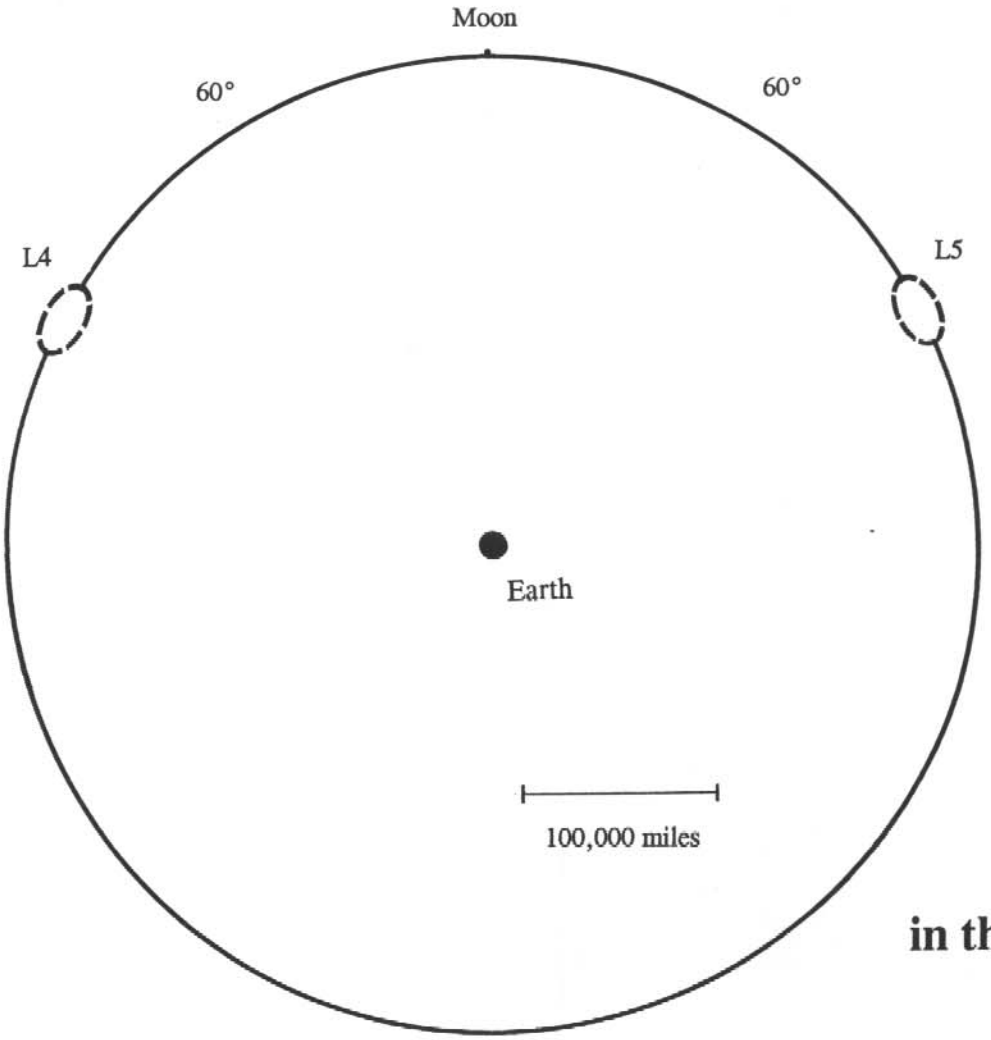
Each nation controls its own taxes and import restrictions. Nations also have their own systems of business law and different levels of government control.

Remote Areas

Much of the Earth's surface is still covered by undeveloped areas of dense forests, deserts, high mountains and frozen wastelands. Nature still rules these areas and makes life difficult for the small groups of humans who occupy them. Local wildlife may be a threat, and Survival skill is a necessity. Technology in these areas ranges from TL7 to as low as TL2.

Remote areas are used as wildlife preserves or military training grounds. Smugglers and black marketeers often set up their landing sites there. They are also likely spots for illegal drug plantations and factories.

Some mercenary groups establish hidden bases in remote areas, camouflaging all the approaches.



Lagrange Points in the Earth-Moon System

Communication facilities are poor. Communication technology is very difficult to find and data net links are virtually non-existent. The only external link for some remote settlements are hundred-year-old telephone lines. Scientific settlements and high-tech criminals or mercenaries may have remote communicators for contact via satellite.

Strength is the law in many of these places. Although every part of Earth, with the exception of Antarctica, belongs to an organized nation, national laws are not actively enforced. Law enforcement agents who do arrive in the remote settlements are quickly paid off by the local crime lord or strongman ruler and the status quo is preserved.

Earth Stations

Earth station is a generic term referring to any of the assorted space settlements which orbit the Earth, including those in the huge L4 cluster. With the exception of a few stations in low Earth orbit, all are permanently inhabited. Only the stations controlled by Terradyne are considered part of the colonies.

Governments and corporations (especially Terradyne) built the stations over the last hundred years for a variety of reasons. The earliest served as observatories for monitoring the Earth's environment and as homes for workers constructing Terradyne's solar power satellites. Others were used as industrial laboratories or zero-G manufacturing facilities.

Today Earth stations are primarily used as factories, orbital warehouses, and convenient places to transfer goods between Earth shuttles and OTVs.

Orbits

Earth stations orbit in three main bands. *Low Earth Orbit* (LEO) extends from the top of the atmosphere to the bottom of the inner Van Allen radiation belt, several hundred miles above the Earth's surface. *High Earth Orbit* stretches from the top of the inner Van Allen belt, at an altitude of 3,000 miles, to geosynchronous orbit at an altitude of 23,000 miles.

The third band is not really a band, but two distinct groups at the libration points, L4 and L5. L4 is by far the most densely populated of the two.

The L4 Cluster

A large cluster of Terradyne stations orbits the libration point, Lagrange-4 (or L4 for short). This is one of the five points in the Earth-Moon system where the orbital forces and the gravitational pull of the Earth and the Moon all *cancel* each other out. The point lies almost directly in the Moon's orbital path, but is always 60 degrees ahead of the Moon. Objects can be placed in very stable orbits *around* the actual L4 point as it orbits the Earth, so it is an ideal location for Earth stations.

L4 was first used by Terradyne for the construction of the solar power satellites. Materials launched by the Lunar mass driver were (and still are) captured at L4 and processed on the spot. The SPS construction facilities were eventually converted to a huge shipyard and zero-G research stations began to appear.

There are now close to 500 different stations with over 10,000 inhabitants in a 5-mile-wide cluster which orbits L4. They are not connected, so they drift around each other as they each follow their own orbit. Small thrusters are used to occasionally nudge the stations back toward the main cluster. Terradyne has expert systems dedicated to generating a new map of the cluster every few days. The latest map is always available on the data net.

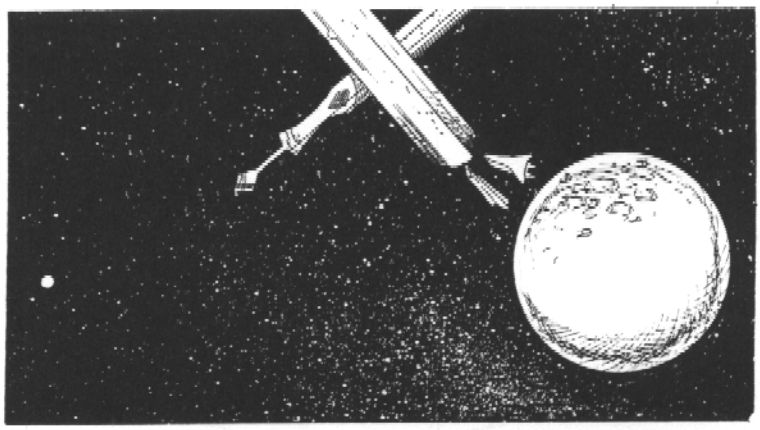
Almost all of the stations at L4 belong to Terradyne. These include the giant L4 shipyard, a windmill-like mass catcher for retrieving materials launched by the Lunar mass driver, and a series of interconnected laboratories which are attached to Lunar University. The few dozen L4 stations owned by Earth organizations — mostly orbital laboratories and factories — are usually gathered in a cluster slightly apart from the main group.

Physical Description

Orbital stations are not designed for looks. They never enter the atmosphere and they accelerate at about 1% of a G, so they are not streamlined. They are generally made up of many small modules joined together by light aluminum girders and cables.

The modular system allows some of the life support functions to be distributed, reducing the chance of a catastrophic failure. Although one module may house the main power supply, every other module will have a backup power supply of some sort.

The GM can design new Earth stations using the starship design rules in ***GURPS Space***, Chapter 8, and the additional design notes in Chapter 7 of this book. Costs will be well below comparably-sized spacecraft because the least expensive hull material is used, streamlining is unnecessary, stress ratings are reduced (by 90% or more) and maneuver drives are small so power plants can be scaled back.



Types of Earth Stations

A single station may fit one or more of the following descriptions.

Port Station

These stations are transfer points for trade between Earth and the colonies. They have transient quarters for space crews, docking and restraint systems for ships and plenty of cargo space. Port stations owned by Terradyne are well maintained and are patrolled by ISF officers. Those owned and operated by Earth corporations of national governments are in poor shape; they run on minimum life support, have poor law enforcement, and are frequented by black market smugglers and privateers. Most port stations have Free Trade League offices which proved assistance to members.

Earth Monitoring Station

Most of Terradyne's original Earth monitoring stations have been converted to other uses, but a few are still operated by the Environmental Research unit. Even these have only a small percentage of their hull space dedicated to monitoring equipment (which is fully automated). The remaining space is used for shipping or industrial research — activities which turn a profit.

Maintenance Base

Thousands of man-made satellites need maintenance or repairs every year. Some of this can be done by automated robots, but humans must perform most of the work. Some Earth stations serve as living quarters for these maintenance

ships. They have modest docking facilities, lots of living space and ample life support. Some carry large enough maneuver drives to rendezvous with satellites which need extensive work.

Defense Management Stations

These are orbital command centers for Earth's national militaries. See p. 98.

Orbital Laboratory

These are relatively small stations used to carry out research in very low gravity and rare vacuum environments. Terradyne's orbital research is all done at the L4 cluster, so any research stations in lower Earth orbits belong to Earth corporations or governments. Security clearances may be required to enter these stations and most have some form of intruder defense system. Transmissions too and from these stations may be encrypted.

Orbital Factory

Once a research station develops a profitable manufacturing process for use in orbit, orbiting factories are built to do the work on a large scale. Some of these are large, highly automated material shops. The material produced (superconductors, drugs, crystals, etc.) may be used by orbiting assembly shops, or get shipped off to Earth or the Moon. The major components of these stations are the production areas, the docking and storage chambers used for raw materials and completed inventory, and the power generation sections. A very large (500,000 cubic yard) factory can be operated by a dozen people, so living quarters and life support do not take up much space.

Shipyard

This is a special type of orbital factory. Shipyards are orbiting assembly points for unstreamlined ships. Even streamlined ships are occasionally constructed in space because of the ease with which large hull sections can be manipulated in zero G. A shipyard is made up of a series of small, movable living modules, plenty of heavy winches and cranes, and the partial hulls of ships under construction, all held together by cables and aluminum girders. Ship workers spend hours every day in space suits, floating between modules and inspecting sections of the hull.

Gravity Simulator

These stations serve as special health spas for colonists and gravity re-trainers for homeworlders who have grown accustomed to low gravity during a long stay in the colonies. Most of the occupants are Lunar children, who must spend a grueling six weeks out of every year in near-Earth gravity to prevent osteoporosis (see *Moonbabies*, p. 118). Most of the hull space is dedicated to life support, living quarters, recreational areas and educational facilities for the children.

Abandoned

A few of the older Earth stations have been completely abandoned. Their orbit may have decayed to a dangerous level, or they may have too many system failures to be worth repairing. Most have been stripped clean by scavenging privateers, but some are still air-tight and occasionally serve as havens for smugglers.

Privately Owned

A few stations have been purchased by wealthy eccentrics who longed for the solitude, or the beauty, or the novelty of living in space. Others have been refurbished and reopened as expensive resorts.

Life Aboard An Earth Station

Day-to-day life aboard the Earth stations is very different for each type of station. While the researchers in orbital laboratories are disciplined, dedicated and rather sedate, the free-fall technicians in the maintenance bases are fond of drinking, gambling and rough play. Life aboard a DMS is very regimented and intolerant, while life on a independent port station is likely to be wild and even dangerous.

There are some common conditions, however. Life on *any* station is cramped. None of them have the wide-open, park-like spaces envisioned by Gerard O'Neill and the space colony supporters of the 20th and 21st centuries. The small open spaces which do exist are just necessary parts of complex life support systems.

Each station was designed for a specific purpose and most were not expected to have permanent residents, so little attention was given to long-term comfort. There are no stations designed solely to provide extra living space for the human race.

In addition to small living spaces, station residents must also get use to limited resources. Air, water and food allocations are barely adequate. A person who has a couple of guests over to his quarters for the evening may have to pay $10 for the additional air they used. The extra water they use will cost $1 per gallon. And if he wants to serve real food instead of synthetically textured algae products, it will cost him $20 or more per person. There are no food preparation or eating areas in the individual quarters, so the group will have to eat in the small living area or move to a communal dining area.

So what is there to do on one of these cramped, restricting stations? Well, there are running tracks and exercise rooms, as well as VR systems, data net access and, of course, work. Some activities, like zero-G sports, are only possible on the Earth stations.

Most Earth station residents spend a fair amount of time counting the days until their tour is done and they can return to their real homes on Earth or the Moon.

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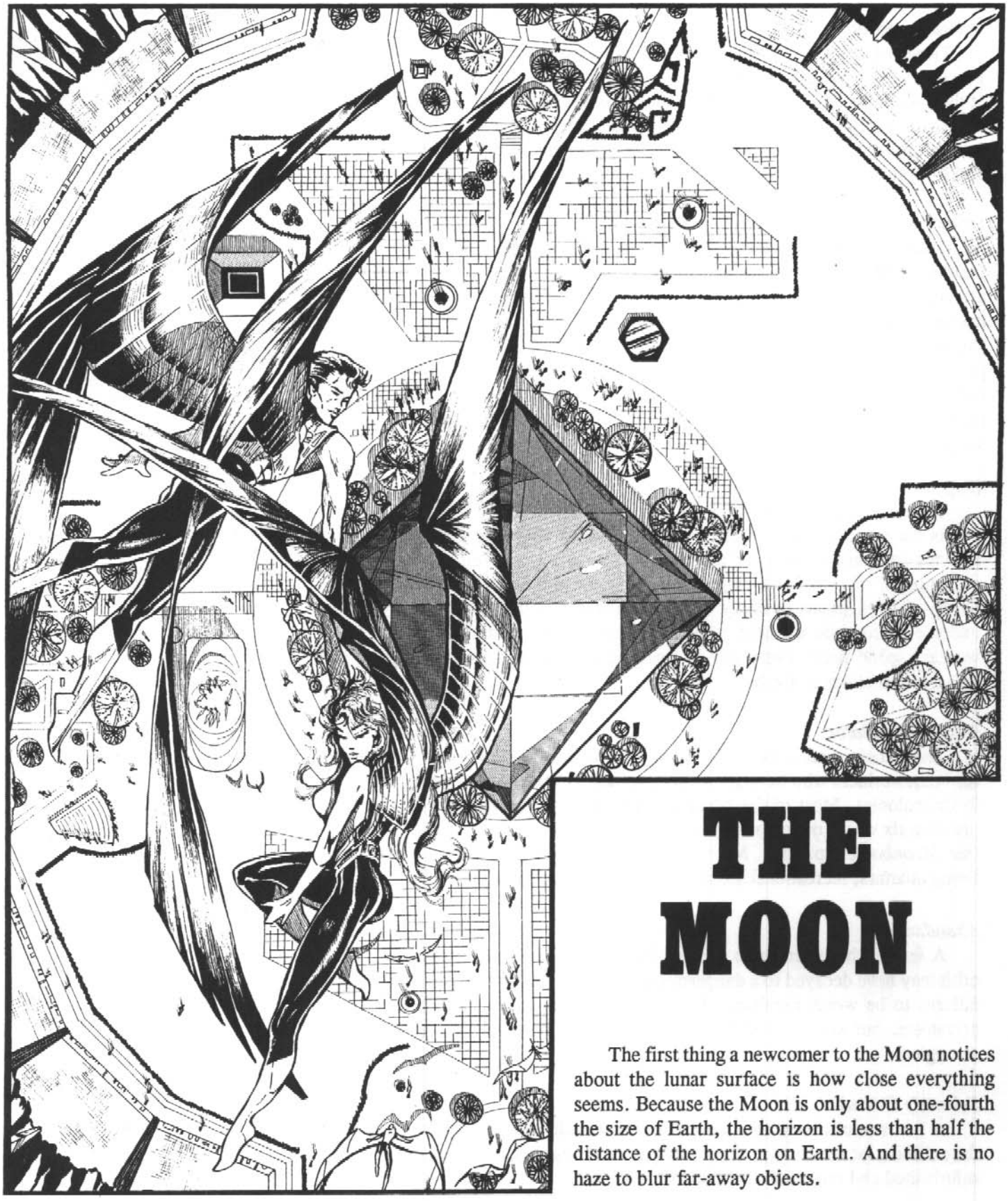


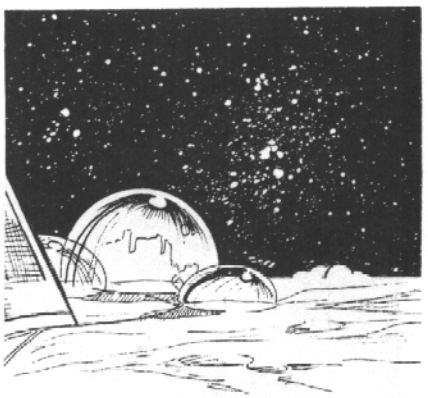
THE MOON

The first thing a newcomer to the Moon notices about the lunar surface is how close everything seems. Because the Moon is only about one-fourth the size of Earth, the horizon is less than half the distance of the horizon on Earth. And there is no haze to blur far-away objects.

The second thing one notices is the utter desolation. There is no living thing on the Moon that humanity has not brought here. No wind stirs a leaf; no bird cries out in the silence. Only the harsh brilliance of the radiant Sun, the crisp dark shadows of boulders billions of years old, and the black carpet of the universe overhead, punctuated by dim, unflickering points of light.

And the Earth. The dazzling sphere of blue, dangling almost overhead. Always visible high above Luna City, the Earth waxes and wanes in glorious blue and white. Even in the lunar night that lasts some 350 hours, Terra lights the darkness with over 50 times the brightness of the full Moon on Earth — enough to read the finest print.

This is the Moon. It is the closest and most familiar of all the worlds outside Earth's protective blanket of air and water — and it's Terradyne's domain, the source of Terradyne's genius and power.



Surface Features

Four different types of terrain are found on the surface of the Moon: mountains, regolith, craters and maria.

Mountains

The lunar mountains are much like the mountains on Earth. They have been weathered, not by wind and rain, but by moonquakes, by the slow, constant shower of particles of the solar wind and by meteoric impacts.

Several lunar mountains reach higher altitudes than Mount Everest. Lunar mountains are geologically similar to Terrestrial mountains, but differ in all other respects, so all Climbing rolls on lunar mountains are at -3 unless the PC has the Survival (Moon) skill. (This also applies to crater walls.)

Regolith

Regolith, the "topsoil" of the Moon, consists of rocky dust and debris from meteorites and volcanoes. The lunar rock, pulverized into a fine powder by these events over the aeons, has built up to depths averaging several yards — or, in the mountain areas, sometimes much deeper. The regolith covers the lunar crust and is itself covered by rocks and boulders of various sizes. Craters scar its surface.

Charged particles in the solar wind interact with the regolith, leaving a residual static charge in the dust. The dust can cling to hard suits and equipment, causing damage to joints and electronics if not removed regularly.

Craters

Craters range from microscopic in size to behemoths hundreds of miles across. Most originate from a meteorite's impact, but some were formed early in the Moon's life by volcanoes.

The walls of craters are typically steep, and can only be traversed by mountain climbing (at -3, as above). Some older craters have slumped walls that are more easily traversed.

Most impact craters have a central peak that rises from the flat crater floor to heights 50% or more of the crater wall. Some of the largest craters on the Moon have no central peak; these craters are classified as *walled plains*.

Maria

Maria are large flat plains made of frozen basaltic lava, formed billions of years ago. They gained their name from an imagined resemblance to seas (in Latin, *maria*) as seen from Earth.

The tremendous size of these lava flows suggest either terrific volcanic activity or titanic collisions with extraordinarily large asteroids — or, most likely, both.

The Tip of the Tip

At the very pinnacle of the Crystal Pyramid, Terradyne's corporate Headquarters within Quad A, lies the corporate boardroom. Access to the boardroom is not by elevator, as one might expect, but by a curved staircase that comes through a small opening in the floor at one side of the square room.

The stairs are peculiar for two reasons. First, stairs are virtually nonexistent on the Moon, due to the low gravity. They can be quite hazardous to anyone unaccustomed to the Moon's lighter gravity.

Secondly, these stairs are, well, plain. Made of wrought iron and painted black, they look like something out of an old library, or a World War II submarine. Apparently imported from Earth (at some expense) at the request of Jodo San, they are a bit of a mystery woven into Terradyne's culture. Jodo San has not divulged their significance.

The Boardroom is simple. At the center sits a ponderous rectangular lunar granite table, polished to a shine. Around the table are eight fabric chairs, enough for the seven board members and a guest. Telecommunication equipment is built into the table in front of each seat.

A small wet bar (sans alcohol or other drugs) is at the end opposite the stairwell.

Some thirty feet overhead, the walls of the Crystal Pyramid ascend to a point. At the pinnacle, a brilliant spotlight shines down to illuminate the table in a pool of light. It is the only light in the room.

All around the Boardroom is the commanding view of Luna City. It is breathtaking. The redirected sunlight from photonic terminals throughout the Quads' ceilings shines through the glass, lighting the Boardroom in bright sunshine during the day. At night, the Quads' floors lay out a carpet of glittering points.

Moonquakes

Moonquakes occur frequently — there are nearly three thousand detectable tremors every year. Most are unnoticeable to anyone not actively looking for them.

The most common time for moonquakes is *perigee*, when the Moon is closest to Earth in its orbit. No moonquake has ever been severe enough to hurt anyone or cause significant damage.

Water

No water has been found on the Moon. Terradyne explorers are still scouring the lunar poles, in places the Sun never reaches, in search of the precious commodity.

Much of the existing water on the Moon has been created from hydrogen imported from Mars, though in the early days, water came from Earth. Today, all new water stocks contain Martian hydrogen.

Finding a large water source on the Moon would be a huge boon to Terradyne. There is a standing offer of 10% of the first year's cost savings to anyone who finds a large enough cache of H_2O; the exact amount is unknown, but would certainly make the finder a millionaire several times over.

Other Volatiles

Neither carbon nor nitrogen is found on the Moon in appreciable quantities. Until recently, Earth had been the sole provider of these vital elements of life. Mars contributes limited amounts of both carbon and nitrogen products to the Moon — but Mars requires imports of these elements itself, for terraforming operations.

The hydrocarbon mines on Titan will be an excellent source of these materials in the near future. The first crew of the new mining facility is on its way to Titan.

Radiation

An unprotected individual on the Moon's surface will receive 1 to 2 rads of radiation from the Sun every month, if the Sun is not active. Before the GM writes this seemingly insignificant amount off as too small to worry about, perhaps a comparison is in order; the typical human is exposed to .2 rads per *year* on Earth. Thus, improperly shielded lunar explorers are exposed to 120 times "normal" radiation.

In a solar flare, this radiation will skyrocket to over 1,000 rads per hour.

Transportation on the Moon

Surface Transport

Several kinds of vehicles regularly traverse the lunar surface. These vehicles (of various capacities) are usually tracked or six- to ten-wheeled conveyances capable of carrying both cargo and passengers.

Besides independently operated surface vehicles, there are two other main types of transport available to residents or visitors to the Moon.

Cable cars traverse the distance from the crater floor to the top of Alphonsus at Luna City. The reduced gravity of the Moon provides an ideal environment for a cable car system — the cables are under less stress from weight, and the support towers can be spread much farther apart than is possible on Earth. These advantages combine to significantly reduce the cost of building and maintaining such a system.

Each gondola is a self-contained life support unit capable of sustaining a considerable impact (in case of cable failure) and can supply air and water for 10

Headquarters vs. Headquarters

Terradyne personnel differentiate Pyramid activities from Headquarters activity. The terminology often found in corporate literature is *Strategic Management* (Pyramid) and *Strategic Operations* (the underground Headquarters).

When someone from Earth mentions "Terradyne Headquarters," he may not be referring to Strategic Operations (Headquarters) nor to Strategic Management (the Pyramid), but to Luna City in its entirety.

If the speaker is a corporate employee, identifying the Pyramid as Strategic Management can indicate that he's an ambitious middle manager involved with Sales and Marketing or Legal Affairs. Someone referring to Headquarters as "the Hole" can indicate a different set of characteristics altogether. And if by "Headquarters" he means all of Luna City, he's most likely a tourist from Earth.

persons for up to six days in case of an emergency. The gondolas are shielded enough to dampen, but not entirely remove, the radiation threat of a solar flare (a protection factor of 4 — see p. S77).

The other method of surface transport available is the high speed "bullet train." It rides a twin-tracked magnetic rail running from Luna City to the Farside Station. The bullet train uses technology similar to the mass driver to propel the sealed train car at some 2,200 miles per hour toward its destination. The train can accelerate at 10G, but for passenger comfort it rarely reaches more than 3G.

In construction and capacity, each train car is similar to a medium passenger crawler, capable of holding eight persons.

Luna City

Luna City has evolved from the temporarily occupied aluminum huts of the early 21st century into the bustling hub of Terradyne and human-occupied space. Over three million men, women and children from all nations live and work here. To most people, Luna City means high technology, good work and high wages. It's the home of Terradyne's headquarters and Lunar University, one of the most respected centers of higher learning in the Solar System.

To the less fortunate trapped in poverty on Earth, however, Luna City means greed and gluttony, excesses and neglect.

The Main Base

The centerpiece of Luna City is the four connected sections that are collectively called the Main Base, or the *Quads*. The Quads are cavernous tunnels, 4,000 feet long and 20 to 40 stories in height. The caverns vary in width from 1,000 to 2,000 feet. Only here does a lunar resident feels relief from the claustrophobic weight of the corridors and passageways. Standing in the center of a Quad, with the brightly-lit rocky ceiling arching high overhead, one almost (but not quite) gets the feeling of being "outside."

The Quads radiate from a central open section, known simply as the *Town Square*. Thus, if a person stood at one end of a Quad and looked past Town Square, he would see the far wall of the opposing Quad, some 1½ miles in the distance.

The Main Base section of Luna City serves several purposes. It is the center of town — a showcase. Parkways and greenery carpet the large chamber's floors and supporting columns that rise to the ceiling. Many-terraced office buildings rise above the forest. Shops line the main avenues displaying their wares. "Outdoor" theaters and restaurants entertain guests. Quad C even sports a small lake for swimming and fishing.

It also serves as backup to the life support systems (LSS). Although the LSS in Luna City is fully able to provide adequate living conditions for all residents, the lush greenery found throughout the large Main Base facilities assists by pollution removal, humidification, and mixing of air. The large parks in Martian cities (see p. 78) play a similar role.

Despite the grand architecture, the vast scale, the lush vegetation and the many sights vying for one's attention in the Quads, a newcomer to the Moon is often distracted by something else — winged people flapping and soaring through the air overhead.

Due to the very weak gravity on the Moon, it is possible for a person of average strength to don artificial wings and take to the air. Human-powered flight, often the object of myth and legend, has become the number one sport on the Moon. Almost everyone who lives in Luna City has tried it at least once (see sidebar).

Winged Humans

Strap on some graphite and plastic wings, jump in the air, and start flapping.

On the Moon, flying is that easy. $300 will buy a set of wings, helmet and knee pads — all the equipment needed to take to the lunar "skies" inside the Quads.

Flying takes some practice, and there is skill involved (see *New Skills*, p. 119). However, just about anybody can climb and descend vertically by pumping their arms.

The maximum speed of a flier is double his ground-based speed. However, due to the relative inefficiencies of a land-based biped trying to act like a bird, maximum speed in a moderate to steep climb is only equal to ground speed.

Most wing sets cannot support more than a 2g turn. Cheaper models can fail at less than 1.5Gs. However, only the most accomplished athletes can take the body strain associated with short-radius turns generating more than 1g. A person's strength generally gives out before the polymer wings do.

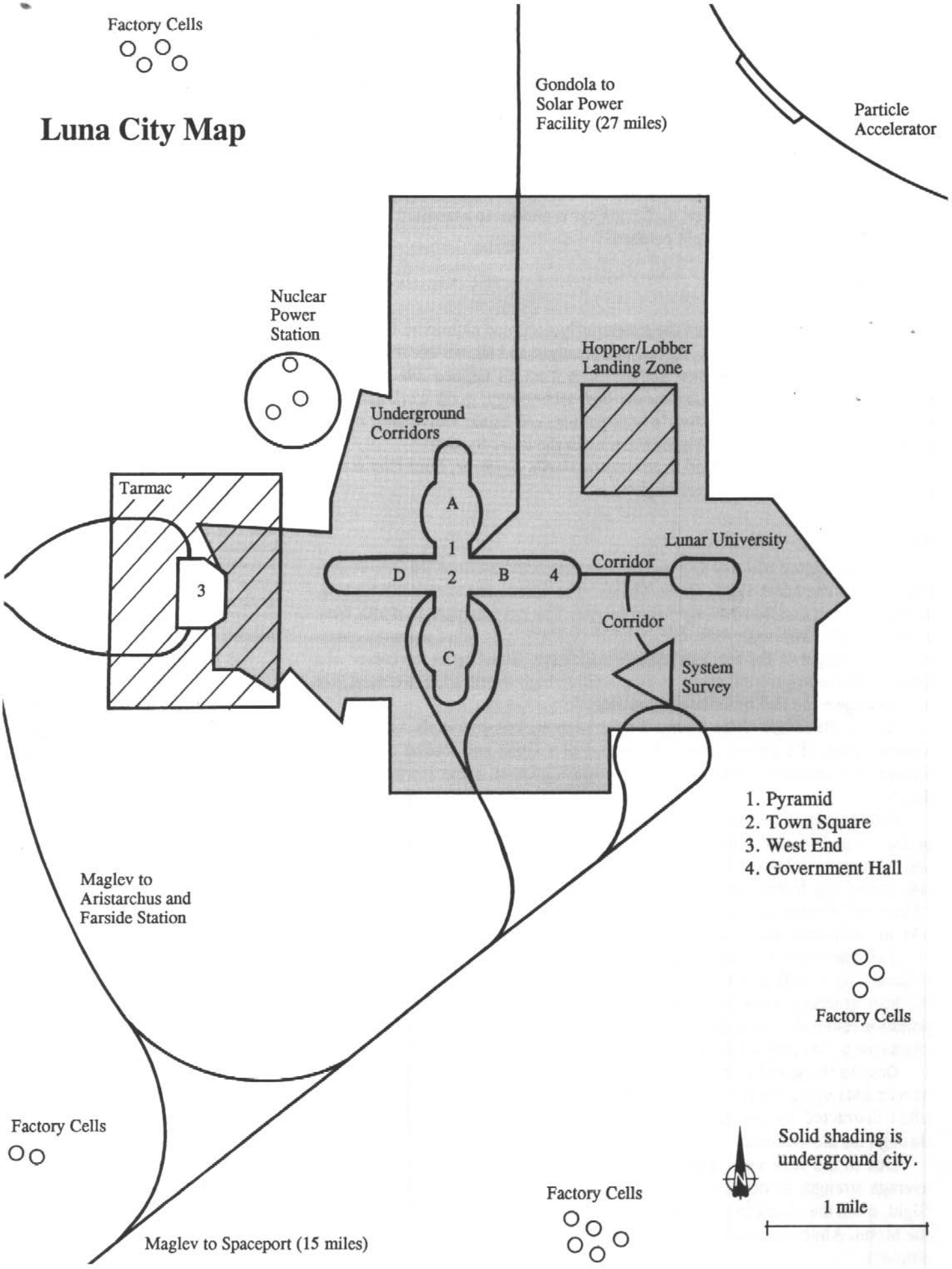
If a player questions this, the GM should remind him that when Olympic gymnasts are performing an Iron Cross on the Rings (body suspended in mid-air, arms outstretched to the rings, at right angles to the body), the gymnast is "only" feeling 1g on his arms.

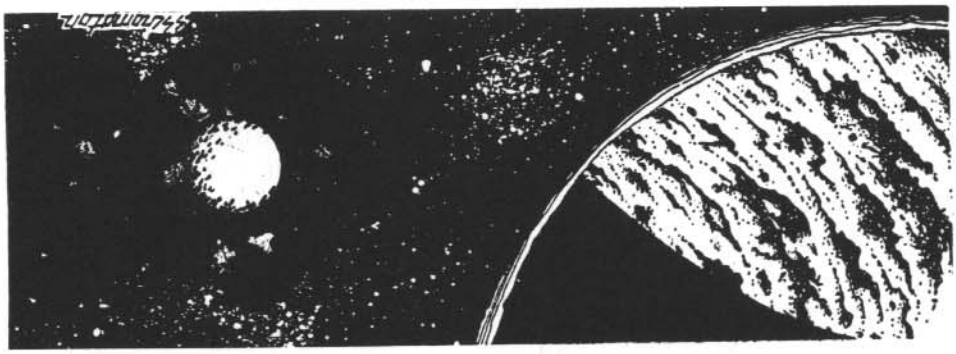
If a person in flight loses consciousness, two factors come to his or her aid. First, the wing sets have a tip to tip span of over 12 feet. Their curved shape and length provide a very stable configuration. The wings have a tendency to pull open into a shallow glide if not counteracted by the flier.

Second, the low lunar gravity allows for a gentle (if not graceful) glide back to the ground.

Treat crashes as a fall from six to ten feet (in 1g).

For detailed flight maneuvers and combat situations, see p. B139. But before characters take to the air with eyes glinting and guns blasting, they should remember one thing: they are in Terradyne country. Company policy does not treat hot-shot combat pilot/assassins very well.


Factory Cells
Luna City Map
Gondola to
Solar Power
Facility (27 miles)
Particle
Accelerator
Nuclear
Power
Station
Hopper/Lobber
Landing Zone
Underground
Corridors
Tarmac
A
1
D
2
B
4
3
C
Lunar University
Corridor
Corridor
System
Survey
1. Pyramid
2. Town Square
3. West End
4. Government Hall
Maglev to
Aristarchus and
Farside Station
Factory Cells
Factory Cells
Factory Cells
Solid shading is
underground city.
N
1 mile
Maglev to Spaceport (15 miles)



Luna City's Corridor Network

While the Quads form the center of the City, most of the residents live and work in the network of corridors that radiate from the Quads. These underground passageways connect the residential areas, office complexes, research, manufacturing areas and the Quads to one another.

The corridors are blasted into the lunar regolith with plasma torches. The rock tunnels are then sealed airtight and covered. When completed, the passageway looks like an office hallway or spacecraft accessway.

The corridors are typically 30 to 40 feet wide and 26 feet high (a person can high-jump 20 feet in the reduced gravity of the Moon).

Terradyne Headquarters

The heart of the most powerful corporation in the Solar System lies below the feet of Luna City residents. The only section of Terradyne Headquarters visible to a lunar tourist is the opulent crystal pyramid that rises out of the floor of Quad A, not far from the Town Square.

The Pyramid, made of translucent lunar glass, is the office and residence of the very highest Terradyne officials, including the CEO, president, board of directors and most senior vice-presidents. Most business and diplomatic meetings occur within the crystal walls. It's only the tip of the iceberg, though; Terradyne Headquarters fills some 50 stories, not including the Pyramid.

Elevator shafts descend from within the Pyramid to various levels. Access to these elevator shafts is restricted by Pyramid security. Each set of shafts services a specific range of office floors; individuals are cleared for specific sections of the office, and are barred from others if they do not have business to conduct there.

Industrial Sector

The Moon provides an environment conducive to high-precision, high quality, contaminant-free materials processing. Luna City's factory cells are the primary source of manufactured items on the Moon.

The factories are typically arranged in clusters of two to five, in a circular pattern. The factories of a particular cluster are linked either by product or process.

Product-linked units perform different sets of operations on a particular item, much like an assembly line. These factory units will be connected by enclosed transport mechanisms (conveyor belts, maglev pallets, etc.) which shuttle work-in-process inventory from one factory to the next. The cluster will output a finished product.

Factories grouped by process do not necessarily work together on a particular item. Instead, they have been grouped because they share some manufacturing process or some raw material needs. In most cases, there is little transport of work-in-process between factory units. The only exception might be if one of the

The Oxygen Trade

In the early days of expansion into space, all propellants, food, water and other supplies needed by the explorers had to be lifted (at great cost) from the Earth. Climbing such a deep gravity well required that the vessel contain mostly propellant, leaving very little room for everything else.

Most of the propellant was (and still is) oxygen. By weight, the ratio between the oxidizer and the fuel was at least six to one. Thus, about 75% of all material lifted from the Earth was oxygen.

Tapping the tremendous stores of oxygen on the Moon greatly reduced the mass needed from the bottom of Earth's gravity well. This made space travel much more affordable..

By the mid-21st century all of the Earth stations and the ships flying in between them were using lunar oxygen. The Moon sold or traded the critical element for whatever it needed.

And oxygen was just the beginning: propellant oxidizer production expanded to propellant manufacturing, which in turn expanded to the mining and manufacturing of metals, ceramics and glasses.

Oxygen is still the base of the Moon's economic vitality. Though the Moon, through Terradyne, has become a diverse source of goods, oxygen is still the number one export by mass.

factories provides a specialized capability to the other factory units in the cluster. Process clusters produce a wider variety of products than product clusters.

Lunar University

The University occupies a large cavern similar to one of the Quads on the far eastern edge of the City, and is connected to the main city by a single large underground thoroughfare. Terradyne's System Survey division is located off this corridor and occupies the space between the University and Luna City.

Lunar University is first and foremost a research center. Graduate level instruction is the focus of the Lunar campus. Undergraduate programs are provided at the several Lunar University extension campuses located on Earth. Lunar campus students (all 100,000 of them) are expected to hold internships with a lunar-based manufacturing or research unit while studying.

The University offers graduate degrees in virtually all disciplines of the natural sciences (with the exception of some biology disciplines). In the Applied Sciences, the University is recognized as the leading institution in all of humanity's worlds. In these areas, graduates of Lunar University have won Nobel awards more than twice as often as any other institution for the last 25 years.

Lunar University also operates Farside Station, a state-of-the-art observatory. Located on the far side of the Moon, it is occupied by faculty, postdoctoral researchers, and scientists receiving UPOE research grants. Farside astronomical research covers the entire electromagnetic spectrum.

Port Facilities

The spaceport facility supporting travel to and from Luna City is located 15 kilometers to the southwest. A series of maglev trains on elevated rails connects Town Square to the port's terminal building. The road beneath the elevated tracks is paved with lunar concrete some 18 inches thick to support heavy crawler transports.

Spacecraft traffic control is located in Luna City itself, while support and maintenance is based within the spaceport proper. Radar equipment is located all around the crater rim. Additional radar antennas scattered across the Nearside, as well as orbital radar equipment, form a computer-controlled network that gives an accurate, realtime, three-dimensional view of all space traffic in the vicinity.

Lunar Society

The Moon is two very different places. Within the walls of Luna City, it is a civilized, urban environment. Crime is virtually unheard of, everyone has a good job, a place to eat and sleep and is part of a fully functioning democracy.

Outside the walls of Luna City, the Moon is a harsh and deadly place. One misstep can spell doom.

Most of the permanent inhabitants of the Moon are linked to Terradyne or Lunar University. If not a student, faculty or resident researcher for the University, a person is usually a Terradyne employee or an employee of a Moon-based contractor working for Terradyne. There are non-Terradyne companies on Luna — but not very many.

Most lunar colonists live within Luna City. But there are also scores of smaller stations scattered across the lunar surface, supporting anywhere from 2 to 200 persons. They range in age from the beginning of lunar colonization to recent construction, and are typically used by prospectors and researchers.

There is also a relatively small number of "illegals" on the Moon: smugglers, drug dealers and thieves. While their illicit products eventually end up inside the walls of Luna City, most of their unlawful business activities take place in old abandoned moonbases or in spacecraft that contain a significant investment in a stealth suite.

Given the sophistication and breadth of Luna City's automated traffic control system, it is difficult to land on the Nearside undetected. Unless a smuggler's ship is properly equipped to suppress detection (with a stealth suite), or someone has been paid to look the other way, a smuggler is safest to land on the Farside and "hoof it."

The spaceport is similar in design to terrestrial airports, with separate levels for arrivals and departures. The main terminal building is semicircular, and is surrounded by a large concrete plain.

Living Quarters/Recreation Facilities

The realities of lunar living become apparent when a newcomer steps into his new apartment for the first time. It is *small*.

Space is limited in Luna City, and getting more means expensive tunnelling, so Luna City residents tend to make the best of the space available to them. Only the very wealthy can afford to blast large and luxurious living quarters from the Moon's crust, so most people are stuck with the small two-bedroom apartments that are standard in Luna City.

Importing furniture from Earth is expensive, so most lunar furniture is made on the Moon from local materials such as foamed cement, lunar obsidian and fiberglass. Nobody mistakes this decor for high-fashion, but it's comfortable.

Water is a precious commodity on the Moon. Residents are allotted a monthly water budget. Those using too much water are charged on a per-gallon basis. Individuals who don't use up their monthly allotment of water are credited for the portion unused.

There are no windows in Luna City apartments — in fact, there are few windows in the entire city. "Windows" in the apartments are three-dimensional realtime projections of scenes selected by the resident. The city provides free access to these "window channels."

Luna City Government Hall

In contrast to the Martian government, which reports to the Colonial Directorship of Terradyne, the government of Luna City is in theory autonomous. City government resides in the back of Quad D, in a squat, somewhat ugly building that is actually a remnant of an abandoned Soviet moonbase.

The government of Luna City is somewhat more detached from Terradyne than the Martian government. The larger proportion of non-Terradyne personnel on the Moon and Luna City's relative proximity to Earth put greater pressure on Luna City to form a government less dependent on Terradyne corporate policy.

Luna City's Council of Governors has seven members — one from each quadrant, one from Lunar University and one from Farside Station. Governors are elected for three-year terms, with a three-term limit on service. Each Governor serves as Council Chairman for four weeks on a rotating basis.

The Council is supported by a small army of professional bureaucrats. The Governors' main job is to enact rules and regulations governing community activities. Issues of general concern (closing times of public parks, flying regulations, etc.) are put to the lunar public for a fully participative democratic vote.

Life Support Systems

Except for the experimental life support systems of Mercury's Solar Observatory, Luna City has the most advanced life support system (LSS) network in the Solar System.

The typical human consumes some 2.2 pounds of food and water every day; over 10 square feet of greenery is required to convert that person's exhaled CO_2 back into oxygen. Prodigious amounts of energy and resources are required to support the three million people in Luna today.

To meet these needs, the lunar LSS network comprises both agricultural and aquacultural components. The multi-unit atmosphere regeneration units are triply redundant. LSS installations are spread throughout Luna City in 14 separate

Navigating on the Moon

The Moon has no magnetic field, so compasses are useless. Inertial navigation equipment or satellite communication is required to fix one's position.

On the lunar Nearside, there is one constant landmark, however. Earth remains forever fixed above the horizon, never moving in relation to the lunar terrain. (Well, almost. Picky astronomers point out there's a little motion, but it tends to average out.) With a successful Astronomy or Navigation roll, a traveler can find celestial north and use the Earth's location in the sky to determine his position (Nearside only).

locations. If a catastrophic failure occurs (considered *highly* unlikely), oxygen reserves produced from regolith can maintain a 5 PSI partial pressure of oxygen throughout Luna City almost indefinitely. "Going Apollo," as the residents call this emergency atmosphere system, suffices for breathing, but poses a *severe* fire hazard.

Quad C is the heart of the LSS network. Its parks, lakes, streams and abundant flora are critical to the functioning of life in Luna City.

Urban Expansion

New tunnels are being built all the time. When tunneling commences, the nearest set of bulkheads within the parent corridor is sealed and digging begins. When the new tunnel is long enough to allow installation of airtight doors at its head, it is sealed off until work is complete, when the parent corridor's doors are reopened and traffic through the area can continue as usual.

Sealing the lunar rock to prevent air loss would ideally be done with pliable plastic. Plastic is not readily available, however, since it has to be imported from Earth at great expense, so lunar tunnelers use a local resource: aluminum.

Thick aluminum foil is placed over the rock face and softened by heat. The foil is pressed against the rock until it adheres, and is then heated further. As the aluminum starts to melt, it flows into the cracks and crevasses, sealing the tunnel walls.

This is usually sufficient to prevent loss of atmospheric pressure and water to the lunar vacuum. In areas of greater than usual seepage, the aluminum coating can be applied multiple times or an additional layer of flexible ceramics can be laid down.

Economics

The Moon is rich in some natural resources, and lacking in others. Like every other powerful nation in Earth's history, Terradyne exploits the economic power of its riches as much as possible while trying to gain access to those things which it needs, but does not have.

Oxygen has played a key role in the development of the lunar economy, followed by metals and mineral processing. The clean vacuum of space has provided manufacturers a unique environment in which to produce high-precision, pure components.

Lunar Industry

The Moon excels in mining, refining and processing of metals, spacecraft construction, chemical production and electronics. Ultra-high precision manufacturing generates significantly less revenue than these, but still commands a strategic competitive advantage over Earth-based companies.

Mining and Manufacturing

The Moon is rich in aluminum, magnesium, silicon, titanium and calcium. While not found in great abundance, iron is also available. These materials are mined from the regolith and either sold as raw material or processed into high-quality construction material.

Low-gravity blending provides for the creation of alloys (such as Glassteel) with a wide variety of valuable properties. Such alloys can be produced only on the Moon, or in space: the Earth's stronger gravity field separates the components.

The Moon is also an excellent source for glass, ceramics and concrete. Virtually all the construction materials used in Luna City (except for plastics) were derived from local materials.

Lunar Shipyards

As the "grounded" part of Terradyne Shipyards, Luna City is the premier builder of spacecraft subassemblies and lunar shuttles. Most of the subassemblies are supplied to Terradyne's zero-gravity L4 Shipyard, where interplanetary craft and OTVs are built.

Chemical Industry

The chemical extraction and processing industry has had a long and profound effect on lunar development (see sidebar, p. 59).

Oxygen is plentiful in the lunar regolith — it is bound into several different compounds that make up the brown and gray soil. Oxygen was the initial export of the Moon, and, in terms of volume, is still the number one exported product.

Several other elements are extracted from the surface that, when combined with an oxidizer, make a low-powered (but inexpensive) chemical rocket propellant. More recently, Terradyne has developed a lunar-based propellant that is quite powerful — see *Chemical Fuel,* p. 92).

Lunar Electronics

Thanks to the availability of high quality raw materials, its pristine environment and its low gravity, Luna City has become a key player in the manufacture of electronic equipment.

Electronic equipment ranging from wrist computers to recording equipment to large medical scanning systems are regularly exported to Earth. Terradyne's lunar manufacturing facility is the leader in the electronics industry; all electronic systems, appliances and gadgets built on the Moon are of the highest TL8 quality.

The main impediment to total Terradyne domination of the market is price. Though manufacturing costs on the Moon are quite low for the high degree of quality, there are significant distribution costs in getting the product to Earth markets. Transportation costs, quotas and tariffs drive up the prices terrestrial customers must pay (see *Economics,* p. 36).

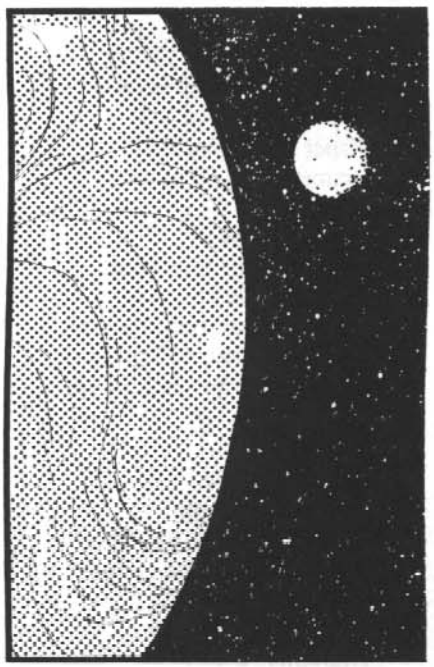
As a result, Earth-based companies are able to exploit the low end of the market by flooding it with cheap copies of Terradyne electronic products. UPOE sees this clone industry as a boon to terrestrial employment and a competitive pressure that can be applied to their space-based adversary (see *Cheap Copies,* p. 99).

Other entrepreneurs attempt to make a buck by circumventing the tariffs and taxes levied on legally imported items. These activities are clearly illegal, but whether or not they are viewed as a problem depends upon which side of the gravity well one is looking from.

High-Precision Manufacturing

The Moon's environment allows the casting and machining of ultra-high-precision components. Though this industry is quite small, it is critical to several key human endeavors, particularly scientific research.

The highly accurate scientific instruments developed on the Moon have allowed scientists to push deeper into the microscopic world by several orders of magnitude. Astronomy has benefited tremendously from the precision casting and polishing of optical-grade glass. The Farside Station telescopes were all produced in Luna City. Their size and resolving power have pushed the realm of observable space to the literal edge of the Universe.



Feeling the Squeeze

The GM must take care not to overindulge visitors in their wants when they shop the markets of Luna City. Just because Terradyne *could* make something doesn't imply that it *does*, or that it is readily available, or that it's cheap.

In addition, the GM should also look for ways that he can make the characters feel a bit of the pain Terradyne feels from its lack of lifeforms, metals or necessary volatiles.

For instance, if the characters wish to build something that requires a significant amount of plastic, make them pay. Plastic is an organic substance and must be imported from Earth — at great expense.

Or if they need liquid nitrogen for coolant, it probably isn't available. All nitrogen on the Moon comes from Earth. Titan is a source of nitrogen and carbon, but the mining facility is only now coming on line.

Available Technology

Luna City is the home of Terradyne, and Terradyne manufactures most of the high-tech items in the marketplace. Thus, TL8 equipment is readily available on the Moon.

The sections below outline the general availability of certain technological categories:

Luna Planetary Record Sheet

One hex = 151.2 miles

Planet Type: Rockball
Diameter: 2,160 miles
Gravity: .17 G
Density: 3.34
Composition: Low-iron
Axial Tilt: 6.7°
Seasonal Variation: Extreme
Length of Day: 655.5 hours
Length of Year: 365.3 days

Atmosphere

Pressure: None
Climate: Extreme
Temperatures at 30° latitude:
Low -243°, Average N/A, High 273°
Surface Water: 0%
Humidity: 0%
Primary Terrain: Hilly/rough

Mineral Resources

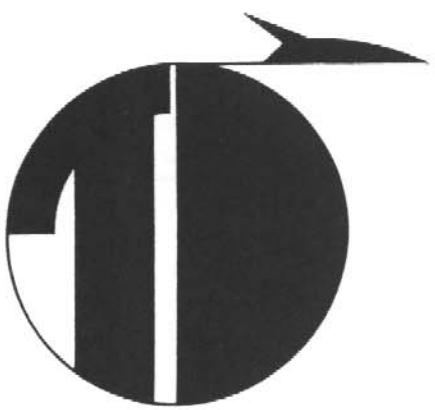
Gems/Crystals: Absent
Rare Minerals: Absent
Radioactives: Absent
Heavy Metals: Absent
Industrial Metals: Scarce
Light Metals: Extremely plentiful
Organics: Absent

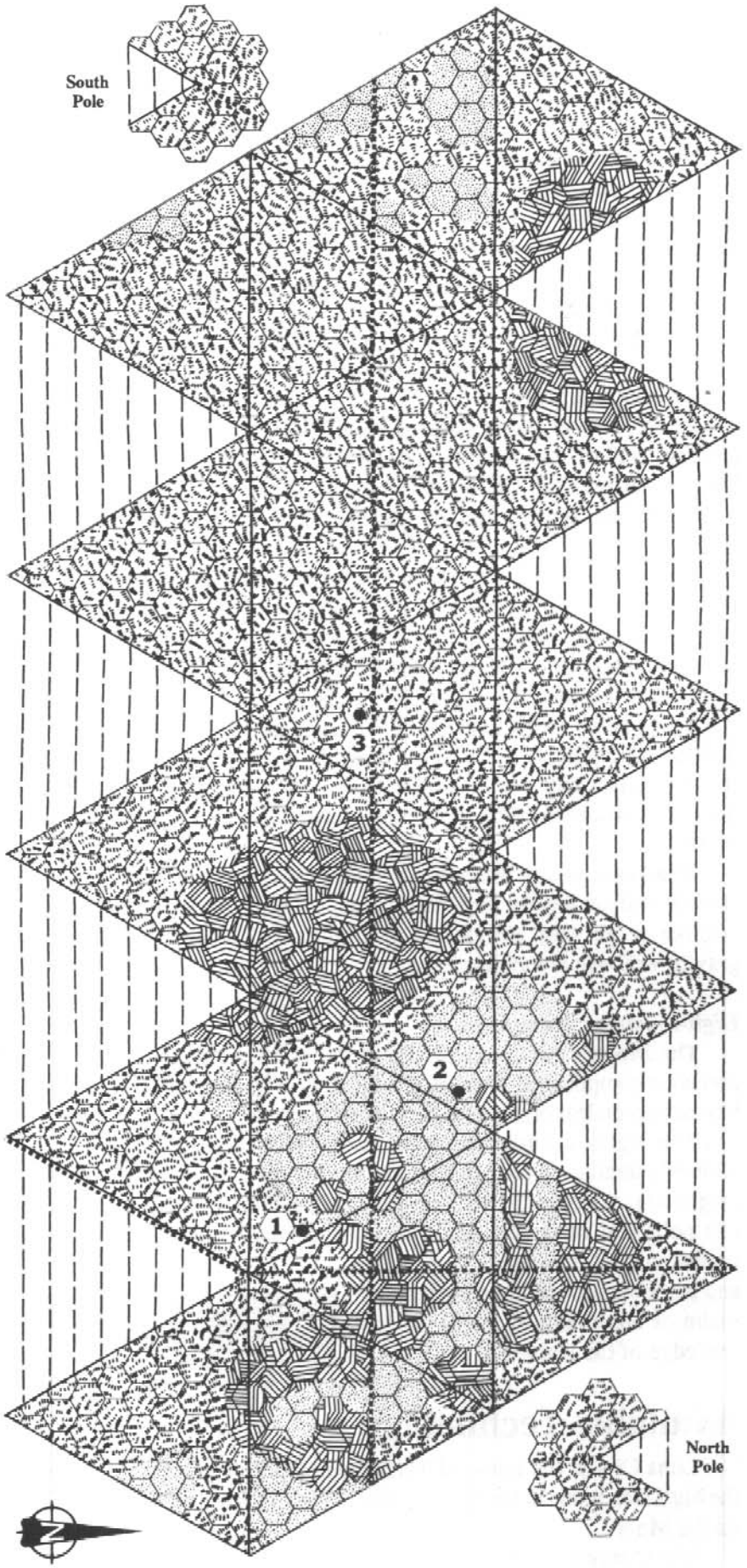
Biosphere

Dominant life form: Humans

Civilization

Population: 3,000,000 (PR 6)
Tech Level: 8
Control Rating: 4
Society: Corporate state.
Starports: Luna City (I), class V, no FTL.
Installations: See text.
Economic/Production: See text.





Communications

Access to data net services are readily available in Luna City and Farside Station. Net services are limited to these areas, unless special custom communication networks are established.

Radio is line-of-sight (LOS) only on the Moon. Communication satellites orbit the Moon, but usage is restricted to subscribers (such as Terradyne, Lunar University, UPOE agencies, etc.). Private utilization of these commsats is expensive: $10 per minute of use (except in emergencies).

A network of radio repeater stations covers most of the surface of Nearside. These stations are remnants of earlier lunar colonization efforts, and have been superseded by the commsats for all official business. There is a 5% chance per hour of communications problems when using this land-based network.

Solar activity can disrupt radio communications, particularly when it is the height of the 11-year solar cycle. Cut transmission rates by 50% to compensate for error correction.

Laser communications technology is common on the Moon — it is secure, since it is directed from point to point, and is not affected by solar activity.

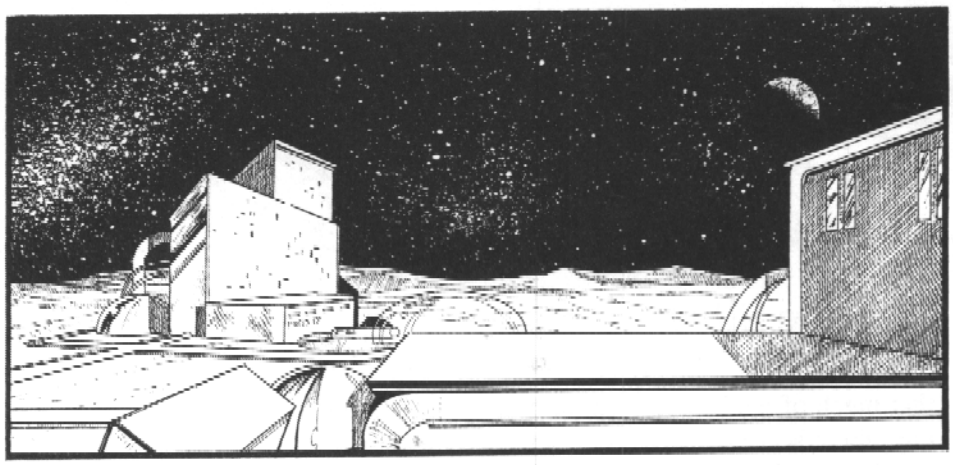
Computers

TL8 computer systems are manufactured on the Moon. Software for these computers is commercially available.

The computer at Farside Station approaches TL9. Built by a joint venture between Terradyne's Basic Research division and the Computing Sciences faculty of Lunar University, it is used to support the study of the cosmos. It is a one-of-a-kind system.

Power Systems

Fusion and solar-based photonic power systems are generally used. TL7 and TL8 power cells are readily available, with the TL7 at a significant (40%) discount.



Weapons

No weapons of any type are allowed to civilians inside Luna City. Security forces (Luna City police, UPOE's ISF forces and Corporate Security Forces) are the only personnel allowed to carry firearms. Security systems routinely scan passageways for weaponry.

Weapons of TL8 and lower may be purchased in Luna City, but only after a lengthy background check, including queries to Earth-based law enforcement agencies. Licenses to sell firearms are costly and hard to come by. A customer may examine a weapon before buying, but may not take delivery until he reaches the Luna City spaceport; the weapons pickup point there is staffed by Luna City police.

A Lunar Factory

Factory MED-17, which belongs to Terradyne's Manufacturing unit, sits with several other factories on a low ridge about 20 miles southeast of Luna City. It assembles bioscanners and a number of other medical devices from parts, including microchips, produced by its neighbors.

Because of the susceptibility of microcircuits to cosmic radiation, it is buried below ten feet of Lunar soil. A passageway protrudes from the ground about 70 feet below the top of the ridge. This is actually an electrostatic "shower" to remove dust from the suits of the rare human visitors.

Access through this passage is limited to authorized company employees by an electronic lock with a six-digit combination, and a voiceprint analyzer (see ***GURPS Ultra-Tech***, p. 10). To trigger the analyzer, a visitor must touch his suit helmet to a small panel on the outer door while speaking. Remote operators in Luna City are also notified when anyone attempts to enter the factory.

There is also a large enclosed tunnel used to bring in parts from other factories and ship finished products. It rises at a shallow angle from one side of MED-17 until it surfaces a few hundred feet farther along the ridge. It levels off after surfacing and connects to a central shipping facility.

The main chamber is a dome 180 feet in diameter and 60 feet high at the center, and is obviously not designed for human workers. There are no discernible aisles, and machinery is suspended at whatever level is most convenient for production, so there are no floors to speak of either. For combat movement, about a third of the dome's hexes would be considered minor obstructions, another third severe, and the remainder impassable even in lunar gravity.

Incoming parts and finished products are both stored at "floor" level, about 90 degrees around the dome to the left from the access passage. Here stationary robots load and unload magnetic sleds which ride the tunnel to the central facility.

When producing, the factory is a blur of activity and a dangerous place to be. Robot arms equipped with clamps, laser drills and other tools are constantly flailing in every direction, and small maintenance robots zigzag about. An uninvited visitor is in even more danger; he will be tracked by six video scanners mounted around the top of the dome about 40 feet high. A computer-controlled laser rifle (skill 13) is built into each scanner, tracking with it, and can be fired by the main computer in the center of the dome or by remote operators in Luna City. The laser/scanners can be disabled by destroying them individually, or by shutting down the main computer.

MED-17 is powered by a large solar cell array on the south side of the ridge, but if that source is cut off it has 24 hours' worth of independent power.

Medicine

TL8 medical equipment and drugs are readily available, although some may only be purchased by doctors or other authorized personnel.

Sensor Equipment

TL7 and TL8 equipment is readily available. Some very experimental equipment approaching TL9 is currently being designed (secretly) by Terradyne's CSF, but access to this equipment is *highly* restricted.

Security Equipment

TL8 security is applied throughout Luna City and is readily available. Some TL7 security systems are also available at a steep discount.

Investigation/Surveillance Equipment

All law enforcement officials have access to the latest TL8 equipment. Privacy laws prohibit the sale of some of this equipment to unauthorized personnel, although for the most part there is no restriction on TL7 and lower equipment.

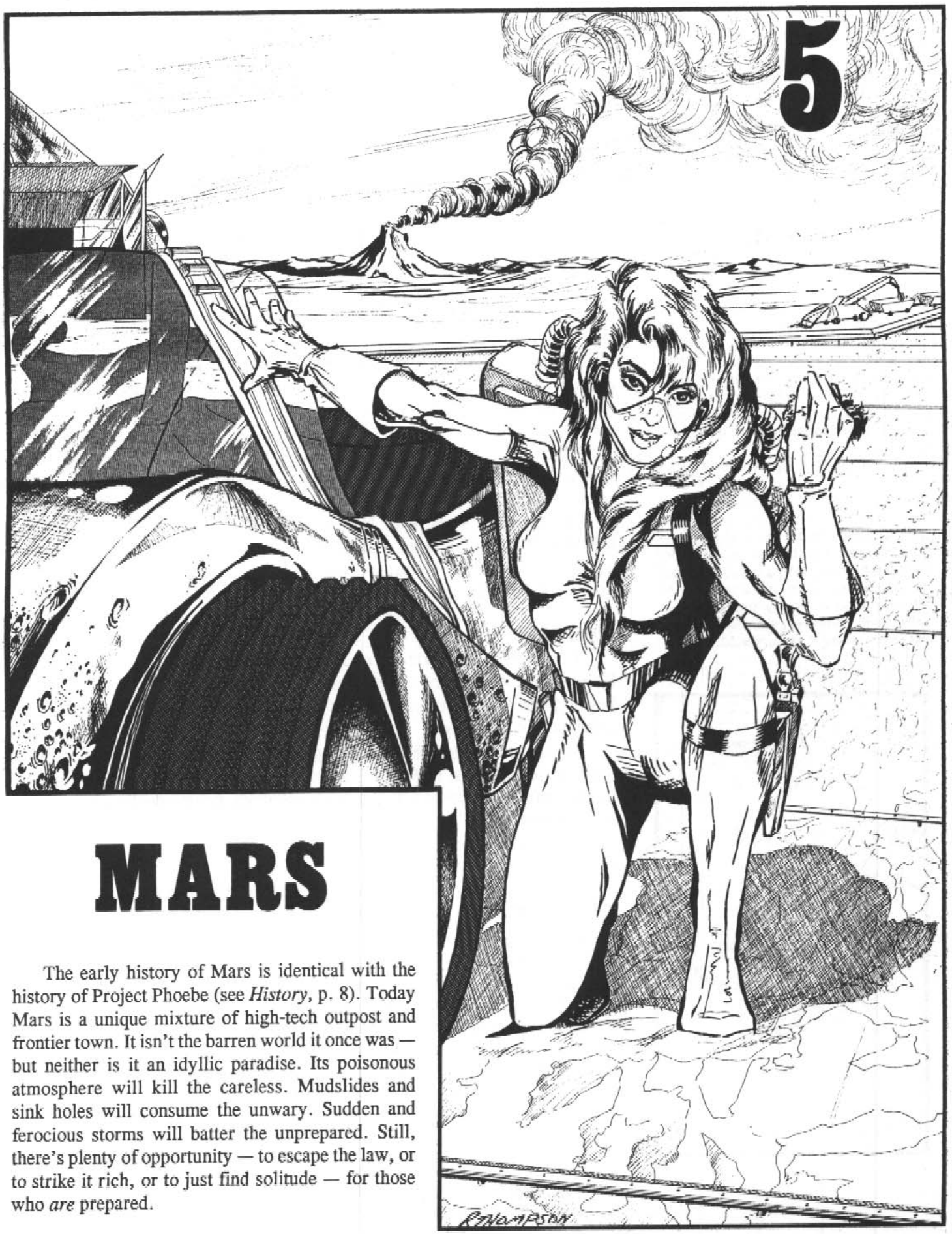
Remote Sites

Luna City is a highly civilized urban environment, and it is easy to forget that much of the Moon is untouched by human hands. Outside the walls of the city, there is only a handful of other settlement sites worth mentioning.

Farside Station, accessible only by maglev train, is virtually opposite Luna City on the Moon's sphere. The manufacturing facility on the floor of crater Aristarchus is the only other highly developed region on the Moon.

A few other human habitats exist on Luna, either from old exploration activities or new lunar missions launched from small national or corporate interests on Earth. Communication to and from these remote areas is difficult. Links to data nets are not normally possible, and law enforcement in Luna City does not see these tiny settlements as part of their turf.

98% of the entire lunar population resides in either Luna City or Farside Station. While in theory Seat 7 on the Council of Governors represents everyone who lives outside Luna City, in practice Farside Station controls the seat.



MARS

The early history of Mars is identical with the history of Project Phoebe (see *History*, p. 8). Today Mars is a unique mixture of high-tech outpost and frontier town. It isn't the barren world it once was — but neither is it an idyllic paradise. Its poisonous atmosphere will kill the careless. Mudslides and sink holes will consume the unwary. Sudden and ferocious storms will batter the unprepared. Still, there's plenty of opportunity — to escape the law, or to strike it rich, or to just find solitude — for those who *are* prepared.

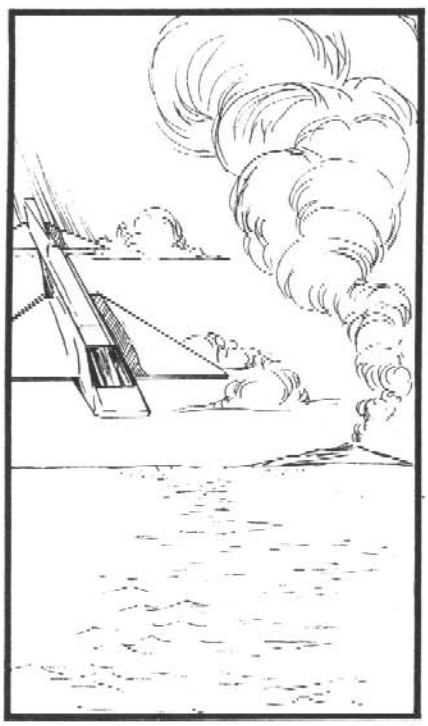
The Surface

The Artemis Engine

In 2042, simple fusion engines were used on deep space craft. But the engine invented by Project Phoebe's scientific staff, known as *Artemis*, used fusion in a fundamentally different way. Improved versions of the original Artemis engine are now standard equipment on most interplanetary spacecraft.

The old fusion drives used heat created in a fusion reactor to superheat a propellant, typically water, which was released through a conventional nozzle. The Artemis engine replaces the traditional reactor and nozzle. The fusion reaction in the Artemis engine takes place within the engine nozzle. The fusion products become the propellant, though additional propellant can be added for more thrust. The nozzle itself also changed dramatically. The old metal casing is replaced by extremely powerful magnetic field lines — the nozzle is invisible, and infinitely more maneuverable.

The most striking aspect of the Artemis engine is that it operates *outside* the hull. When fired, a small sun erupts into existence several tens of yards behind the craft, with brilliant streamers of gas spewing away from the ship and a clearly defined shock wave pushing violently toward the vessel, but never quite reaching it. Viewing such a display unprotected is quite deadly, however, since large quantities of gamma rays are produced.



Terrain

The Martian surface is 35% water. A single ocean, appropriately named *Phoebe*, covers most of the northern hemisphere. Two smaller seas, the *Hellan* and the *Argyrian*, occupy the southern mid-latitudes. The *Australian Sea* circles the south pole.

Phoebe reaches depths of over 12.5 miles in places (at impact sites now underwater), but typically does not go deeper than 1.5 miles. The Hellan and Argyrian run as deep as 2.5 miles. The Australian Sea is shallow; its deepest point is less than 4,000 feet down.

Three continents make up the land masses of Mars. The two smaller continents lie within Phoebe. *Borealis*, a snow-covered desert, centers upon the north pole. *Elysium* (somewhat smaller than the United States on Earth) surrounds the volcano bearing the same name. The largest continent, *Ares*, covers most of the southern hemisphere and contains several geographically distinct regions: *Tharsis*, the great volcanic plateau; *Mariner*, the eastern Tharsis lowlands and great canyon; *Solis*, the high plains between Tharsis and the Argyrian Sea; *Syrtis Major*, the large land mass extending into the northern ocean; and *Hesperia*, the plains south of Elysium.

There are many small islands in Phoebe. Most are crater rims, formed by the stolen moon's impacts, that partially emerge from beneath the sea. Volcanic activity formed the remainder.

Elevations on Mars range from sea level to over 17 miles at the top of the largest volcanoes. For comparison, Mount Everest rises less than 6 miles above sea level. Yet Mars' atmosphere is three times thicker than Earth's, so the pressure differential is less dramatic (see sidebar, p. 78).

Water Bursts

The surface temperature of Mars has risen dramatically since Project Phoebe, and seismic and volcanic activity have increased. These changes have begun to melt the great storehouse of native Martian water locked away in subterranean permafrost.

As this ice melts, the surrounding rock sags. The resulting friction melts more ice, causing the rock to sag further. This positive feedback quickly melts the permafrost completely. The bedrock collapses, putting the liquid water under intense pressure. The water then erupts out of the ground like an exploding volcano. While short-lived, these water bursts can do tremendous flood damage to the surrounding terrain.

Bursts only occur on Martian plains — mountainous regions are not affected — and in regions with subsurface ice. Permafrost melting must be occurring for a water burst to form.

Water bursts vary in scale. *Small* bursts can release several hundred thousand gallons of water in less than one minute. *Sinkholes* typically accompany small bursts (see sidebar, p. 80).

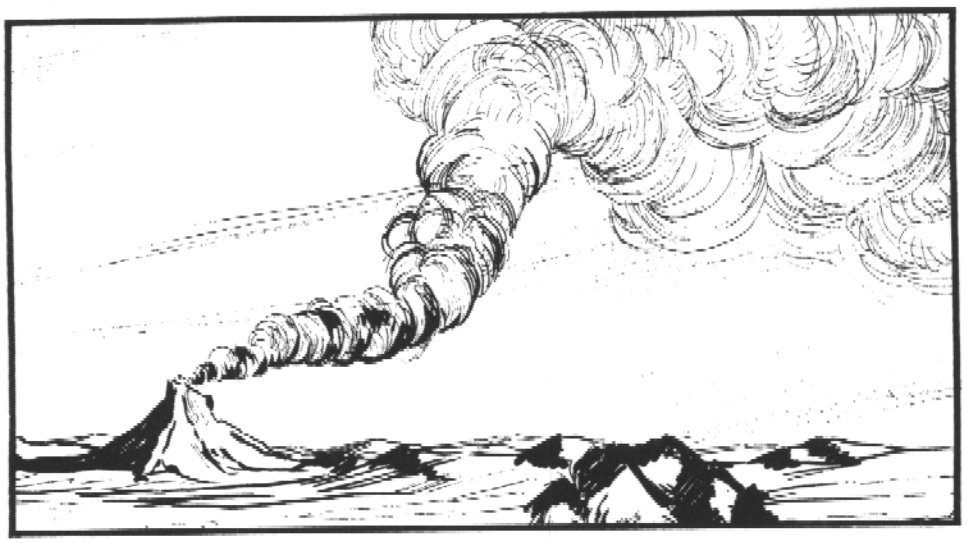
Medium bursts release millions of gallons of water and last for several minutes. Sinkholes and the occasional small *marsquake* (DX and all DX-related skills at -2 for duration of the quake) usually accompany medium bursts.

Very large bursts coincide with the creation of *chaotic terrain* (see sidebar, p. 77). They are extremely rare, and release prodigious amounts of water. Floods can blast out of the ground and reach depths of 200 feet or more in seconds. The complete collapse of the surrounding bedrock always accompanies a large burst, as do medium to strong marsquakes (DX at -6 to -10). Anyone caught in a large burst will probably die — they'll be crushed, drowned or buried alive.

A very large burst and the resulting chaotic terrain can raze an area hundreds of miles across.

If the party is traversing terrain susceptible to water bursts, roll 3 dice weekly. On a six or less, roll the dice again. If the second roll is greater than six, the party has encountered a *small* water burst. If it is less than six, the party has run into a *medium* water burst.

If the GM decides to kill off the entire party, he can have them caught in a *very large* water burst and bury their remains in the resulting chaotic terrain. However, this event will be preceded by seismic activity and numerous small and medium water bursts — and there have been no very large water bursts in the past 30 years.



Volcanoes

Geologists once believed most of Mars' volcanoes to be extinct, but Project Phoebe proved them to be merely dormant. The impact reactivated most of the volcanoes north of the equator.

The only difference between terrestrial volcanoes and those on Mars is size. Martian volcanoes are *big*. Olympus Mons is as big across as Nebraska, and it climbs to over 17 miles above sea level. Most other volcanoes, while not as wide, reach similar heights. Very high (3,000 to 6,000 feet), nearly vertical cliffs skirt most Martian volcanoes. Access to the volcanic slope from the surrounding plateau is limited to rock bridges built up by lava flows.

The largest volcanoes are on the Tharsis Plateau and in Elysium. Glaciers are forming on many of these volcanoes, and if a glaciated volcano erupts, flash flooding could result from the lava flow meeting the glacial ice.

Canyons

Mariner Canyon is the largest, deepest and longest canyon in the Solar System. Phoebe has partially flooded its eastern end, and the Viking River flows through its entire length. Melted glacial ice runs into the canyon from the west, cutting a path eastward to the shores of Phoebe. Large portions of the canyon east of 55 degrees longitude are now underwater. Mariner Canyon is susceptible to intense flooding from volcanic activity melting large portions of glaciers.

There are many smaller canyons all across Mars, most of which were cut by the stupendous and sudden onrush of water that created the rubble at their head. Many accompany chaotic terrain and lead out into the surrounding plains.

Martian canyons tend to branch heavily, with scores of interconnecting canyons running parallel to one another. Careless explorers can easily become lost in these canyon mazes.

Atmospheric Contents — A Terraformer's Guide

Earth's atmosphere is 77% nitrogen, 21% oxygen, 1% water vapor, .93% argon plus many other minor, but important, gases. These gases and their relative amounts are critical for life to exist.

Oxygen

Oxygen is necessary for two reasons. First, it drives tremendous chemical energy releases within the living cell, providing the power of life. Second, it forms the ultraviolet light shield, ozone, which protects life on the surface from some of the Sun's harmful radiation.

Why is Earth's atmosphere only about 20% oxygen? A higher partial pressure would be too much of a good thing; high concentrations of oxygen are corrosive and dangerous. At concentrations higher than .21 bar, even damp twigs and branches can spontaneously catch fire.

Nitrogen

Nitrogen serves three primary functions. First, it provides a neutral, nonflammable buffer in the air to provide pressure and dilute the powerful chemical effects of oxygen. Second, it is a prerequisite for life, since it is incorporated into the proteins from which life is made. Lastly, when combined with oxygen in the upper atmosphere, it forms nitrous oxide, which blocks the Sun's shorter-wavelength ultraviolet light.

Water Vapor

Water in its liquid form is clearly important to Terran life. However, in its gaseous form, it plays an equally important role — it keeps the Earth warm. Water vapor is one of the most powerful greenhouse gases present in the atmosphere.

Carbon Dioxide

Carbon dioxide makes up only 550 parts per million of air (in the 22nd century), but is critical for plant respiration. Carbon dioxide is also a greenhouse gas. In concentrations greater than 1%, it becomes poisonous.

Sudden increases in wind inside the larger canyons can bring on short-lived but vicious *sandstorms* on the canyon floor (see *Weather*, below).

Sand Dunes

Martian sand dunes are also record-holders in the solar system for both size and quantity. There are scores of large fields and hundreds of smaller ones on the planet, and fields spreading over hundreds of square miles are common.

Martian sand is finer than that on Earth. It will easily penetrate and damage equipment not specifically designed with extra protection. All products built on Mars, or built by Terradyne to Martian specifications, have such protection, although many people risk buying less expensive, non-protected equipment because it costs less (see sidebar, p. 75).

Many dune fields in the deep southern hemisphere have not yet been "neutralized" by rainfall. This soil is a good source of oxygen for stranded travelers or other interested parties — but it carries the danger of both explosions and *red lung* (see sidebar, p. 76).

Polar Regions

Phoebe's arrival destroyed the polar ice caps of the Red Planet. What was once the southern ice cap is now beneath a shallow sea. The northern pole has become the small island continent of Borealis.

The polar regions are deserts and receive little precipitation. The Australian Sea formed over a buried bed of dry ice (frozen CO_2) and "fizzes" at times.

Weather

Wind Patterns

Mars is much smaller than Earth. Where Earth has three *Hadley cells* (see sidebar) in each hemisphere, Mars has just one in each. This affects Martian trade winds and desert regions. Trade winds in the Martian northern hemisphere are northeasterly, becoming stronger and more easterly as one approaches the equator. In the south the winds mirror the north but are from the southeast.

Surface winds, driven by high and low pressure areas close to the surface, can blow in any direction, though weather patterns — and the highs and lows — always travel from east to west.

Precipitation

The lack of multiple Hadley cells moved the desert regions that girdle the Earth at +/- 30 degrees to the poles of Mars. Very little precipitation falls at the poles. Therefore, the island continent of Borealis receives little snow, though what does fall stays through most of the year. In the south, the Australian Sea is free of pack ice.

The prevailing northeasterlies bring significant precipitation to the eastern coast of Elysium, Mariner and most of Syrtis Major. Water-laden air driven up the steep slopes of Tharsis falls as snow, some of which remains as the Tharsian glaciers.

In the south, the northwest coast of the Hellan Sea receives significant rain, as does the southwest coast of the Straits of Apollo, the narrow strip of Phoebe that separates Elysium from the southern continent.

The west coast of the Argyrian Sea receives precipitation mostly in the summer and fall, when cold polar air sweeps over the sea, causing storm squalls downwind of the sea.

In more general terms, the northern hemisphere is wet, the southern hemisphere is dry. The farther south one travels, the less open water he is likely to

Atmospheric Motion

Planetary atmosphere is driven by two mechanisms: the temperature differential between a planet's poles and equator, and the rotation of the planet.

Warm air at the equator rises to be replaced by cooler air descending from the poles. The warm upper air travels poleward, cooling as it ascends the globe. This vertical motion is called *Hadley circulation*.

Air from the poles moves horizontally much more slowly than air at the equator. When Hadley circulation moves 'fast' air from the equator toward the poles (or vice versa), the air, which used to hang over 'fast' equatorial ground, is now over much 'slower' mid-latitude or polar ground. The result is wind.

Hadley circulation, combined with the Coriolis effect of the rotating planet, creates global wind patterns. These wind patterns deliver moisture worldwide, and moderate temperatures at the equator and poles.

find, with the exceptions noted above. Even at the South Pole, where a small shallow sea can be found, there is little precipitation. The humidity in the south is very low.

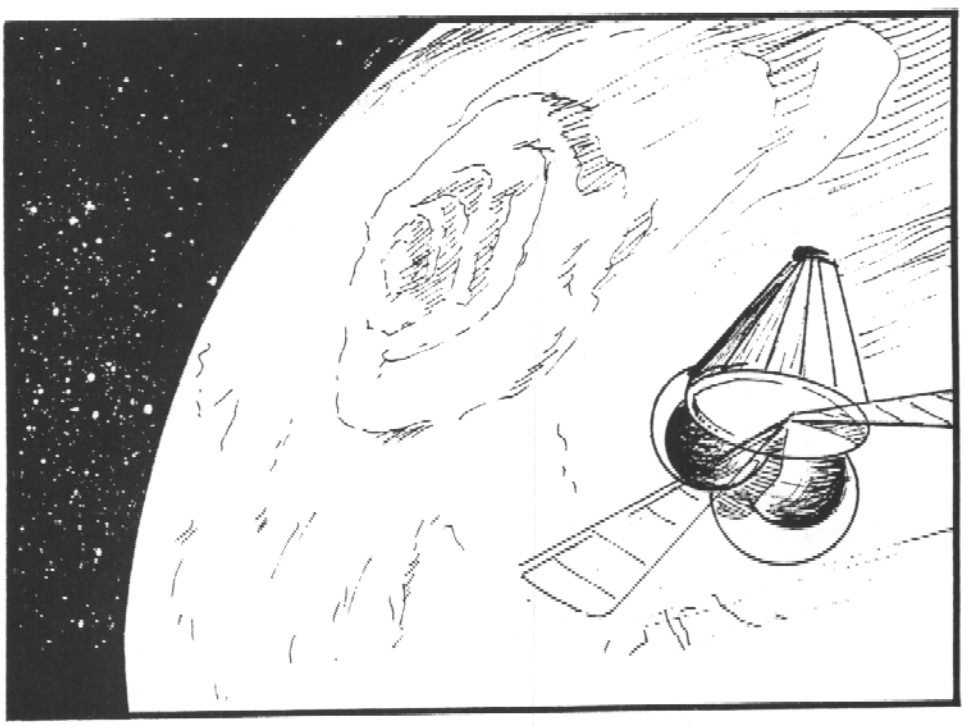
Because Mars has an exaggerated topography, "rain shadows" — the dry regions found leeward of mountain ranges — affect much of Mars' regional climate. Areas that are west of significant land rises, such as the western edge of Elysium and Tharsis, see little precipitation. Typically, areas that fall within such rain shadows are not desert, but are semi-arid through most of the year with short rainy seasons and the occasional mangala storm (see below).

Volcanic eruptions and the accompanying ash clouds can "seed" clouds. The added particulate in the atmosphere causes what little moisture exists in the air to condense and fall as rain.

Storms

Most Martian storms are mild. They build slowly, release a moderate rainfall for several days or weeks, then dissipate. Weather fronts seldom make a complete circuit of the world.

Once in a while, however, the thick Martian atmosphere promotes the creation of *mangalas* — fierce, torrential storms accompanied by high winds and hail, with cloud tops that can reach over 30 miles in height. Mangalas can cause flooding and whip up large amounts of surface dust, turning torrential rain into torrential mudfalls, causing severe erosion.



Mangalas can spawn secondary storms and tornadoes, and can circle Mars twice before dissipating, though crossing Syrtis Major or Tharsis usually saps them of most of their energy.

Mangalas are not hurricanes. Martian hurricanes are generally no stronger than their terrestrial counterparts, primarily due to the small area of equatorial ocean. Hurricanes tend to spend their energy quickly once they make landfall. Only one Martian hurricane to date has reached a ferocity even approaching a small mangala.

Storms in the southern hemisphere occur as often as in the north. Since the southern hemisphere is drier than the north, these storms tend to be *sandstorms*.

Gaia

An ancient theory of Terran ecology guides Terradyne's work on Mars. According to James Lovelock, who originated the Gaia Theory over 150 years ago, *Gaia* can be defined as follows:

"Gaia — a complex entity involving the planet's biosphere, atmosphere, oceans and soil; the totality constituting a feedback or cybernetic system which seeks an optimal physical and chemical environment for life on the planet. The maintenance of relatively constant conditions by active control may be conveniently described by the term *homeostasis*."

To be sure, Gaia is not conscious and cannot deliberately effect change on herself to protect and promote life. Rather, the feedback network between living creatures and their activities (breathing, eating, decomposing, etc.) form a synergistic whole. It is this network that maintain conditions on the planet that further promote life — free water, free oxygen, temperature, etc.

An example: Earth's atmosphere is clearly unstable. Free oxygen would not normally exist on a planet without life. It would react with the rocks and be absorbed into the planet's crust. Yet there is oxygen in our air, put there by plants and breathed by animals. Animals exhale CO_2 which is recycled by plants into energy and oxygen. Oxygen is critical to life. But as discussed in the *Atmospheric Contents* sidebar on p. 69, too much oxygen in the atmosphere is dangerous.

Thus, it is in the best interest of the plants to produce oxygen (so animals can live to generate CO_2), but not so much as to cause worldwide fires. And this is the exact amount of O_2 in our atmosphere. Yet plants clearly are not consciously directing oxygen production.

This example is highly oversimplified, but it makes the point: life begets life. Life promotes life. Once life is in a place, it will stay in place — in the absence of a catastrophic interruption, that is.

This principle is the basis of Martian terraforming efforts. By introducing the critical basic forms of life — the nitrogen cyclers, the oxygen cyclers, the carbon cyclers, etc. — Gaia will arise on Mars as she did on Earth.

Perhaps mankind's real role as part of Gaia is simply to spread her to other worlds!

Mars Planetary Record Sheet

One hex = 295.6 miles

Planet Type: Earthlike
Diameter: 4,223 miles
Gravity: .38 G
Density: 3.94
Composition: Low-iron
Axial Tilt: 24°
Seasonal Variation: Earthlike
Length of Day: 24.62 hours
Length of Year: 687 days / 1.88 Earth years

Atmosphere

Pressure: 1.0
Type and Composition: CO_2 (53%), N (20%), methane (5%), H (10%), O_2 (2%), H_2O (5%), others (5%)
Climate: Earth-normal
Temperatures at 30° latitude: Low 60°, Average 80°, High 100°
Surface Water: 35%
Humidity: 50% N, 20% S
Primary Terrain: North — Desert/barren with volcanic activity; South — Desert/barren

Mineral Resources

Gems/Crystals: Scarce
Rare Minerals: Absent
Radioactives: Absent
Heavy Metals: Scarce
Industrial Metals: Ample
Light Metals: Extremely plentiful
Organics: Scarce

Moons

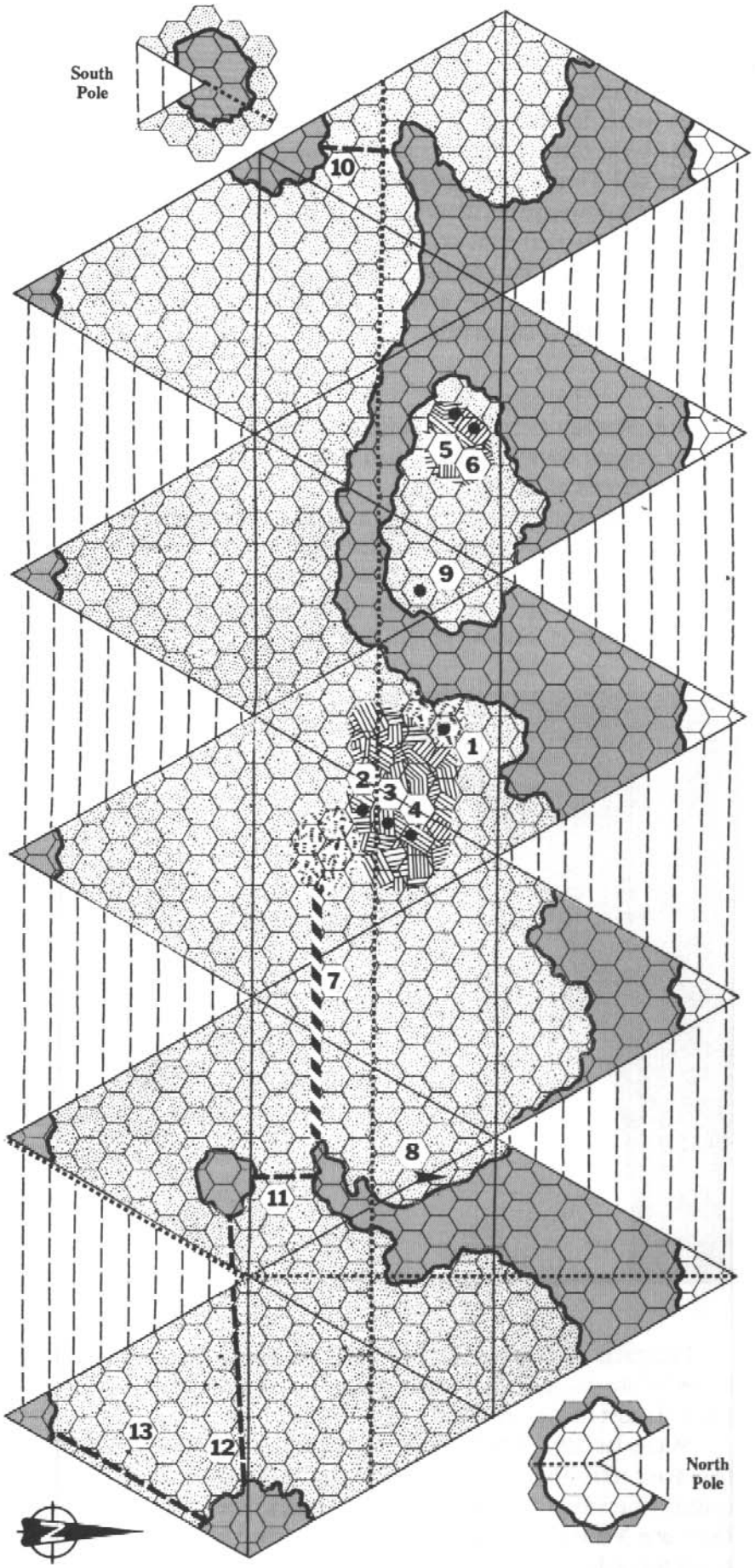
Two asteroidal moons — Deimos and Phobos

Biosphere

Dominant life form: Proto-organisms, lower plants, some higher plants. Heavily genetically engineered.
Other significant life forms: Some lower animals engineered and released. Humans.

Civilization

Population: 1,000,000 (PR 6)
Tech Level: 8
Control Rating: 3-4 in cities; 0-2 in wilderness
Society: Corporate state operating as a limited representative democracy.
Starports: 1 class IV (no FTL) at Uruk. Some other cities and company facilities have class III ports.
Installations: See text.
Economic/Production: See text.



Sandstorms also occur on Earth and on Venus, but they are nothing like those on Mars. Thanks to positive feedback, Martian sandstorms can engulf the entire southern hemisphere for weeks at a time. Dust in the air cools the surface but warms mid-altitude air, which scrambles Hadley cell circulation, causing further disruption. Resulting vortices of air can whip up more dust, while other regions, suddenly bereft of wind, allow the dust to settle.

These storms are characterized by high winds and abrasive sand. A clear glass plate can be turned opaque by pitting in hours. The highly corrosive soil of the southern hemisphere makes these storms even more dangerous to the hapless human caught in one's grip (see sidebar, p. 76). Unprotected persons or equipment will take 1d-3 points of damage every *second* they are exposed to a light to moderate storm, 1d-1 for a heavy sandstorm. Faceplates of airmasks, windshields of vehicles, etc. will become opaque in 1d hours if made of non-armored glass.

Southern mangalas usually grow to engulf the entire hemisphere in a sandstorm. Smaller sandstorms usually accompany weaker southern storm fronts.

Areas north of the equator do not experience sandstorms — there is sufficient moisture in the air to prevent sand from building to critical levels in the atmosphere. Interhemispheric isolation prevents the mixing of air masses between the north and the south, and keeps southern storms from crossing the equator.

The dense Martian atmosphere allows clouds to grow very thick — it can get very dark beneath a large storm! Apply *partial darkness modifiers* (see p. B92) to any activity occurring beneath a mangala or sandstorm.

Temperatures

Global temperatures are very close to those experienced at similar latitudes on Earth, though temperatures in the deep southern hemisphere are more extreme than in southern Argentina or the coast of Antarctica.

Survival on the Martian Surface

Mars is still being terraformed, and it's still a hostile environment. Martians — the ones who survive, anyway — have managed to adapt to the challenges their new home presents.

Survival (Mars) skill is applicable across all Martian terrain types.

Atmosphere

Martian air is poisonous. It contains high concentrations of carbon oxides, methane and hydrogen and very little free oxygen. Anyone outside the domes needs an *air mask* or a *rebreather* (see p. S49). Human beings don't require body coverings to protect them against the Martian air — but they do need protection against heat, cold and other natural events! In particular, Martians use lightly armored vacc suits in the deep south to protect against sandstorms and Red Lung.

Martian rebreathers are modified to extract oxygen from the CO_2 and water vapor in the environment. Modified rebreathers do not need air tanks and cost $2,000. Armored faceplates (for protection against the sandstorms of the south) cost $200.

Breathing gear must keep a tight seal against the face. There isn't enough free oxygen in the Martian atmosphere to allow the methane and hydrogen present to ignite — but if outside air enters the mask (and the wearer's lungs!), it is in the presence of plenty of O_2, and an equipment short or static discharge can easily ignite it. For this reason every Martian's air mask is molded to fit his face. No one ever leaves home without his air mask, and no one ever asks to borrow someone else's.

Injection Events on Mars

In the Pleistocene, the northern tip of West Africa moved away from the southern tip of what is now Spain. What was once an intercontinental dam separating the Atlantic from a broad, flat desert plain disappeared in a horrendous rush of sea water, creating the Mediterranean Sea.

The time it took to fill the new sea was measurable in days.

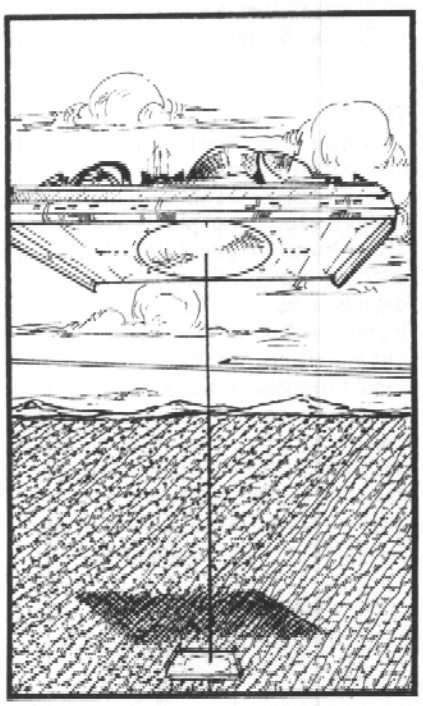
This was an *Injection Event.* The sudden and rapid change in sea level caused an equally sudden change in salinity in the Atlantic. Many species died as a result.

The new Martian topography consists of a single large ocean in the northern hemisphere and two mid-latitude seas in the south, with a smaller south polar sea. It is inevitable that, given enough time, the Hellan Sea and the Agyrian Sea will overflow their banks and flood northward.

These seas will have been isolated until that time. Furthermore, they will have a higher concentration of salts, since they are located in the more arid southern hemisphere. The drier soil of the southern hemisphere will not have been rinsed of its high salt and mineral concentrations.

When these seas overflow their banks and flood into the northern ocean, the rapid increase in ocean salinity will kill many of the species inhabiting those waters. Ecological shocks of this magnitude in a biosphere still in its infancy pose a serious threat to the continuance of life on Mars.

Canal systems connecting these geographically separate bodies of water would allow marginal changes in salinity to occur immediately, thus preventing large, one-time Injection Events from occurring.



Terraforming Timetable

2051

Saturn's outermost moon, Phoebe, is propelled into a trajectory that, using gravity assists, will slam it into Mars.

2064

Phoebe strikes Mars with the energy of several billion megatons of TNT. The old atmosphere is blown away in the explosions. Very heavy seismic/volcanic activity. Heavy secondary impacts from Phoebe debris. Remaining debris forms a ring circling the planet in low orbit.

2086

Seismic and meteorological activity on Mars subsides to tolerable levels. Oceans and seas formed. Humans reestablish their foothold on the surface. Mudslides and minor quakes continue from permafrost melting. Simple lifeforms introduced. Secondary impacts from debris ring wane.

2100

Martian climate stabilizes at a more temperate level. Equatorial tropics are flanked by temperate mid-latitudes and colder polar regions. Temperature ranges are similar to Earth's. Permafrost quakes continue, as does volcanic activity initiated by Phoebe. Simple lifeforms continue to be introduced.

2120

Sophisticated meteorological models now possible in stable atmosphere. Large human presence on surface. Some simple, oxygen-producing plants taking hold. Large anaerobic population in soil and in intertidal regions. Some naturally mutated organisms found in deeper areas of ocean. Heavy mechanical desalination of soil effort in southern hemisphere assisted by organic processes. Canal connecting Hellan Sea to Phoebe open. Argyrian and Polar Canals under construction. Permafrost quakes expected to continue in some regions for another 600 years. Martian volcanoes continue to erupt. Some indications that ozone layer is forming seasonally.

Continued on next page . . .

Terrain

Settlement sites are chosen carefully to avoid risks from such hazards as unneutralized soil, melting permafrost (which can create sinkholes), water bursts and Marsquakes. Severe weather is a problem everywhere on Mars, though there are areas such as the west side of Tharsis where its effects are minimized.

Magnetic compasses do not work on Mars — the planet's natural magnetic field is too weak to be of any use. To compensate, navigational beacons are scattered all over Mars. A computer with the appropriate navigational software and map data can use these beacons to pinpoint a location to within 1 foot, or a character with the Orienteering skill (see p. 119) or Survival (Mars) skills can use these beacons, a directional radio and a map to fix his position to within about a mile. Inertial compasses are also available.

Water can be taken from streams, rivers and lakes, but must be filtered or distilled. Nonfiltered water contains high levels of metals and salts that have leached from the soil. Treat unfiltered Martian water as a poison; each ounce drunk does 1d damage (roll vs. HT-5 to only take half damage) within one minute. Water distilled from the atmosphere is not poisonous.

Ultraviolet Radiation

Mars does not yet have a permanent protective ozone layer to filter out ultraviolet light. Low level radiation (1 rad per month) bombards the Martian surface during the daylight hours. This reduces to ½ rad per month in the northern summer, when the distance between Mars and the sun is greater and seasonal ozone appears in the atmosphere. The southern areas do not benefit from any reduction in radiation levels — not enough ozone forms in the south to compensate for the shorter distance between the Sun and Mars during the southern hemisphere's summer.

To prevent damage from exposure, all skin areas must be covered by clothing or by protective cream. Applying "sun cream" has become a normal part of Martian culture, like saying good-bye. If a character grew up on Mars, or has lived there longer than one Earth year, the GM may assume that he takes all needed protective measures regularly. If a non-Martian character is in the presence of a friendly Martian, the same assumption can be made, since it's considered impolite not to warn the uninitiated about the hazard. Otherwise, roll against IQ at +2 to see if the visitor remembers; if not, he gets a nasty sunburn (2d damage) and the modifier goes up to +6 for later attempts!

Protective cream can be found in any human settlement and costs $.05 a dose. It's usually sold in jars or tubes of 30 doses each ($1.50 per jar or tube).

Martian Bestiary

A large anaerobic single- and multi-celled microorganism population has been established across Mars. Additionally, some heavily modified lower plant forms, including lichens, mosses and fungi, have taken to their new home.

High mutation rates have allowed rapid adaptation to the surface conditions. Organism exposure to the ultraviolet radiation was once a great concern of Terradyne biologists. Terraforming progress would be severely impeded by large scale die-offs resulting from radiation poisoning. But instead, the radiation

has had a positive effect on the immature biosphere. While the high doses of UV do kill many newly introduced life forms, natural selection quickly hardens the species to further damage.

The increased mutation rate caused by the radiation also allows populations to diverge quickly into separate, naturally evolving species. Thus, ecological niches fill much more quickly than Terradyne scientists had predicted. Identification of these new species has become a major part of the terraforming biologist's role on Mars.

Most organisms currently on Mars are not particularly exciting or threatening to the adventurer. Most are anaerobic in nature, contentedly fulfilling their critical role in the Martian nitrogen cycle, making the nitrogen locked away in the planetary crust 'bioavailable'. Simple oxygen-producing plants have established themselves in some places, but these regions are carefully nurtured and periodically fertilized.

Higher order plants and lower order animal life are not scheduled for large-scale introduction into the biosphere for at least 30 years. Scientists estimate that to be the minimum amount of time necessary to create sufficient oxygen in the atmosphere for the animals to survive. Small-scale releases are occurring now, confined to small, heavily managed and protected tracts in the north. Biologists hope that Gaia will work wonders at the places where the raw Martian environs meets the nurtured gardens and help these plants and animals 'cross over'.

Politics

Terradyne Sovereignty

Mars is far from Earth. Travel between the planets takes weeks. Communication lag times make real-time conversations infeasible. Thus, the Martian community is isolated from events and politics on Earth. This means that the UPOE, based on Earth, has little real power over the events on the Moon and Mars — and that Terradyne is, in effect, the government there.

Politics on Mars are unique in current human affairs. Work-related politicking between the various business units goes on, while simultaneous social politicking occurs throughout the Colonial Directorship. Pervading all this is the bipolar political struggle between UPOE and Terradyne. Political allies in one arena may be political foes in another. And in no other Earth-bound democracy is there such a flagrant conflict of interest between an individual's expression of political power and his economic well-being — a person's political adversary may be his boss!

Martian "Democracy"

Theoretically, the company's cultural and social institutions are not linked to line management. The political battles fought in the Martian legislatures, the decisions made in Martian courts, etc. don't affect an individual's work and vice versa. Still, the astute cynic would point out that strong company culture and peer pressure often force reality to differ from theory.

Most political scientists agree that Mars has a functioning democracy. However twisted the relationships between citizen and state, or employee and em-

Terraforming Timetable (Continued)

2150 (est.)
Nitrogen levels in atmosphere reach sufficient concentrations to permit large-scale fertilization of land tracts. Oxygen levels sufficient to form permanent ozone layer. Microbe population exploding. Further release of higher order oxygen-bearing plants. Possible genetic enhancement of Martian population to decrease adaptation problems to new environment. Possible moon brought to Mars from asteroid belt (Ceres).

2200 (est.)
Oxygen reaches Earth-normal levels. Plants have very strong hold on land. Some species found in the seas. Simple animal lifeforms, engineered to handle excessive carbon dioxide released.

2250 (est.)
Animal kingdom on Mars expanding. Worms, some insects, and amphibian life forms released.

2300 (est.)
Reptiles, mammals introduced.

Sand In Your Shoes

Martian sand is so fine and so destructive, it can penetrate even equipment specifically designed to keep it out. Once per week, roll three dice for every piece of equipment used on the Martian surface, from heavy construction machinery to the smallest hand computer. Subtract 6 from the roll if the equipment was built to Martian specifications (which doubles the cost); add 6 if the item was built on Earth (½ cost). On a 12 or higher, the equipment fails and must be repaired (takes 1d days and ⅓ the equipment's original cost); on an 18 or higher, the equipment is destroyed and must be replaced.

ployer may be, Terradyne employees are happy with their government. Voter participation is always above 90%. Because Martians are such an intellectually and socially homogeneous bunch, however, Martian politics tend to be rather bland, especially when compared to the hard-fought, mudslinging electoral campaigns on Earth.

Vexation without Representation

The friction between UPOE and Terradyne is felt at every level of society. Through various applications of international law, UPOE has stationed ISF, Justice and OCA agents on Mars whose job it is to monitor and report on Terradyne activities.

These people are barely tolerated by Martians. This dislike does not stop some of them from taking bribes now and then, though. Much to the chagrin of corporate officials, history has proven that UPOE gets its juiciest political information, not from Earthling spies or other deviously concocted schemes, but from the small number of disgruntled Terradyne employees who fink for cash.

Of course, Terradyne tries to capitalize on UPOE's wayward Earthlings as well. After all, they are far from home and in need of a friend.

Society

Despite the protests of Earth governments, Terradyne has become a de facto nation. Whether the UPOE assemblies choose to recognize Terradyne as a member, Earth's government is too far removed to have any influence on Syrtis Major or Luna City. Terradyne colonists have developed internal legal and multiple-party political systems which closely resemble those of the United States of America or the democratic societies of western Europe in the mid-20th century.

Terradyne is a corporation, and isn't structured to perform the daily activities required to meet social needs. Terradyne's management was pressured to provide these services when populations on the Moon and Mars overran the existing social management system's ability to address the problem.

Colonial Directorship

Terradyne's Board of Directors created a new Direct Reporting unit to solve the social issues raised by burgeoning populations. The position of Colonial Director has as its mission the oversight and governing of colonial legal, legislative and executive institutions. The Colonial Director has jurisdiction over all Terradyne employees and their families, as well as settlers (as provided in the Settler Contracts signed by each prospective Terradyne colonist).

Visiting dignitaries, UPOE representatives, non-Terradyne colonists and other non-Terradyne personnel do not fall under the authority of the Director. Thus, only the UPOE's International Law restricts their activities. Terradyne's lack of authority over these people cuts both ways. What Terradyne deems illegal for an employee may not be recognized as such by international law. Therefore, a visitor to Mars may be perfectly safe from legal action in performing an act deemed illegal by Terradyne law enforcement.

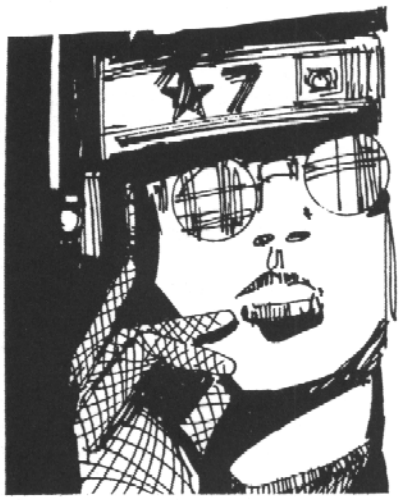
If non-Terradyne personnel feel a crime has been committed against their person or property, they can report the incident to the Colonial Militia or Corporate Security Forces for investigation. They are not entitled to, nor are they guaranteed, corporate assistance to resolve the issue. UPOE does not recognize Terradyne as a nation, and thus cannot require that Terradyne's 'national' laws protect foreigners.

Red Lung

The virgin Martian soil is highly reducing and corrosive in the presence of water. It also tends to be quite powdery. The soil in regions near bodies of water or in areas that receive substantial amounts of rainfall has been neutralized, and no longer poses any threat. However, large tracts of relatively unaffected soil remain, particularly in the southern hemisphere.

Anyone who spends a lot of time on the Martian surface runs the risk of contracting *red lung* — the effect of the corrosive Martian atmosphere on the human respiratory system. Roll against a character's HT once a year. Failure means the victim loses one point of HT *permanently*.

If the exposure comes in a single large dose (e.g., the character loses his respirator in a dust storm), roll against HT-4. Failure means the character takes 1d damage to his lungs; if he fails a second HT roll, the damage becomes permanent. Critical failure means death.



Exploding Soil

Native, or "unneutralized," Martian soil releases large quantities of oxygen when it first contacts water. This oxygen mixes explosively with the methane and hydrogen currently in the Martian air. This means that fireballs can explode from the ground when water is poured on it!

Note that this water can come from anywhere — including a sudden melt of permafrost! And if permafrost were to suddenly turn liquid, not only is there a risk of explosion, but probably a mudslide or marsquake as well. The southern hemisphere is *not* a safe place — especially for the unwary.

The Other Law

The only official recourse non-Terradyne personnel have is to appeal to UPOE itself. The Earth government maintains a contingent of Interplanetary Security Forces and colonial offices of the Justice Department on Mars. These offices are understaffed and overworked, however, so depending on the nature of the alleged crime, the response by UPOE officials could be immediate or never.

ISF forces and Colonial Militias cooperate begrudgingly in solving most serious crimes. This cooperation dissolves when the crime involves company trading policies, privateering, tax evasion, and other economic activities that impact corporate profits.

Terradyne employees can also request assistance from UPOE, but this is considered socially unacceptable — almost treasonous, in fact — by the average Terradyne employee. UPOE capitalizes on individuals who have "run home" and uses them in anti-Terradyne publicity campaigns (see sidebar on Martian values, p. 80).

Martian Government Services

The government on Mars is somewhat relaxed in comparison to Earthly predecessors. Martians tend to keep to their own affairs, leaving the government to deal with community issues like park space, schools for children, scheduling of surface and air/orbital transport and building roads. Crime is rare, though with the influx of settlers (particularly unauthorized ones), it is rising. Almost everyone is employed, and everybody is fed. Being Mayor of Uruk, the largest Martian city (named after the first city of Earth, in ancient Mesopotamia) is a part-time job.

Life in the Domes

Most people on Mars reside in the Terradyne-built and controlled cities or *domes*. The term "dome" is really a misnomer. The cities more closely resemble the cities back on Earth than the first totally enclosed human habitats of a century ago.

The domes are made up of individual buildings that are sealed against the poisonous Martian atmosphere. These buildings typically range from single-story dwellings to multi-story office buildings. The tallest building on Mars is only 40 stories.

Rails, roads and walkways form an airtight network beneath the city to allow transport without exposure to the unfriendly environment. Much of the heavy transport necessary for commerce or other reasons travels on surface road and rail. Almost every city on Mars sports a large airport for air and space travel. Most cities are located along the coast of Phoebe and have large harbors as well, although mangalas make surface ocean travel difficult. Above-ground maglev rail is the primary means of travel between cities on the same land mass.

The cities are the primary residence and workplace for most people on Mars. Only those individuals involved in surface work (researchers, construction workers, field biologists, etc.) or heavy manufacturing venture far from their walls.

Chaotic Terrain

Chaotic terrain is a large area (often tens to hundreds of miles across) of fractured and jumbled rock resulting from the sudden melting of subsurface ice. When vast areas of permafrost suddenly melt (typically from volcanic heat), the overlying rock collapses. The water, now under intense pressure, bursts out of the ground, causing catastrophic floods (see *Very Large Water Bursts*, p. 68).

Some chaotic terrain was created by geologic activity in Mars' past, but it is also being created in the present by terraforming activity.

Insider Trading

As mentioned earlier, there is a problem maintaining a democratic government within a fully functioning business unit. What if a Martian's boss — whom he believes is a dolt — is running for city council and asks for his support? More seriously, what about political battles spilling over to business decisions, such as product approval, employment of individuals, etc.?

Most Martians hasten to point out that their system, while not perfect, functions. After all, no one is complaining. UPOE political observers say that is precisely the point. It's not natural that no one is complaining.

Most Martians have grown up in this system and know subconsciously, even if they won't admit it publicly, that there is a certain amount of risk involved in speaking up. Most internal Martian political battles take place behind the scenes. Competing factions drum up support quietly and apply tacit pressure.

The more sensitive the issue, the less visible the battles become. After all, Terradyne is a business first, a colony second. Politics don't come before profits. Besides, Terradyne has a public image it is spending a considerable amount of money to maintain.

Martian Altitude

A character can stand on solid Martian soil and be over 17 miles above sea level. How should the GM handle the effects of such an altitude?

If the climber is in a pressurized suit, there is no effect. Most Martians, however, wear only standard respirator gear, which is not pressurized, there will be adverse altitude effects.

The gravity of Mars is 38% that of Earth, and its atmosphere is three times thicker. Thus, equivalent atmospheric pressures are experienced by two characters when one is standing on Mars at three times the altitude of the other on Earth.

Pressures on the two planets are compared in the table below:

Pressure	*Earth Altitude (miles)*	*Mars Altitude (miles)*
Standard	< 1	< 3
Thin	1-2	3-6
Very Thin	2-5	6-15
Extremely Thin	5-8	15-24
Near Vacuum	> 8	> 24

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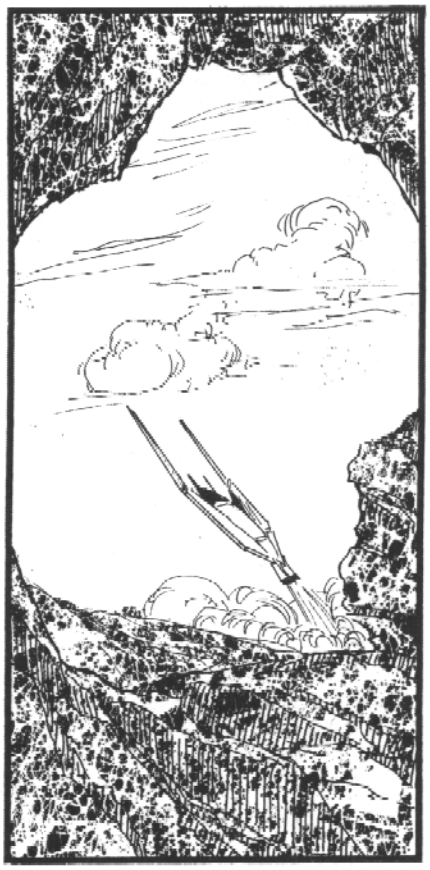


Residential, office and manufacturing areas were initially well segregated, but as the cities have grown, these areas have begun to resemble the patchwork-quilt neighborhoods and industrial parks of terrestrial cities. The population of a Martian city can be as low as 25,000; Uruk, the largest, has 212,000. Lowell, on the eastern coast of Elysium, is second in size, with just over 90,000 citizens.

City Parks

Glass-enclosed atriums, referred to as *city parks,* can be found in most of the cities of Mars. The parks are usually large, and perform both social and environmental functions.

Socially, these parks provide the same function as did the town square of the early 20th century and the megamalls of the mid 21st. People come to relax, to meet others, and to get away from the day's drudgery. All classes of people rub shoulders in the parks.

The parks also provide food and are an important biological link in the life support systems of the cities. Though the cities' environment is not totally closed (mechanical converters extract oxygen from Martian seawater), the vast greenery found in the parks provides critical nitrogen circulation and pollution removal. Because of this, Martians treat their parks with great respect and deal harshly with anyone who attempts to vandalize them.

Environmental Systems

The increasing populations of Martian cities have taxed the ability of their existing environmental systems. Rather than upgrading the core systems, newer structures have been built on the edge of town and integrated into the transportation and communication network. This has created a Martian version of "urban sprawl."

This also means that the typical Martian city's environmental system is decentralized and not prone to massive breakdown. Typically, if one section malfunctions, the others pick up the slack until repairs are made. It also means that these systems are highly individualized — the crews tending them are very protective of their fiefs. Any attempt by someone not familiar with the particular system to repair it is at -2 to the appropriate skill.

City Air Ducts

Miles upon miles of air ducts connect the various sections of the city with the environmental plants — and with each other. Martian folklore has it that these ducts provide an undocumented travel network used by smugglers, thieves, general nonconformists or just anyone who wants to go from point to point without being seen, except presumably by anyone else using the air ducts — or by the maintenance robots.

These robots roam the ducts, performing repairs and checking air quality. They are essentially autonomous — mechanical rats that, unlike their fleshy rodent brethren, perform activities that are beneficial to humans. (So far biological rats and other vermin have not made it to Mars — cargoes are checked scrupulously before shipment, and sometimes evacuated to kill anything that might have taken refuge in the cargo hold.)

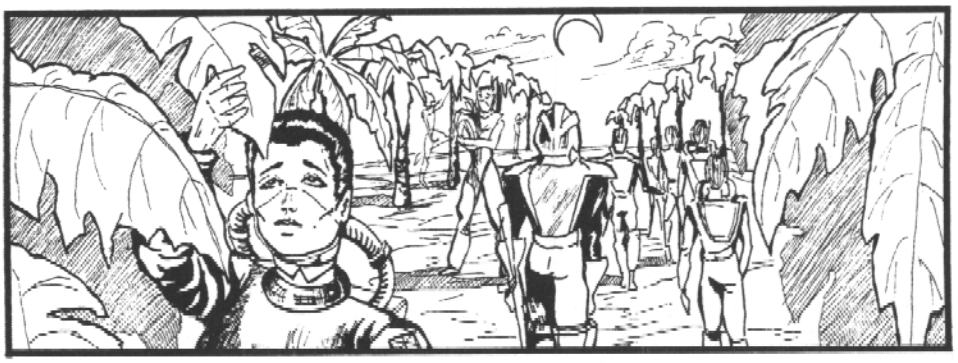
Additional myths claim these mechanical critters are capable of "breeding" — constructing other robo-rats. There's no evidence to support this, or to back up rumors that some of the tunnel-crawlers might be reprogramming the robots for any of a variety of imaginative reasons.

Surface Activities

The Martian surface is a forbidding place to some, a haven or laboratory for others. Despite all the environmental hazards and occasional human threats in

less civilized regions, it is the promise of the great stretches of red Martian land and seas that makes the dreamer's heart pound and Terradyne's investors see profits.

The new Mars' land mass is about 65% that of Earth's. Yet there are only about 1 million people on Mars, versus 11 billion terrestrials. That translates to a lot of space for individual expression. In other words, the brave traveler is liable to find many unique and interesting people doing whatever they want.



Farming

In the equatorial regions close to Phoebe, the primary activity outside the walls of the cities is farming. Great tracts of carefully managed land are tilled and harvested by men and machines. The crops are not grains and vegetables, but exotic strains of fungus and lichen, molds and microorganisms. In these vast farms Martian biologists are creating the cornerstones of the new Martian biosphere.

Typically, a single road or rail will connect the farm's control facility to the larger global transportation network. Smaller roads connect the control center to the various fields.

The control center is generally staffed by Terradyne biological scientists and researchers, mechanics, technicians and administrators in a farm's central control facility. Outside the control facility, visitors are more likely to run into robots, or perhaps a barn where the robots are maintained and stored. Security around these barns is generally low, unless there's some reason Terradyne feels they *need* to be protected.

Scientists are generally not found far from the control center.

Civil Engineering

Not all of the changes necessary to make Mars habitable occur naturally, and not all of the natural changes are beneficial. Terradyne is conducting large-scale civil engineering projects on a continuing basis, designed to reshape the surface to either make it more habitable, speed up the terraforming process, or to make it of more use to the eventual settlers when terraforming is finished.

A typical environmental engineering project might involve blasting a canal a thousand miles long into the bedrock by shaped nuclear charges; this canal, when finished, will link Phoebe with a depression near the equator to form a smaller sea. The eventual goal is to create several small seas in the southern hemisphere to help control sandstorms by reducing the surface area from which the storms can draw their sand.

Road Gangs

The massive effort required for these large-scale civil engineering projects requires the labor of thousands of individuals and machines. Most of the non-professional direct labor force on Mars is employed by roving 'road gangs.'

Martian Altitude (Continued)

Characters not using pressure suits (or not breathing pure oxygen, which has other dangerous effects in the Martian atmosphere) are subject to fatigue in non-standard pressure. Lose 1 fatigue point per number of turns in the table below if the character is not completely at rest during any of those turns:

Pressure	*# Turns Standard Air Mix*	*# Turns Pure Oxygen*
Standard	N/A	Lethal*
Thin	5	Narcotic*
Very Thin	3	Narcotic*
Extremely Thin	2	N/A
Near Vacuum	1	2

* *(see p. S109)*

Holding one's breath will not forestall the fatigue loss, as it does in swimming or suffocation. Air is driven into the lungs by outside air pressure. When the pressure in the lungs equals the outside pressure, the lungs are full. Thus, someone can only inhale as much air as the altitude will allow. Again, this only applies to characters that are not using pressure suits.

Constantly breathing pure oxygen at ambient pressure at very high altitudes can diminish or remove the fatigue loss. However, Mars' atmosphere contains highly explosive gases. Care needs to be taken not to mix outside air with the oxygen and inadvertently blow up your lungs!

Pure oxygen should only be breathed periodically at pressures higher than very thin to prevent fatigue. Constant use at higher pressures is narcotic at best and deadly at worst.

Fatigue can be recovered normally in Thin to Very Thin pressures. An oxygen supplement is required to recover fatigue in Extremely Thin to Near Vacuum pressures. At these higher altitudes, the only way to prevent fatigue loss is to do absolutely nothing: no movement, no talking.

These rules should be modified (at the GM's discretion) if the climber is native to higher altitudes.

Martian Values

The typical Martian's value system is a product of his environment and his family history.

For the past century, Terradyne has sent its best and brightest to Mars — individuals who excel in their field, are technically astute and are able to work as a team to achieve their goals. These qualities tend to have associated qualities as well: perfectionism, intolerance for perceived mediocrity, rejection of outsiders and their views.

Additionally, the closed-in physical surroundings Martian settlement force social conditions to minimize friction. Politeness and conformity is required. As a result, the typical Martian values intelligence and the ability to work hard.

Martians are strongly committed to the terraforming project and to one another. Outsiders are tolerated and accepted if they profess similar beliefs and have proven themselves to be worthy of trust — but they are *not* Martians. There are many stories of colonists who have turned their backs on blood relatives from Earth rather than non-related friends. Mars is their home, and those who built this home are their family.

Needless to say, the typical Terran sees the typical Martian as conceited, cliquey and intolerant — and a Terradyne toady to boot. That same Martian would see the Terran as unintelligent, selfish, short-sighted and jealous.

Sinkholes

A sinkhole is the result of the collapse of surface soil into a cavity that has formed below ground. Sinkholes can form and stabilize in seconds. What was flat ground an instant before collapses into a deep, funnel-shaped hole. The hole grows quickly in depth and width, then stops just as fast. The collapse will suck down and bury anything above it.

On Mars, sinkholes generally result from permafrost melting.

Sinkholes can range in size from one or two to several hundred yards across. A very few reach larger sizes. The walls of a sinkhole are of loose soil. Scaling them (in either direction) does two things: it makes the sinkhole wider, and it buries anything at the bottom that isn't already buried. Use Climbing skill at -3 to climb out of a sinkhole.

Typically, individuals sign up for this work in three month stints, spending the majority of this period on the Martian surface performing heavy labor on a particular project (building a dam, digging a canal, etc.). There are four major draws to this kind of work: First, no prior experience is required. Second, the individual receives significant training in machine maintenance and other construction skills. Third, work on a road gang is often the only opportunity for less skilled or poorly connected individuals to establish themselves (and their families, if any) on Mars. And fourth, like the French Foreign Legion of old, when someone signs up for a road gang no questions are asked as to his identity or background. For some, this is a very real plus.

The gangs are overseen by project engineers, supervisors and crew chiefs — the *bosses*. These persons are armed at all times, since violence is common among the laborers' ranks. Bosses are generally considered to be the equivalent of sergeants, lieutenants and captains in the Army Corps of Engineers.

All lower-level salaried line personnel receive six weeks of intense training similar to that in military officer training schools. Mid- and upper-line personnel are always promoted from within the ranks, and are relatively insulated from the day-to-day activities of the road gangs. (Their supervisors, however, tend to be Terradyne career personnel. Few of the "generals" come up from the ranks of the gangs.) Most of the project planning and tracking occurs off-site. Frequent, one-day visits to projects are common.

Road gang encampments are supplied on a weekly basis by company aircraft from the nearest city. Life support equipment is provided, and the first lesson of the uninitiated is the care and maintenance of this essential piece of Martian life.

Malfunction of air masks and/or rebreathers is the primary cause of death in road gangs. Violence is second. Accidents and unexplained equipment failure is third. It's generally assumed that many mask failures and accidents were helped along by someone who had a grudge against the deceased, but few gangers are prosecuted for murder in any but the most obvious cases.

Terradyne officials are aware that the gangers support a thriving black market in everything from cigarettes to drugs to construction equipment. There's even a legend that tells of the black market sale of a backhoe to an offworld tourist who was told it was a special vehicle for traveling on the Martian surface! (Almost any ganger will tell you he knows someone on another gang who was in on the sale.) Periodic searches of encampments have proven to be unfeasible due to substantial physical resistance of the laborers; upper management is open to suggestion.

Much Martian mythology, in fact, centers on the road gang. The symbolic significance of individuals with nothing but their hands and their sweat reforming a world is powerful stuff. Many important Martians have risen to greatness from the dusty encampments on the Martian plains.

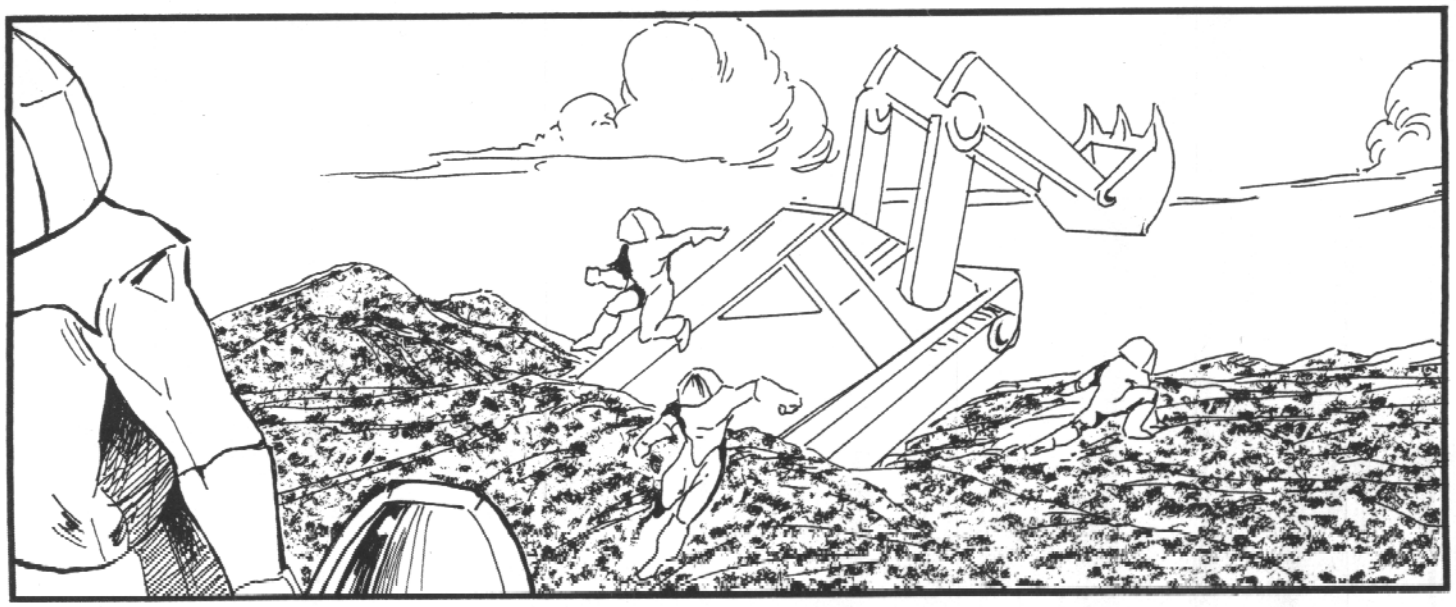
To be a road ganger is nothing to be ashamed of. Quite the contrary — many gangs have high reenlistment rates and great pride. Being a ganger is dangerous and not for the faint of heart — but it can be rewarding and renewing.

Mining

Mining operations on Mars are very different than on Earth. Free-flowing water and tectonic geologic activity have not occurred enough to form large, highly concentrated ore deposits. Furthermore, Mars contains less of the valuable heavier elements than Earth and the other inner planets.

Two major mining methods are used on Mars: *filtration* and *surface skimming*.

Many elements and compounds are dissolved as water runs over the Martian soil on its way to the rivers. Filtration plants remove these materials, concentrate them and load them onto maglev transports for shipment to a nearby city or



manufacturing plant. Such operations typically dam the river upstream of a large processing plant. Currently there are currently four river mining sites on Mars, three along the Viking River in the Mariner Valley and a fourth in a smaller canyon farther north. These dams at these sites also provide flood control for the rivers.

Surface skimming is similar to strip mining. Soil is removed from the surface by shallow bulldozers and shunted to a mobile processing plant. There the soil is treated and the important materials removed, and the soil is returned to the surface. Skimming often precedes road gang activity in the southern hemisphere — processing the soil helps to neutralize it, reducing the risk of Red Lung.

Both methods are very expensive to operate and produce comparatively little refined material. This is due to the composition of Mars and the difficulty of removing large quantities of particular dissolved materials from river water. Mars still imports nearly all of its heavy metals and rare earths. Mining continues, however, for development reasons — future mining methods that evolve from this technology may provide more metals at a lower cost — and for environmental reasons (flood and Red Lung control).

Physical Sciences

Mars is a new world undergoing tremendous changes. Biologists, geologists, meteorologists and many other scientists can be found singly or in large research teams all over the planet. Sometimes they will have their transport with them on site; sometimes they are dropped off for weeks at a time, to be picked up later.

Construction

Cities need building, roads need surfacing, wells need digging. Some of the more mundane civil engineering projects are regularly undertaken by construction crews. These crews are typically Terradyne employees, but there is a trend toward contracting such work out to private construction companies.

There are a half dozen or so private contractors in business on Mars. Originally formed by non-Terradyne colonists, these companies were responsible for the building and maintenance of several of the outsider towns and villages. Several receive subsidies from UPOE via Free Space contracts or other means.

Bidding on Terradyne projects has only recently proved fruitful, primarily because Terradyne's growth has outstripped the ability of its company maintenance crews to keep pace.

Sandrats

Most Martians live in the domed cities that sprinkle the Martian surface, yet there are few who live outside the walls. There's no way of telling how many of these "sandrats" are out there; estimates range from a few thousand to several tens of thousands.

Most sandrats are unauthorized settlers who have managed to book a one-way trip to the Red Planet. Others are black market operators, miners, thieves, spies or just former Terradyne employees who didn't want to leave Mars when they quit the company.

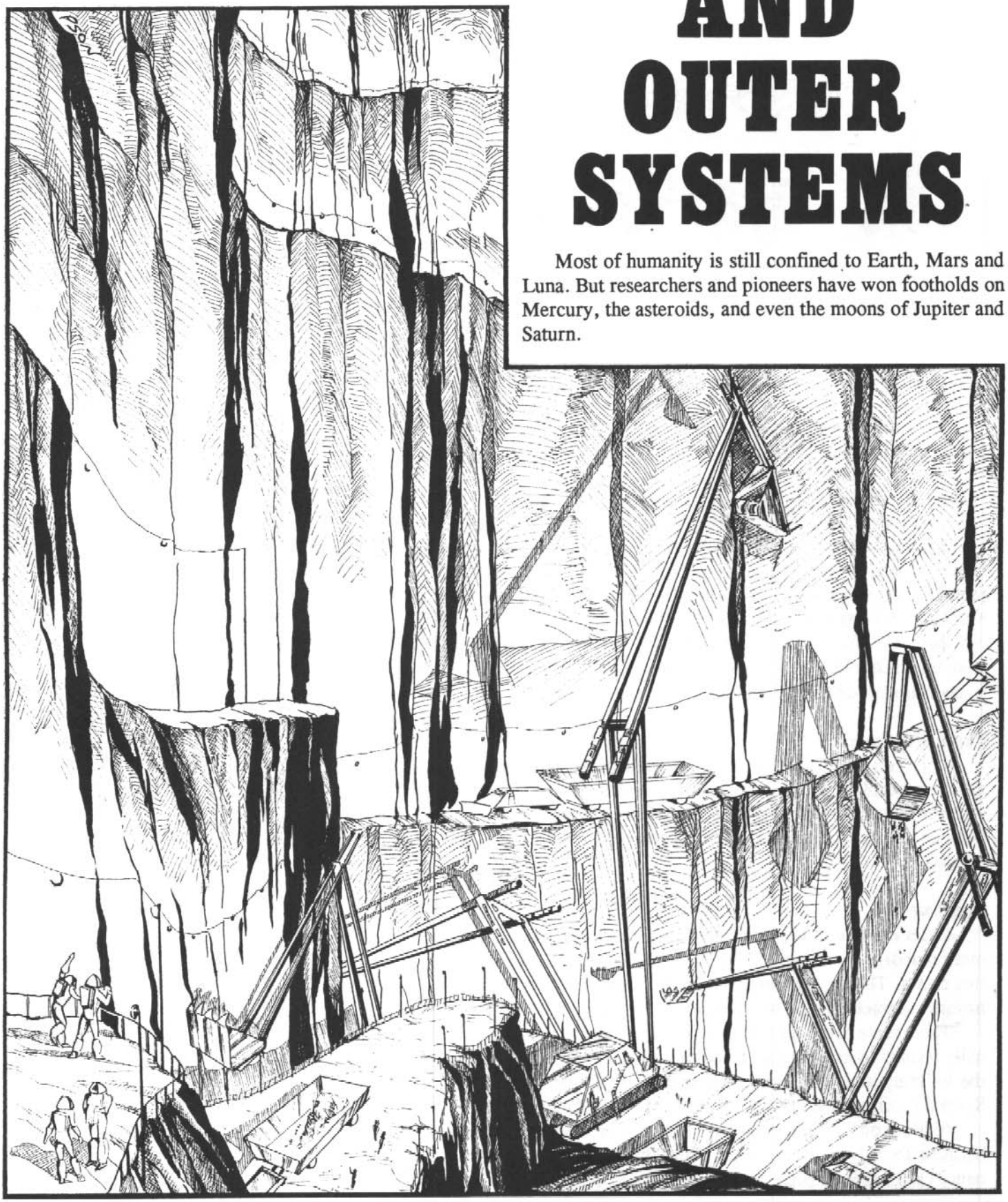
The Martian plains are beyond the reach of regular law and order. Terradyne's Colonial Directorship lacks jurisdiction over the sandrats, and the overworked UPOE forces on Mars are more concerned with keeping an eye on Terradyne. The sandrats are on their own.

Several books have been written comparing this secondary Martian culture to the frontier West of 19th-century America. The resemblance is striking. From the kinds of people taking the risk of frontier living, to the formation of boom towns and trade routes, to the enforcement of frontier law by strong-armed individuals, Mars, the Frontier Planet, has a frontier of its own.

6

THE INNER AND OUTER SYSTEMS

Most of humanity is still confined to Earth, Mars and Luna. But researchers and pioneers have won footholds on Mercury, the asteroids, and even the moons of Jupiter and Saturn.



Mercury

As the innermost planet, Mercury is an ideal platform from which to observe and learn more about the sun. But these opportunities don't come without dangers.

Solar Weather Station

Maintained by Terradyne, the Solar Weather Station is actually a complex of several observing stations designed to monitor solar activity. In addition to the observation sites on Mercury's surface, there are five satellites scattered about Mercury's solar orbit, three more satellites in polar orbit around the sun, and an underground neutrino observatory.

These platforms gather data, analyze it and transmit it to other points in the Solar system. Because of its proximity, the SWS can detect and predict solar flares, storms and other events much more quickly than stations in Earth orbit can.

Solar Flares

The primary threat to humans in space is a solar flare. If flare radiation strikes an unshielded craft, the inhabitants of the craft can receive lethal amounts of radiation damage (see p. S77). This also applies to individuals on planets or moons not surrounded by a protective atmosphere or magnetosphere.

The SWS can give settlements in Earth orbit three hours' notice of solar flares in advance of what the settlements themselves can detect.

Station Geography

The main station is near Mercury's north pole, built on the mountainous rim of a large crater. Mercury has no axial tilt, so the station always has an unobstructed view of most of the sun.

Additional observatories are scattered about the northern hemisphere of Mercury. None is more than 750 miles from the primary facility, and most consist simply of telescopes, monitoring equipment and minimal housing facilities.

Travel is extremely dangerous on Mercury, and is restricted to times when the path is in shadow (except in case of emergency). Any given point on Mercury spends roughly 88 days in the glare of the sun and another 88 in the dark, so teams in the various remote observatories can be "locked away" for three months at a time.

Communication

The first communication systems on Mercury were radio repeater systems. These proved to be very unreliable due to interference from solar radiation, so a system of optical land lines was laid down. These are redundant systems; if a line goes down, repair crews cannot repair them until nightfall.

Radio is used as a backup system, but is limited to line-of-sight unless repeaters are used. All of the repeaters between source and target must be working for a message to get through, and solar flares can knock out transmissions.

Station Personnel

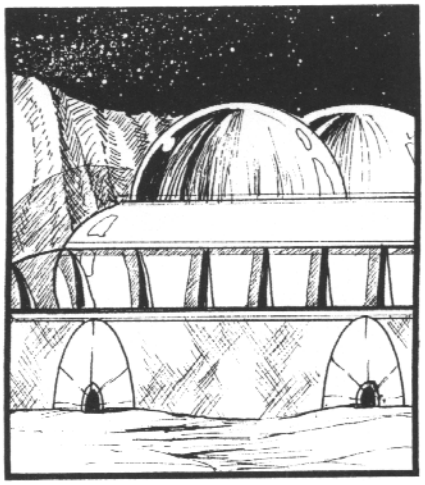
The main complex houses up to 125 people. The team consists of scientists and technicians, with two or three of the senior scientists doubling as administrators, and a small maintenance crew.

Terradyne does not restrict its use to employees. The station is treated as an extension of Lunar University, and is funded as such. Most assignments to the station are through research programs and postdoctoral work. UPOE maintains a rotating but permanent contingent of 5 to 10 scientists on Mercury through an

Lost Cargo

Evidence strongly suggests that not all of the metals mined and refined on Mercury reach their intended destinations. Solar sail craft fitted with cargo containers have been spotted in Mercury's orbit accelerating at .5 G. Even in the strong Solar wind at .3 AU, this would suggest that the craft was traveling without cargo. Also, estimates of Terradyne's mining output exceed those of Martian and Lunar imports by anywhere from 20% to 30%, depending on whose figures you accept.

Terradyne isn't saying anything about the situation one way or the other — its only official comment is that "mining operations on Mercury are proceeding in accordance with corporate goals." Skeptics label this doubletalk; some believe that Terradyne is siphoning off materials for reasons they don't want to talk about, on the theory that if the shipments were being pirated, they would announce that they were taking steps to stop the hijacking. No one knows for sure.



agreement with the university. Relations between the Earth-based and Terradyne-based personnel are generally good.

The typical assignment to Mercury can be as short as six months or as long as five years.

Station Life Support

The life support systems are fully recycling and include subterranean greenhouses that supply all vegetables and fruits. Meat is a luxury on Mercury.

A small contingent of biotechnologists and botanists maintain and upgrade the life support system. Lunar University claims this system is the most advanced of its kind.

Station Security

No weapons of any kind are permitted on the station. Additionally, all rules and policies in effect at Lunar University apply here as well, including Terradyne corporate policies. All non-Terradyne employees coming to Mercury must sign a statement agreeing to these terms.

A single unarmed security official from Lunar University Campus Police is in charge of law enforcement. This has never been a real job — just an assignment intended to satisfy corporate policy. Generally, the security officer works with the maintenance crew.

Other Station Information

There is a fully equipped machine shop on site for use by scientists and maintenance crews. It even has a state-of-the-art computer controlled solar forge and molding system for fabricating new metal parts.

Raw materials are stocked in a warehouse. Additional metals and glasses can be had by contacting the mining operation in the southern hemisphere (see below).

Communication to Earth is available, but is subject to significant time delays. Entertainment can be ordered and downloaded to the station.

Transports arrive and depart monthly from a landing strip located on the crater floor below the station.

Mining

Mercury is rich in heavy metals. Terradyne is very interested in exploiting this mineral wealth, since it is currently dependent on Earth and UPOE for its supplies.

The hellish conditions of the planet prevent Terradyne from tapping this source economically, due to the high cost of designing and building equipment, performing maintenance and protecting personnel. However, due to the strategic nature of this mining, Terradyne is actively pursuing research to reduce costs.

The mining of Mercury is treated as a corporate research project. As such, its mineral output is small, but is growing appreciably. It will be several years before production levels are high enough to affect Terradyne's dependency on Earth.

Mining Mercury

Mining occurs in the southern hemisphere of Mercury to prevent damage to the solar weather station's sensitive equipment in the north — even the slightest dust could cause significant damage to some telescopes!

About fifty miners are stationed on Mercury, with small research, administration and technical staffs. Mining is done in two ways: strip mining and pressurized shaft mining. Both are expensive, and the research staff is trying to find less expensive ways to perform them, as well as to research more exotic methods of mining.

Adventuring in the Inner System

Setting an adventure on Mercury or Venus can be a good first step into the worlds of Terradyne, both for the GM and the players. These worlds are isolated, sparsely populated. They provide the GM a means to keep the characters from wandering off the planned path.

At the same time, they are high-tech settlements on the frontiers of the solar system, full of danger and potential fame and fortune. So the players are not in any way slighted by the focused environment.

Furthermore, even though the inner system's settlements are not heavily populated, many different groups are working side by side: Terradyne employees, UPOE and other government officials, other corporate lackeys, and even plain hard-working joes can be found here.

The situation is similar to scientific expeditions to the Earth's Antarctic — relatively small groups of scientists doing research in a harsh environment, cut off from civilization for long periods of time. This analogy immediately brings to mind several possible adventure themes: the real-life exploratory death march of Dr. Scott or Theodore Sturgeon's chilling tale of The Thing. And what about David Brin's *Sundiver*, the precursor to the *Uplift War* series?

The scope is focused, but the possible adventure is endless . . .

Strip mining is performed by huge automated bulldozers and cranes that crawl across the surface, stripping away layers of soil for processing in large, portable mills. The entire collection of mining equipment moves about half a mile a day. Pressurized shaft mining is more labor intensive, but has the advantage of more conventional equipment and safer working conditions. The only risk that shaft miners incur that terrestrial miners do not is the potential loss of atmosphere. Bulkheads with self-sealing doors, identical to those found in spacecraft, are placed throughout the mine.

Material Delivery

Ore is processed into ingots of refined metal on Mercury, then loaded onto a mass driver that delivers the material to low orbit. Transports collect the metals and load them into large cargo carriers, which then rendezvous with solar sail ships. These ships deliver their cargoes to the Moon and Mars.

Corporate Control

The mines on Mercury are a research project — not a profit center. As such, they are under the joint control of Lunar University and Terradyne's Basic Research Division. This provides flexibility for new ideas and creativity.

The Resource Development Division advises the joint venture on strategic matters, and has a strong role in the day-to-day operation of the actual mining process, particularly the surface mining. When the mines prove reasonably profitable (or at least very low cost), Resource Development will take over their operation.

Dante's Foresight

In 2078, a small international consortium built and launched the only attempt to date to send humans to the surface of Venus. The craft was assembled in LEO under the auspices of UPOE and Terradyne, funded by the seven members of the consortium, and used the very latest in available technology. Eight people (four men and four women) set out for Venus.

The landing craft, named *Dante's Foresight*, developed minor structural damage while entering the turbulent atmosphere of Venus. The craft landed safely, but the damage exposed sections of the engine control equipment to the outside environment, which it was not designed to withstand. Before any of the six people aboard had the chance to don their hard suits to repair it, the fuel vessel burst and flooded the cabin with hydrogen.

Dante's Foresight continued to transmit scientific information for several hours afterward until Venus' environment, now able to reach into the craft, destroyed the equipment. The two survivors returned to LEO in the command module.

Human remains are not likely to be found by future explorers. They will have been eroded by the caustic air and cooked by the extreme temperatures, leaving only the ship and the silence behind.

Venus

No human has attempted to set foot on Venus since the *Dante's Foresight* disaster (see sidebar), and no missions are planned for the near future. Terradyne is gathering information by means of the Venus Orbital Meteorological Sciences Station (VOMS), a manned observation platform circling Venus in high orbit.

VOMS' Mission and Mechanics

As described in *Environmental Research* (see p. 20), about 50 people occupy VOMS. The mission of VOMS is to gain a detailed understanding of the Cytherean atmosphere's evolution and dynamics. This information is vital to the Martian terraforming effort and Earth's environmental battles.

VOMS is equipped with the latest technology available to science. It has a TL8 standard sensor suite, adjusted to enhance planetary analysis. Use standard spacecraft rules for sensor use.

VOMS sensors can measure heat, radiation, mass, velocity, etc., of objects as small as six inches across. This pinpoint accuracy degrades at ranges farther

than VOMS' altitude above Venus. If sensors are pointed at targets other than Venus, the GM should modify their effectiveness accordingly. VOMS' sensor suite is not tuned to identify life — they are set to study geologic constructs, atmospherics and chemical reactions.

VOMS is also equipped with automated atmospheric and lander probes and manned atmospheric probes (which fly through the upper atmosphere).

Current Research

VOMS typically launches two to three manned atmospheric probes in a year. Plans call for increasing that number to six in the next fiscal year. A manned lander is currently on the design table. Several Terradyne subcontractors on Earth are testing Cytherean environmental suits.

Atmospheric modeling and greenhouse theories are becoming more accurate. The latest models developed at VOMS can predict with 95% accuracy global weather for up to 24 days in advance on Mars and Venus, and up to 15 days on the more complex surface of Earth.

There is some interest in Dr. Moriyov's theories (see p. 20) about terraforming Venus on VOMS, but extensive research funds to support or refute such ideas are not forthcoming from Lunar University. A small group of non-Terradyne researchers is looking into such matters part-time; their parent company, Astarte, a robotics manufacturer, has funded limited queries into the Venus terraforming question. Astarte provides most of the robotic probes sent down into Venus' cloud deck and surface.

The Jovian System

Jupiter and its moons are not for humans — the conditions are extreme, and the environs can be deadly. Yet people are in Jovian space. Much can be learned here. And there may be other riches as well . . .

Jupiter

Jupiter is a gas giant, made up of mostly hydrogen and helium, with traces of methane, ammonia and other noxious gases. Its atmosphere is one continuous raging storm. Its surface, if one can call it that, is metallic hydrogen, buried by billions of tons of gas and liquid.

Humans have found three roles for the king of the Solar System: science, navigational aid and hydrogen source. Planetary scientists, meteorologists, astrophysicists and other researchers study Jupiter regularly from planetary and orbit-based observatories to learn its secrets.

Mission planners and ship captains use Jupiter to leverage spacecraft performance via gravity assists. A slingshot around Jupiter can greatly reduce fuel consumption and/or flight time for missions to Saturn and beyond.

Missions to the Jovian system can benefit from Jupiter as well. Aerobraking through Jupiter's upper atmosphere can reduce travel time and fuel use for spacecraft entering the system.

Attempts have also been made to scoop hydrogen from the planet's atmosphere. Using a technique similar to aerobraking, an open-mouthed cargo ship flies into the gas giant. As it passes through the air, it pumps the hydrogen it encounters into a pressurized tank. The course takes the vessel out into vacuum just as the tanks top off.

This technology has not proven cost-effective, however. The structural requirements of the scoop-ship are complex and expensive to build and maintain, and Jupiter's deep gravity well increases the cost of transporting the hydrogen to the rest of the Solar System.

Terradyne and VOMS

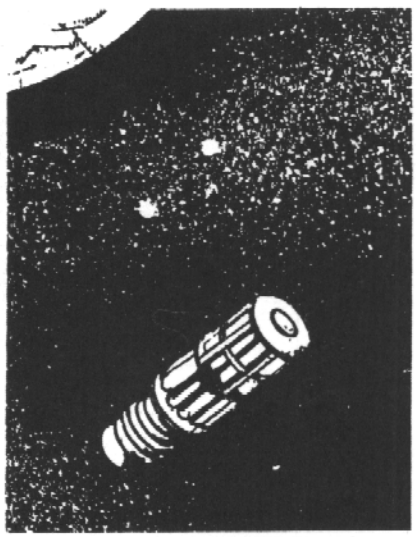
Terradyne's original charter called for extensive environmental research to help understand and mitigate the damage humans have done to Earth's biosphere. Since the company's reorganization, that mission has taken a back seat to other goals and objectives. Why, then, did Terradyne construct VOMS?

Two reasons are generally cited: terraforming and politics.

The terraforming of Mars requires an intimate understanding of atmospherics. Studying Earth alone is insufficient. Studying Venus — described by some as "an Earth gone wrong" — provides another reference point and valuable data about such things as global wind patterns and greenhouse effects.

Politically, Terradyne must appear committed to solving Earth's environmental issues. Building VOMS for the express purpose of studying the greenhouse effect on Venus provides proof positive to UPOE of Terradyne's commitment.

By staffing the station with a large contingent of non-Terradyne researchers, engineers and technicians, from both the private and public sector, the company displays its great humanitarian goals. Outside staffing also helps spread the cost of station maintenance: non-Terradyne researchers gladly pay a hefty price to live and work on the Cytherean research platform.



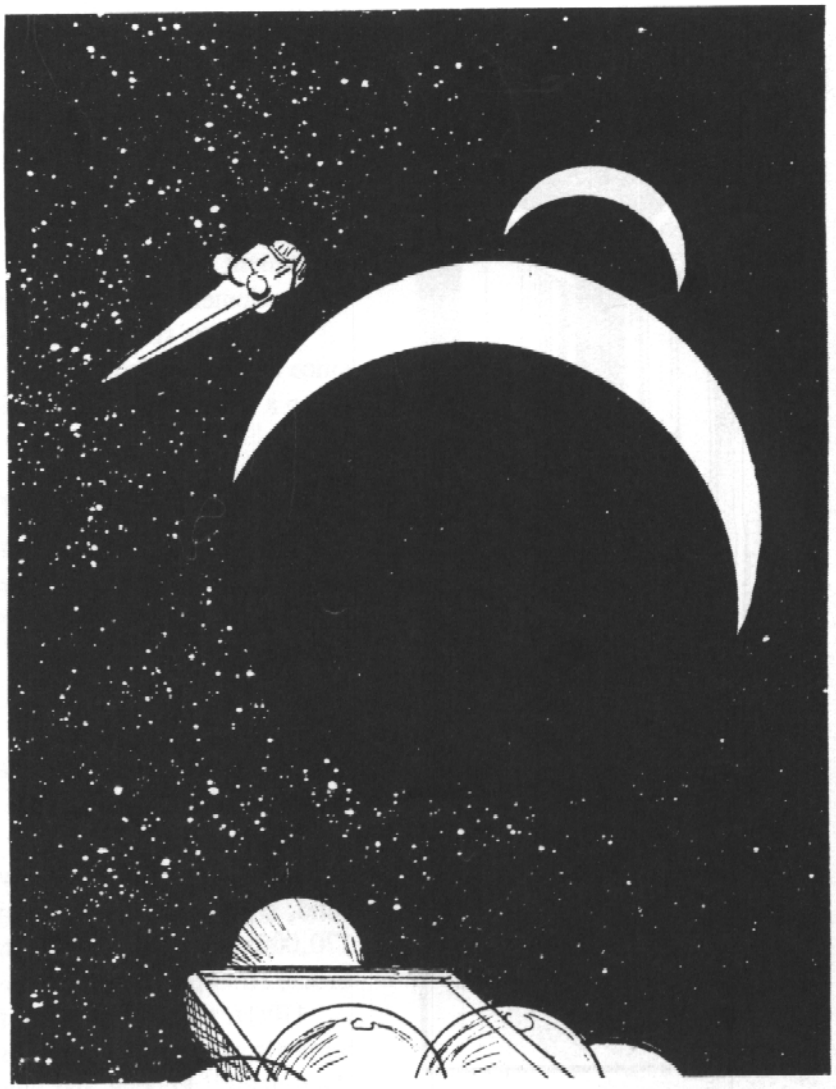
Lastly, Jupiter's hydrogen is anything but pure — it must be refined prior to use. Using unrefined hydrogen is possible, but can increase the risk of damage to the drive system (or whatever) due to significant corrosion.

Research is continuing, and if the Jovian system ever sees a significant increase in traffic, scooped hydrogen may become a potential fuel source.

Io

Io is a hell-hole. No human has ever walked its surface.

Maps of the innermost Galilean satellite cannot be kept up to date; the surface completely changes in a matter of months. Usually an unmanned mission to Io consists of an orbiter and a lander. When the probe reaches orbit about Io, the orbiter section maps the moon, then programs the lander accordingly.



The Galilean satellites typically have surface temperatures at or near -250°. But due to its relative proximity to the largest planet in the Solar System, Io is heated by tidal forces — often to more than 600°. At any given time, up to half of Io's surface can be molten sulfur and sulfur dioxide erupting from one of its many volcanoes.

Eruptions can be very short (less than five minutes) or long-lived, and can happen anywhere on the planet at any time. They are frequent — at least one major eruption is always occurring somewhere on Io.

Subsurface lava lakes form on a regular basis. If they do not break to the surface, temperatures above such a lake average about 80 degrees. If the lake does surface, temperatures will soar to the low 600s. Such lakes form slowly and either erupt into full-blown volcanoes or cool slowly over a period of about two weeks.

The surface above a subterranean lava lake is unstable. Strong quakes are frequent. Fractures may open temporarily, then seal again.

Io is bathed in radiation, electricity and magnetism. Jupiter's radiation belts pelt Io with high-energy particles. Unshielded people and equipment on or about Io should be treated as if exposed to a solar flare.

Europa

Europa, the second innermost Galilean satellite, is the smoothest, most featureless object in the Solar System. It's a dirty white ball with dark marbling reminiscent of Lowellian drawings of an ancient Mars. The greatest relief found on the moon is the 150-foot-tall, manned drilling rig stationed on the equator.

Beneath the smooth ice veneer, Europa becomes more exciting. The moon consists mostly of water and rock. The tidal forces that churn Io are at work here as well, but are more subdued. The resulting heat has melted much of the ice. Thus, Europa is an ocean moon, covered by a protective ice sheet averaging some 30 miles in thickness.

The Jovian radiation belts and magnetosphere reach past Europa, but their deadly forces are weakened by the increased distance from the planet. Thus, gear sufficient to protect against the bitter cold and vacuum is sufficient to shield against any radiation effects (this does not necessarily include a solar flare).

Terradyne runs a small well on Europa's equator, drilling into the ice to the liquid ocean below. Water is pumped into large storage tanks on the moon's surface.

A small science/engineering station near the wellhead can split the water into hydrogen and oxygen. Thus, either water or hydrogen and oxygen are available to vessels in the Jovian system for reaction mass, propellant or other needs.

Ganymede and Callisto

Neither of these satellites has had any (known) human visitors. Jovian space is expensive to reach; trips to the surfaces of any body out here must be justified. So far, a few unmanned probes have been sufficient to study these two moons.

A small splinter group has proposed Ganymede as the site for the first permanent human settlement in the outer system. Known as *Project Heinlein,* this settlement would be completely built and operated by Earth.

Callisto is sometimes cited as a less expensive source of water than Europa, since it's farther from Jupiter's gravity well. Terradyne officials have so far not given a reason why they prefer to hang on to the station on Europa.

The Saturnian System

The gem of the Solar System, Saturn is special. It has the most stupendous ring system in the Solar System. And it was where humanity began its greatest creation, or its worst folly, depending upon one's point of view: the terraforming of Mars.

The Rings of Saturn

Galileo proclaimed the Saturn ring the "most extraordinary marvel" when he announced its discovery. In the 22nd century, it is no less marvelous or extraordinary.

The "ring" is really several hundred small rings in a nearly continuous band, separated by a few major gaps. The ring system stretches outward over 170,000 miles, but is less than 100 yards thick and is made of ice chunks ranging in size from pebbles to houses.

UPOE's ExPERt Act of 2051 (see sidebar, p. 90) specifically protects Saturn's rings from exploitation. Terradyne, remembering the repercussions of "acquiring" Phoebe, has generally respected this restriction.

Several scientific missions have been sent into the rings. Current scientific theory states that the rings are some two million years old, formed by two to four (depending on whose theory you buy) moons that collided or were ripped apart by tidal forces.

A small cult on Earth believes that the rings were formed by intervening extraterrestrials to herald the beginning of mankind's line on Earth. The cult is small, but wealthy: Los Angeles sports the largest faction of *Saturnists*. Several virtual-reality movies have been made on the subject.

Titan

Titan is one of the most interesting places in the Solar System. It has an atmosphere, oceans, land masses, rivers, plains and mountains. It is crawling with robots that no one has seen, and it is about to get its first human residents.

Titan's Atmosphere

Titan's atmosphere is about 60% denser than Earth's, and is primarily nitrogen gas, just like Earth. Other gases in Titan's air include methane, ethane, propane, and hydrogen cyanide. Additional organic compounds create the orange smog that obscures Saturn's splendor from Titan's skies.

Methane exists in gaseous, liquid and solid forms on Titan, much as water does on Earth. Rainstorms and snowstorms of methane compounds regularly sweep across Titan's surface. Oceans of methane wash up beaches. Rivers of methane cut canyons in Titan's soil of rock and water ice. Methane cycles through Titan's air and crust just as water does on Earth. The science of *hydrology* on Earth is transmuted into the science of *methology* on Titan.

The Study of Titan

To date, there has been only one manned visit to Titan — over half a century ago, in 2049. Most of what's known about Titan has been obtained via unmanned probes.

Recently, Titan has undergone a rather traumatic event: Phoebe made a very close pass to Titan on its way out of Saturnian space. The resulting tidal forces caused extensive flooding. Several large rivers were dammed with debris, causing further flooding.

Exogeologists and methologists are studying these effects (remotely) in the hopes of understanding the large scale environmental impact of Project Phoebe on Titan and, by extension, preventing further damage to Earth's coastal areas as the greenhouse effect continues to melt polar ice caps.

Resource Development's Plan for Titan

Terradyne has received special dispensation from the ExPERt Act of 2051 to operate a hydrocarbon mine on Titan's Plain of the Gods, near the Titanic Ocean. UPOE has granted permission for the operation with the restriction that the base be used for scientific study as well as resource exploitation. Furthermore, two UPOE observers must be stationed on Titan at all times, and Terradyne must provide for the observers' transportation, room, board, equipment and safety.

Terradyne's Resource Development division has been given the task of constructing and operating the hydrocarbon mine. The mine will extract hydrocarbons from the air, land and seas for transport back to Mars or the Moon. These hydrocarbons will be used as nitrogen sources for terraforming purposes (fertilizer, atmosphere component, etc.) or in manufacturing processes (plastics, coolant, etc.).

Building the Base with Robots

The base has been under construction for three years. Robots have been working to build the living quarters, material processing facility and spacecraft launch areas.

A major portion of Resource Development's annual budget has gone into designing, placing and controlling the small army of automatons. Due to the very long signal delay time between the Moon and Titan, the robots must have the capability to work with a minimal amount of human instruction and intervention. The Titan project has been the source of extensive AI development.

A small fleet of quickships left for Titan about five years ago, and arrived at Titan one and a half years later. An automated robot construction facility was quickly assembled on the surface. Raw material for robot construction was supplied by Terradyne, and soon some 3,400 robots were operating on the surface.

The Asteroid Belt

Contrary to mounds of science fiction literature, the asteroid belt is not virtually bursting with flying boulders nor running over with mineral wealth.

All of the asteroids combined mass less than 1/500 the mass of the Earth. There are only 33 asteroids with diameters larger than 125 miles (the size of Phoebe). Given that most of this mass is spread between the orbits of Mars and Jupiter, some 350 million miles apart, the asteroid belt is only slightly more crowded than other regions of the Solar System.

There are a few hardy souls scraping a living from hunks of nickel and iron floating through the darkness, though. It's a way to make a living — for someone who's patient, lucky and has a few bucks to invest.

The primary concern humans of the 22nd century have with asteroids is orbital in nature — is an asteroid going to strike a planet or in some other manner get in one's way? To answer this important question, Terradyne's System Survey has as part of its responsibilities identifying and recording asteroid orbital paths in the solar system.

The ExPERt Act of 2051

Terradyne had originally planned to use ring ice in terraforming Mars. Project Phoebe removed that need. However, outrage at the corporate theft of Saturn's outermost moon spurred UPOE's enactment of the Extraterrestrial Protection of Environmental Resources Act of 2051 (ExPERt).

ExPERt prohibits the unauthorized exploitation of several specific bodies in the Solar System. Primary on the restricted list are Ganymede, Titan, Triton and the ring systems of Jupiter, Saturn and Uranus.

Phobos, Deimos and Earth's Moon were included on the list submitted with the original bill, but were not included in the version that finally passed. Human activity had already significantly altered these bodies. Instead, these bodies were addressed in a non-binding resolution attached to ExPERt which stated that these moons were to be utilized in a manner "respecting their special status in the Solar System." Lawyers continue to battle over what this means.

Terradyne has not had much trouble getting the necessary authority from UPOE to mine resources from these bodies. Usually, it is a simple matter of funding a select group of UPOE representative's pet projects or opening a Terradyne distribution center in a particular district.

As needs change, robots return to the facility for refitting or recycling. Additional material requirements from the Moon is kept to a minimum.

Humans on Titan

Titan's first semi-permanent visitors are set to arrive within the next year. The crew of the quickship *Titanic II* consists of six chemists, a geologist, a meteorologist, two UPOE observers and seven engineers of various disciplines.

The crew of Titanic II will be on station for about 30 months. The replacement crew is set to leave Luna City late next year.

Titanic Statistics

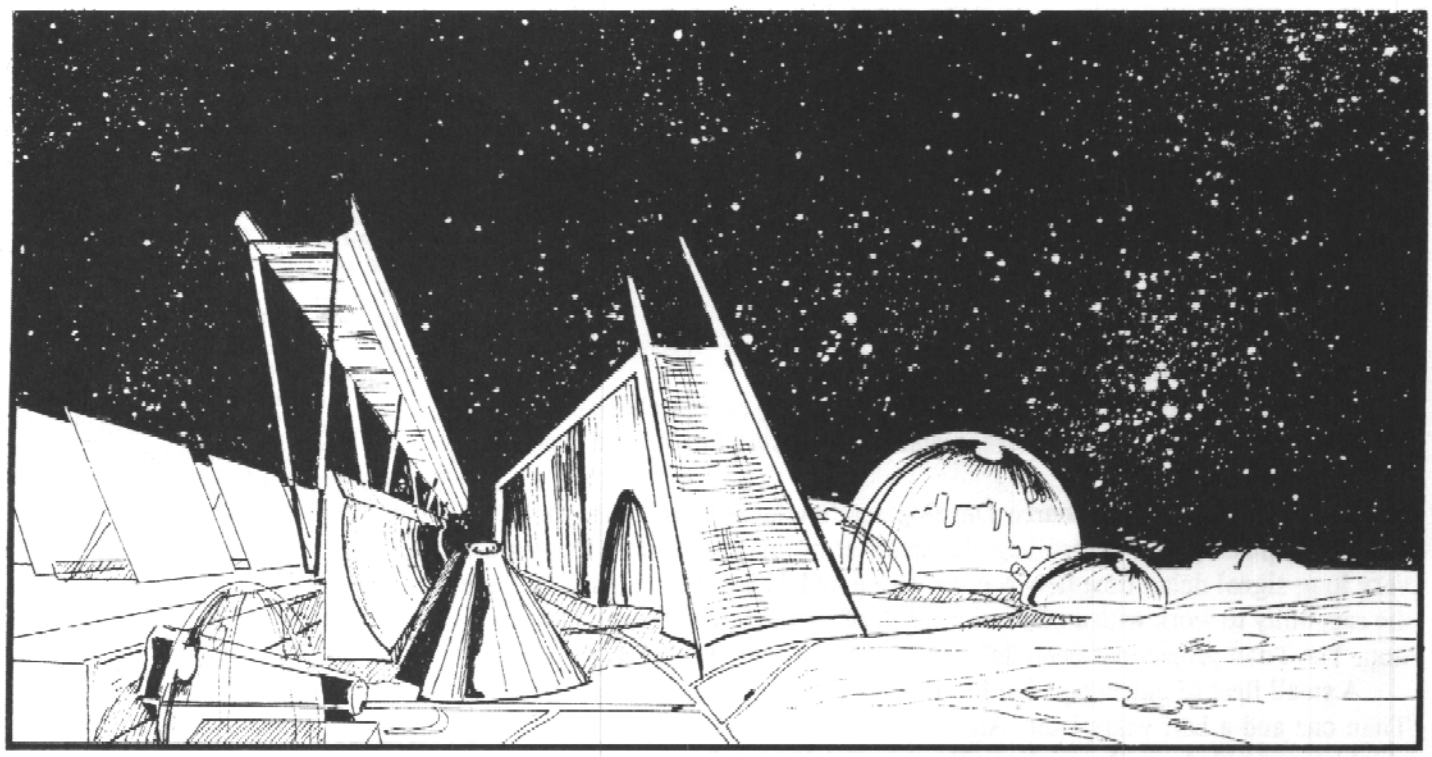
Titan is very cold, and the sky is a murky orange. Given the distance from the Sun, light barely penetrates through the smog to the surface. Titan is tidally locked to Saturn; the same side always faces the ringed giant.

Daytime and nighttime fluctuate, depending on where one is located. Planetward (on the side of Titan facing 'in'), day and night are blurred — the dim red glow of sunlight is not much brighter than the dim glow of night reflected by Saturn.

On the hemisphere of Titan facing away from Saturn, the dim orange hue of penetrating sunlight fades to utter darkness for the 190-hour-long night.

The Outer Planets

Uranus, Neptune and Pluto are under almost constant observation from observatories on the Moon and in Earth orbit, but it's not likely that any of the three will be visited any time soon — Uranus is more than twice as far from the sun as Saturn. All of these planets, and their moons, are icy rock balls. Little more than that is known about them.



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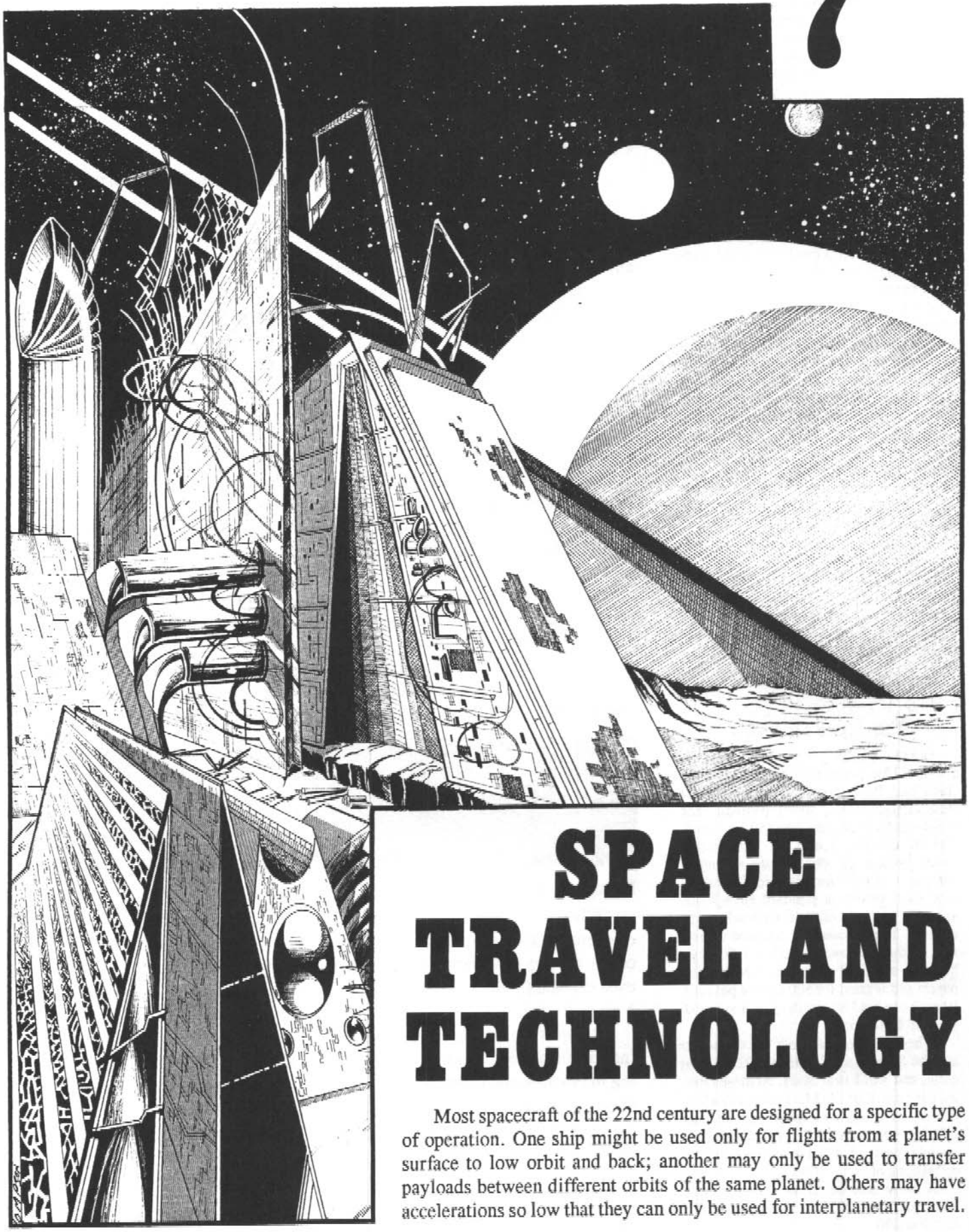


SPACE TRAVEL AND TECHNOLOGY

Most spacecraft of the 22nd century are designed for a specific type of operation. One ship might be used only for flights from a planet's surface to low orbit and back; another may only be used to transfer payloads between different orbits of the same planet. Others may have accelerations so low that they can only be used for interplanetary travel.

Solar Sail (TL8)

Since the mid-40s, the cheapest drive system available has been the solar sail, which requires no reaction mass. The pressure of photons from the sun is literally used to *sail* cargo through the solar system in low-energy transfer orbits. The technology provides low accelerations (usually .01 G or less), so it is used only for long trips which take months or years.

Sails are generally stored in long rolls suspended on a large superstructure around the ship itself. As the sails are unrolled, small thrusters start the ship rotating. The centrifugal force keeps the sails rigid, and each strip can be rotated to control its angle with the sun. Deployment times range from 20 minutes (1 square kilometer) to 4 hours (100 square kilometers).

One square kilometer of sail provides 1 ton of thrust at 1 AU from the sun, costs $1,500,000, and masses 10 tons (including deployment thrusters and superstructure). Thrust drops off with the square of the distance from the sun. Sails take up no hull space, even when rolled up. The practical limit on total sail size for one vessel is 10 square kilometers, but sizes up to 100 square kilometers can be built at 4 times the cost and double the mass.

Solar sails can withstand 1 G acceleration when deployed without a load, .1Gs when deployed with a load, and 6Gs when rolled up. Ships with solar sails (deployed or not) cannot enter an atmosphere. But it is possible to leave the sails in orbit to be picked up later.

Terradyne Sailships

The two standard Earth-Mars sailships are the 12-square-kilometer *Gossamer* class, and the 4-square-kilometer *Sunrise* class. Each Sunrise has a payload rack which can hold 24 standard (50-ton) modules. It also has a 600 cy. hull section which houses the complexity 4 control computer, communication equipment, 2 MW solar panels, a standard airlock and up to 200 tons of additional payload or passengers. The *Gossamer* is a scaled up version of the *Sunrise*. Its hull is 1,500 cy., has *two* standard airlocks, 3-MW solar panels and is rated for 500 tons of payload. Its rack can hold 80 standard payload modules, or 4,000 tons!

When fully loaded, both the *Gossamer* and the *Sunrise* accelerate at .0025 G near earth, and .0011 near Mars. At these rates, the trip from Earth to Mars takes anywhere from 1 to 6 months, depending on their relative positions. After releasing their modular payload, sailships can achieve accelerations of up to .075 G.

A new *Sunrise* class sailship costs $5,830,000. A new *Gossamer* costs $20,400,000.

The normal mode of travel from one planet to another is to take a shuttle to an orbiting station, transfer to an interplanetary ship which eventually reaches a station orbiting the destination planet, and take a second shuttle down from there. There are very few ships capable of 'direct' flights from the surface of one planet to the surface of another.

Spacedrives

Chemical Fuel (TL7+)

Chemical fuels, most notably hydrogen and oxygen, have been used in space ship drives since the mid-20th century. Fuel components are mixed, and the energy from the resulting reaction expels the reaction's products as exhaust. The fuel itself becomes the propulsion mass. The speed of the exhaust (and the amount of thrust) is limited by the ratio of the energy produced in the reaction to the weight of the fuel which produces it. Most spacecraft still use chemical fuels because fusion drives produce deadly gamma radiation, and ion drives cannot generate heavy thrusts.

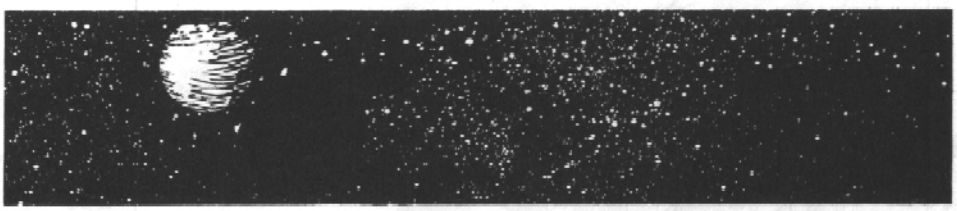
All chemical fuel drives are *slow* reaction drives (see p. S82), but the exhaust velocity varies slightly, depending on the type of fuel.

The most common fuel is still liquid hydrogen mixed with liquid oxygen (LOX). A ship which has 18% of its mass as this type of fuel could accelerate for a week at .0001 G. Each ton of H-LOX fuel takes up 2.3 cy.

On the moon, aluminum is abundant and hydrogen must be imported, so ships operating from the lunar surface generally substitute aluminum for hydrogen. This reaction is 40 percent less efficient, however; a ship which is 18% Al-LOX fuel could accelerate for a week at only .00006 G. This type of fuel takes up 1.1 cy per ton.

More efficient fuels than H-LOX are available, but they are very expensive to make and store. Two examples are suspended atomic hydrogen, or *SAH*, (+20%, $200 per ton), and Terradyne's own *RF-12* (+30%, $300 per ton). Both of these fuels take up 1 cy per ton.

Chemical fuel drives require no power plant, but the engines mass .02 ton, cost $2,000, and take up 0.05 cy per ton of thrust.



Ramjets (TL7)

When launching from a planet with a significant atmosphere, it is often more efficient to 'fly' into a low orbit using *ramjets*, then move from there to higher orbits or escape velocity using maneuver drives. This technique is commonly used on Mars, which now has an atmosphere extending roughly three times as high as Earth's.

Ramjets are similar to conventional jet engines, but they are lighter, simpler (no turbines) and designed to operate *only* at very high speeds. Ramjets operating in Earth-normal atmospheric pressure generate no thrust until they reach 344 meters per second (Mach 1); adjust this figure *upward* for lower pressures. For example, a ramjet operating in .5 atmospheres (an altitude of 55 kilometers on Earth) only generates thrust when traveling at least 688 meters per second.

Ram jets mass .1 ton, take up .2 cy, and cost $10,000 for every ton of thrust. One ton of thrust for one hour burns up ½ ton of *jet fuel* (kerosene). Jet fuel takes up .2 cy and costs $150 per ton.

Ion Drive (TL8)

Ion drives accelerate charged particles to very high speeds using static electric fields. They cannot provide heavy thrust, but are good for long trips at very low accelerations.

Each ton of thrust requires a .5 ton, .2 cy drive costing $10,000. Ion drives using *cadmium* (see p. S82) as a reaction mass have *fast* exhaust. So accelerating at .01 G for a week would use up 18% of a ship's mass in cadmium.

A separate power plant is needed for ion drives; 1,300 MW is required for each ton of thrust.

Terradyne Spacecraft

Spaceship Design

There are very few general purpose spacecraft in the 22nd century. Each class of ship is designed for a specific function, or a specific trip.

For full starship generation rules, see pp. S78-90. No technology above TL8 is available unless specified.

Payload Ships

LEO Shuttle

These ships were originally designed in 2075 to reach low earth orbit (LEO), but improvements in hull materials (TL9) and fuel (notably RF-12) have increased its effectiveness. It can now reach orbits up to 4,000 miles with a full payload, and can reach geosynchronous orbit (23,000 miles) with a reduced payload.

Each LEO shuttle consists of a booster section and an orbiter section. The booster is a streamlined split-fuselage. It is 100 feet long with a 150 foot wingspan, masses 1,850 tons (when full) and has a volume of 2,000 cy. It runs out of fuel after about 2½ minutes at 3-4 G thrust, detaches from the orbiter section and glides back to Earth under computer control. Its engines burn RF-12 and can produce 6,400 tons of thrust.

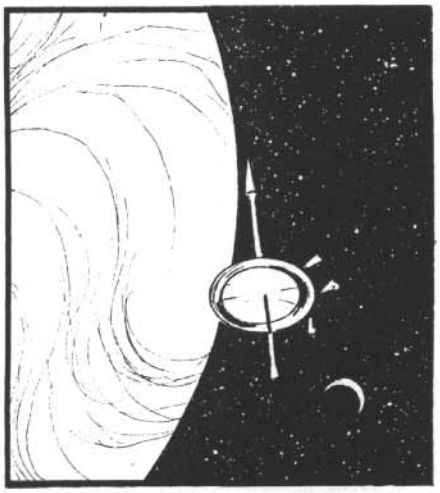
The orbiter section is a lifting body. It is 130 feet long, masses 1,150 tons (including 900 tons of RF-12) and has a volume of 1,200 cubic yards. It thrusts while the booster is attached, and continues thrusting at 2-3 G for 2½ minutes after separation, which gets it to orbit. It is streamlined so it can glide back to Earth.

In addition to fuel and engines, the orbiter carries three crew members, 2 MW solar panels, 2 MW-h of energy stores, 3 complexity 4 computers and a standard airlock. The remaining space on the orbiter can handle up to 175 tons of payload. Configurations of this payload section vary, but the most common are the *Orbiter-P*, which can carry up to 120 passengers, and the *Orbiter-C*, which contains cranes and restraints for 3 standard, 50-ton cargo modules.

A new LEO shuttle system, including the booster section and an Orbiter-C, costs $20,900,000. Fuel for one flight costs $780,000.

Interplanetary Courier

The *Interplanetary Courier* is a modified version of the orbiter section of a LEO shuttle that can reach orbit around Mars or Venus. It carries 20 tons more RF-12, and roughly half of the standard orbiter's payload bay is filled by a fusion power plant which generates 160 MW to power a small ion drive. This drive only provides 240 *pounds* of thrust (.0005 G), but it can sustain it for 100 days on only 3 tons of reaction mass (cadmium). All of these extras leave 65 tons for



Hohmann Transfer Orbits

The most energy-efficient routes between planetary orbits are the *Hohmann transfer orbits*. The Hohmann orbit between two planets is an ellipse with its *perihelion* (point nearest the sun) at one planet's orbit, and its *aphelion* (point farthest from the sun) at the other planet's orbit. A ship leaving the innermost planet can accelerate into the transfer orbit, then accelerate out of it when it reaches the outermost planet. The length of the trip can be approximated as half of the average of the planetary periods.

The ship must be launched within a small time window so it will meet up with the destination planet. The length of the window itself depends on how much 'extra' thrust the ship has available to compensate for not launching at the optimum time (and not getting into the ideal Hohmann orbit). A few percent extra thrust can extend the window by days in most cases. Launch windows occur at different times on each planet.

To get into the transfer orbit to Mars, a ship in high Earth orbit (or Lunar orbit) must accelerate at 1 G for approximately 200 seconds (or .1 G for 2,000 seconds, etc.) The trip to Mars takes 260 days, after which the ship must accelerate at 1 G for approximately 120 seconds to get into a high Martian orbit. The window for this trip occurs every 779 days, but the window on Mars comes 64 days before the window on Earth. A window opens between Earth and Venus every 584 days, and between Earth and Saturn 378 days. The trips would take 146 days and 14 years, respectively.

Hohmann orbits are the most efficient path between planets, but they are also the slowest. Travel times can be decreased by increasing the thrust at both ends of the trip. For example, a 130 day trip from Earth to Mars would require 460 seconds at 1 G to leave Earth, and 950 seconds at 1 G to reach orbit around Mars.

payload. The hull of a Courier is 1,600 cy. (400 cy. larger than the standard orbiter), so there is enough space and payload capacity for 22 steerage accommodations. A Courier outfitted this way (including the standard booster section) costs $28,200,000.

Mayflies

More payload is sent down from Earth orbit to the surface than comes up, and it doesn't make sense to bring up an empty shuttle just to take some payload back down. This excess traffic to the surface is handled by mayflies — small gliders which are built in orbit for a single trip down to the planet's surface.

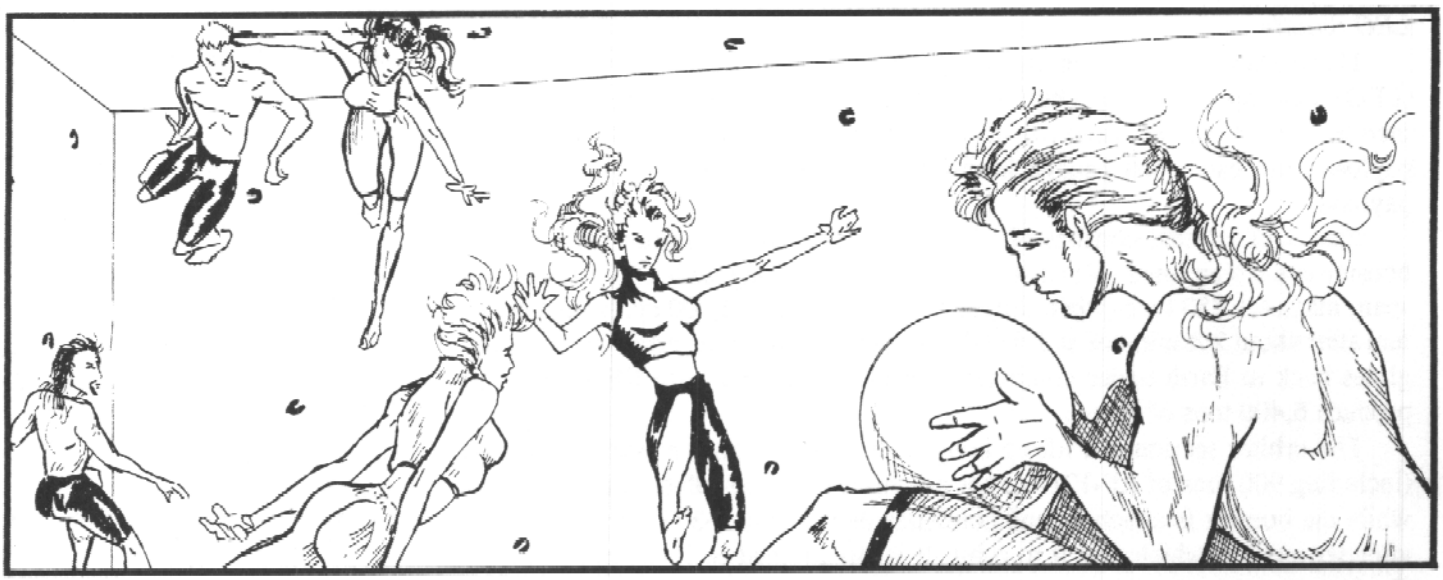
There are many different sizes of mayfly. The smallest have wingspans of 15 feet, mass 3 tons, and take up 5 cy. The largest have a 70-foot wingspan, mass 65 tons, and take up 100 cy. Mayflies require a small guidance computer, and some amount of thrust (even after being catapulted off an orbiting station), so only 80% of their mass is available for payload. The largest mayfly costs $7,500 and can carry 50 tons — a standard cargo module.

OTVs

Cargo and passengers are moved around in planetary orbits using Orbital Transfer Vehicles, or *OTVs*. These orbital tugboats are just drive sections which push cargo modules around at low (.05 G) accelerations.

There are many different types of OTVs. The most common is Terradyne's *Hojo* class, nicknamed the "Mother Hen." A Hojo is 35 feet long (not counting cargo racks), 42 feet in diameter, masses 1,350 tons and displaces 1,800 cy. It can transfer 150 people in comfort, and the large aluminum framework it pushes along can hold 20 standard cargo modules (1,000 tons). It has a fusion drive which can generate 120 tons of thrust and enough reaction mass (H_2O) to provide 0.5Gs for 8 hours. The power to sustain the fusion reaction comes from 20 MW-h of energy stores, which are charged by 3 MW solar panels.

Because of the radiation hazards of fusion drives, Hojos also have an aluminum-LOX drive which can provide 50 tons of thrust for about ten minutes. It is used during docking and departure, so the fusion drive does not have to be used in the vicinity of orbital stations.



Most OTVs operating around Earth, including the Hojos, can transfer their passengers and cargo to low Lunar orbit in 2-3 days. They could also make the trip from Earth to Mars, or Earth to Venus, but ion drive ships are more efficient on such long journeys.

A new Hojo costs $4,200,000 without fuel. Filling all fuel storage tanks (Al-LOX and H_2O) in orbit costs $346,000.

Lunar Mass Driver

Launching cargo from the Lunar surface using spacecraft is very expensive, so anything which can withstand the 32 G acceleration is sent into Earth orbit using the mass driver south of Luna City. The driver is a 6-mile-long, 500-MW magnetic accelerator which can get a 1-ton canister to Lunar escape velocity in under 8 seconds. It can easily send 1,200 tons of cargo into space every day.

Lunar Shuttle

Passengers and cargo from the Lunar surface which cannot withstand the high Gs of the Lunar Mass Driver (see sidebar) must fly to low orbit on a *Copernicus* class lunar shuttle, or "L-shot." An L-Shot is a cubical ship, 30 feet in each dimension, with three retractable legs that end in landing pads. It masses 820 tons, displaces 1,000 cy, uses an aluminum-oxide engine which can generate 640 tons of thrust, and it carries 550 tons of fuel — enough to reach a low orbit, where it can refuel for the return trip. Each L-shot also carries 2 crew members, 1 MW-h of energy storage, a standard airlock, and up to 240 tons of payload (passengers and cargo).

A new L-Shot costs $1,660,000 without fuel. Fuel for a single trip costs $66,000 (on the Moon).

Mars Jet Shuttle

The Mars Jet Shuttle is an interesting hybrid of rocket and jet engine technology. It launches at a shallow angle using LOX rocket engines for thrust, but in less than two minutes the rockets shut down and fusion ramjets take over. Because of the extreme height of the Martian atmosphere, the shuttle can literally fly into a low orbit. When the atmosphere gets so thin that the ramjets are no longer effective, the hydrogen-LOX rockets kick in again to get it into a higher orbit.

Jet shuttles are sleek lifting bodies with the two large ramjets set in close on the wings. They are 95 feet long, mass 1,100 tons, and take up 2,400 cubic yards. Their chemical engines provide 1,100 tons of thrust, and their ramjets 600 tons. The LOX fuel accounts for nearly half of the takeoff mass, but there is still 420 tons allotted for payload.

A new Martian Jet Shuttle costs $14,900,000 without fuel. Fuel for a single trip costs $64,200.

Scientific Ships

With the exception of a few orbital stations, virtually all scientific spacecraft belong to Terradyne's System Survey and Resource Development units. They operate a dozen or more modified versions of the Interplanetary Courier, fitted with a complete sensor suite and extended life support for 6 to 12 passengers. They also have powerful quickships, originally built for the Titan survey. But the pride of their fleet are the two huge exploration stations, the *Victoria* and *Trinidad*.

Victoria Class Exploration Stations

The *Victoria* and her sister ship, the *Trinidad,* serve as mobile observation platforms for planetologists, geologists, physicists and cartographers. Up to 100 scientists can live on board in reasonable comfort, with access to the latest sensor equipment, computers and virtual reality interface technology. These ships move through the system in low-energy Hohmann transfer orbits, stay in an interesting place for a few months, then move on.

There is no doubt that the data collected by the *Victoria* and *Trinidad* could be obtained using unmanned probes, but the probes could not match the volume of data which these exploration stations can take in and process. There also seems to be a great deal of synergy among the scientists stationed on these ships — they've become System Survey's "Think Tanks."

Each ship is disk-shaped, with a rotating outer ring and a stationary center section housing the drive systems and sensor arrays. The disk is 90 feet across and 32 feet thick; it masses 3,300 tons and takes up 7,500 cy. Its fusion drive provides .03 G acceleration and it is equipped with an auxiliary aluminum-LOX drive. Power comes from a 12 MW solar panel array (9,600 square yards) and a 40-MW fusion plant.

There are first class living quarters and full life support for 100 System Survey people plus 35 Freeze Capsules for those who don't want to endure the long journeys between planets. Passengers have access to four complete sensor suites and four complexity 5 mainframes. There are also 2 standard airlocks and 1,600 cubic yards (1,400 tons) of additional space filled with recreational facilities, labs, unmanned probes, and cargo.

Each *Victoria* class ship cost the System Survey Unit $76,000,000. Refueling costs $484,000 in Earth-Moon orbit, and $870,000 in Mars orbit. The

Spaceport Costs

Independent spaceports and orbital port stations charge a landing or docking fee of about $10 per ton, plus an additional $5 per ton per day the spacecraft is parked at the base. Sites that sell fuel may also tack on local taxes of up to 20%. Ships are allowed to make emergency landings without a permit, but they must pay all appropriate fees *plus* a stiff fine!

The best-equipped and most economical spaceports are those operated by UPOE or Terradyne, but these are limited to official use. Launch or landing permits can be obtained from officials for $5 per ton with a successful Administration or Carousing roll. "Docking" fees are also $5 per ton per day, but there are no additional taxes or fees.

Transport Costs

The base cost to transport payload can be derived from the costs of operating shuttles, transfer vehicles, and the Lunar mass driver and their typical payload mass.

Earth to Earth orbit: $7,000 per ton.
Earth orbit to Earth: $200 per ton.
Earth orbit to Lunar orbit: $150 per ton.
Lunar orbit to Earth orbit: $150 per ton.
Lunar surface to orbit(L-shot): $500 per ton.
Lunar surface to orbit(driver): $100 per ton.
Lunar orbit to Lunar surface: $700 per ton.
Mars to Mars orbit: $1,200 per ton.
Mars orbit to Mars: $225 per ton.
Earth/Lunar Orbit to Mars Orbit: $300 per ton.

So transporting payload from the surface of the Earth to the surface of the Moon costs about $7,850 per ton. Transporting from the surface of the Moon to Earth costs only $450 per ton for high-G payloads, and $850 for low-G payloads.

To calculate how much it costs to transport *people,* assume that each person accounts for 2 tons of payload, including life support and personal cargo. So a one-way trip from the surface of Earth to the surface of Mars costs $15,050 and a round trip costs $18,450. For trips of a few days or less, reduce the cost by 25%; increase cost by 50% for first-class accommodations and 150% for luxury accommodations.

Remember that these are the *costs* involved. In order to make a profit, Terradyne and independent carriers will have to charge more. So will Free Space and UPOE concerns, although their charges will be lower than Terradyne's because of subsidies.

Lowell Stations

The first Lowell Stations were built in the late '50s to provide an efficient and comfortable means of getting to Mars. They carried most of the human traffic during the colonization boom of the '60s and '70s, but use has declined as faster methods of travel have become available.

They are basically large space stations in Hohmann orbits between Earth and Mars, containing ample living space and extended life support for 1,600 passengers. Unlike many ships traveling to Mars, which take their living space and life support with them in and out of the transfer orbit, the Lowell Station system leaves the living spaces there and just moves the people in and out. It's a more efficient approach which allows for more comfortable travel conditions.

From a distance, a Lowell Station looks like a long, thin thread with two small objects on its ends and another partway along its length. In fact, the thread is a set of very strong, 11,300-foot cables and the small objects are cylindrical sections of hull the size of office buildings. The two end sections spin around the center hull section once every 100 seconds.

During the flight from Earth to Mars, the hub section of the Lowell Station moves along the cable, and mass (in the form of water) is shifted from one end section to the other to keep the center of mass at the hub. The rotation provides artificial gravity in the end sections, which varies from .4 G to 1 G depending on where the center section is.

Currently, of the 12 Lowell Stations, only three are active, all owned by Terradyne. Five others are "mothballed," and three are abandoned derelicts. The remaining one has fallen into "pirate" hands, and is now a permanent smuggler's haven swinging between Earth and Mars. See p. 98.

biggest expense in running these ships is the salary of the skilled crew! Quarters are available for rent on these stations (e.g., for prospectors surveying a planet), but the cost is steep — $10,000 per month!

Quickships

These interplanetary shuttles were designed by the System Survey unit for the manned exploration of Titan, but they are also used to service the automated water pumping station on Europa. They are 90 feet long, mass 750 tons, take up 1250 cubic yards and are heavily streamlined. They have life support and standard quarters for 22 people, plus freeze capsules for 20. Living space is very limited.

Quickships operate between high Earth orbit and the surface of Titan. Their fusion drive gives them 0.4 G acceleration for 3 hours — enough to get from high Earth orbit to Titan in only 17 months. Once there, they enter Titan's atmosphere and land on a long runway. Water is plentiful on Titan, so the shuttles refuel there for the long trip home. The atmosphere on Titan is very dense and very high, so Quickships use fusion ramjets to get from Titan's surface into low orbit. In theory, a quickship could *land* on Earth — but the use of fusion drives is prohibited there, so it would not be able to take off again.

Each ship has a standard airlock, a complexity 5 computer, and a 24-MW fusion plant. There is also room for 60 tons of additional payload. Quickships cost $13,420,000 to build, and $201,000 to refuel in Earth orbit.

Military Ships

Terradyne's Corporate Security Force operates a small fleet of armed and armored ships in orbit around Earth, Mars, and the Moon. They monitor smuggler traffic and ISF ships, and they shield Terradyne operations from the prying eyes of UPOE spy satellites. They would also protect the colonies in the event of an open attack from space by a terrorist group or angry Earth nation.

Daimyo Class Security Cruiser

This is the standard patrol ship of the CSF. They are 40 feet long, mass 280 tons, takes up 320 cubic yards, and are *not* streamlined. They have a fusion drive which provides 1 G of thrust for 35 minutes and an aluminum-LOX drive for proximity maneuvering. Power comes from a 1-MW solar panel array and 100 megawatt-hours of energy storage.

Each cruiser has 1 defense factor of armor and is armed with two medium lasers and a full sensor suite. There are steerage accommodations for 8 crew members, 80 man-days of life support, a standard airlock (including a passage tube) and 10 cy of additional payload space.

Up to four 80-ton fuel pods can be attached to the outside of each ship. With all four in place, and the payload space converted to additional life support, a security cruiser can make the trip between Earth and Mars in just 40 days.

A new *Daimyo* class security cruiser costs $5,300,000 to build and $54,500 to refuel in Lunar orbit.

Non-Terradyne Spacecraft

Free Space Shuttles

Various companies, working under *Free Space* subsidies and grants, have developed LEO shuttle designs to compete with Terradyne models. Many are just variations of the Standard Terradyne shuttle, but others, like the *Payload-90* (made by China's Cheung Group), are truly innovative.

Payload-90 Shuttle

The Payload-90 is an effective rebirth of a very old design concept — an orbital spacecraft launched from a jet. Suspended atomic hydrogen (SAH) engines take the jet "booster" and the orbiter past Mach 1, where conventional ramjets take over. The jet section, including the expended rockets, accelerates to Mach 10, then detaches at 200,000 feet. Finally, the orbiter's engines kick in to take it to orbits as high as 2200 miles.

The Jet section, often described as looking like "an ace of spades with engines," is 55 feet long, has a 50 foot wingspan, masses 500 tons, and takes up 435 cy. It contains the takeoff engines, the ramjets, fuel, and a small flight computer which controls its glide back to Earth.

The orbiter section is a 70-foot-long lifting body which masses 700 tons and takes up 800 cy. Its SAH engines provide 1,400 tons of thrust, and all of its power comes from a 3-MW *fission* plant. The orbiter requires a crew of two and has limited life support. It has a standard airlock, a complexity 5 computer, and can carry 90 tons of payload.

A complete Payload-90 system costs $9,000,000. Fuel for one launch costs $185,500 (including $22,500 for 150 tons of jet fuel).

Earth Orbit Spacecraft

Earth orbit is full of manned stations, many of which belong to UPOE or its member nations. Most transport between these stations is accomplished using unmanned boosters which transport standard cargo modules. The basic booster unit is a 16-foot-long cone-shaped Al-LOX fuel tank with a small engine at its tip. The cargo module is strapped to its base with aluminum cables, and the entire unit, with cargo, is 34 feet long, masses 100 tons, and takes up 175 cubic yards.

The booster only holds enough fuel to thrust at .1 G for 17 minutes. Fortunately, most stations orbit between 3,000 and 4,000 miles, a distance which the booster can traverse.

The basic, single module boosters cost $130,000 and can be refueled for $19,780 in Earth orbit. Larger models are available at roughly the same cost (and mass, etc.) per cargo module transported.

Diplomatic Spacecraft

UPOE is uncomfortable with its dependence on Terradyne for transportation beyond Earth orbit; on the other hand, UPOE has very little need to go beyond Earth orbit, except to visit Terradyne colonies on a diplomatic or law enforcement mission. For diplomatic purposes, UPOE has purchased and independently operates three Interplanetary Couriers. It also maintains two OTVs at a small ISF base orbiting the Moon, and leases a Mars shuttle at Terradyne's Uruk launch site.

The Price of Gravity

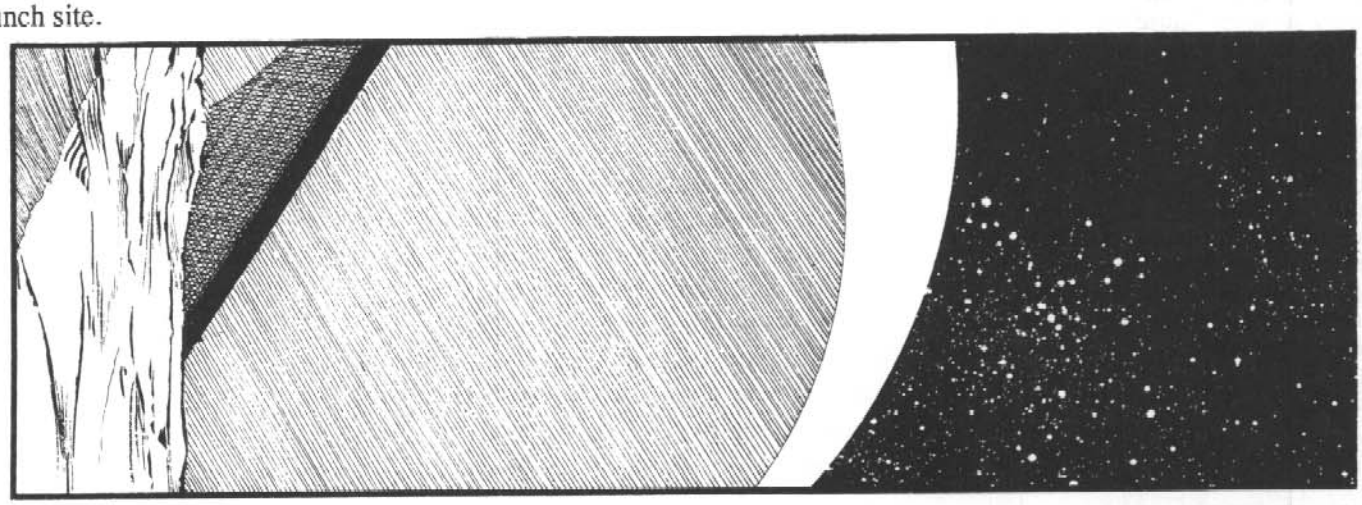
Gravity is possibly the most important reason why Earth-based corporations have such a difficult time competing with Terradyne. Many products manufactured on Earth cannot be sold at competitive prices in the colonies because of the cost of shipping them to Earth orbit ($7,000 per ton).

The price of items with high cost to weight ratios, like advanced electronics and photonics, are not affected significantly, but Terradyne is years ahead of Earth companies in their development. Because of these costs, many Earth corporations have moved manufacturing operations into orbit, but much of the money saved in shipping products is spent getting workers to orbit and paying Terradyne for oxygen.

Terradyne, on the other hand, has all the advantages. Its L4 stations can ship products to the Earth's surface for $200 per ton. Products manufactured on the Moon can get to Earth for $850 per ton if they are fragile, or only $450 per ton if they can withstand the G forces of the mass driver.

UPOE has taken a number of steps to reduce the effects of this disadvantage. The first was the imposition of import quotas in 2070; the Interplanetary Trade Commission sets these quotas each year and monitors the flow of products at all off-world customs checkpoints. Quotas have helped Earth corporations in some respects, but they also forced Terradyne to begin actively supporting orbital smugglers who sell Terradyne products on Earth's black market (see *Privateers*, p. 30).

The second step was the Free Space program. Space technology firms participating in the program are given financial subsidies through the World Economic Reserve and granted some relief from anti-trust regulations — much like the special status once granted to Terradyne by the United States. This program is having a major impact on the Earth-Terradyne trade imbalance, primarily due to the success of the highly efficient *Payload-90* shuttle.



Lowell Station Four

Nearly two decades ago, a young Terradyne middle manager named Edmund Toledo and a small group of followers stole an OTV from L4 and barely managed to fly it to Lowell Station Four. Toledo had been accused of serious crimes, including manslaughter, and fled to avoid trial on the Moon. When he and his crew arrived at the mothballed station, they successfully neutralized the security systems, deployed the solar panels and got the life support systems working. They also found hostages — six Lowell Station crew members in freeze capsules.

Terradyne Corporate Security decided not to risk boarding the station as long as the hostages were unharmed, but they did send out a Security Cruiser and another OTV to retrieve the ship stolen from the station.

Other ships full of misfits, outcasts, and criminals have rendezvoused with Lowell Station Four over the years, raising the population to over 300. These ships are usually set adrift behind the station, and have occasionally been retrieved and returned to Mars or the Moon.

Toledo still rules Lowell Station Four and is addressed as 'Baron' Toledo. His real power does not come from his band of thugs, but from the fact that he controls the handful of technicians and engineers that keep the place running. People with power plant and life support expertise are so valuable that the new arrival of such a person usually results in a few deaths before the Baron restores 'order.' The original Lowell Station crew members were revived years ago and afforded the same privileges as Baron Toledo's other subjects.

Military Spacecraft

For the last century, Earth's orbits have been the "high ground" of military strategy. There are hundreds of manned and unmanned orbital platforms, all armed with lasers, missiles and the latest sensor equipment. They have also become the command and control centers for combat on the Earth's surface.

Defense Management Stations

Most major Earth nations operate at least one DMS in low Earth orbit to coordinate the activities of its armed forces and provide detailed information about the activities of other nations. They range in size from a few hundred cubic yards to over 100,000. One of the largest is the main Indian DMS, *Siva,* which is 350,000 cubic yards, masses 110,000 tons, and has a crew of 4,000. These stations are equipped with lasers and missiles, primarily to destroy other stations in the event of a major conflict.

The ISF Fleet

The ISF operates a few stations around the Earth, Mars, and the Moon, and has purchased a fleet of 48 *Daimyo* class security cruisers from Terradyne. The ships are used to track unscheduled flights and intercept privateers and suspected smugglers.

A typical tactic for intercepting smugglers is to disable their ship's drive system and, if necessary, its life support. The security cruiser can then dock with the disabled ship. The smugglers usually cooperate — by then, their only alternative is to die in space.

Black Market Privateers

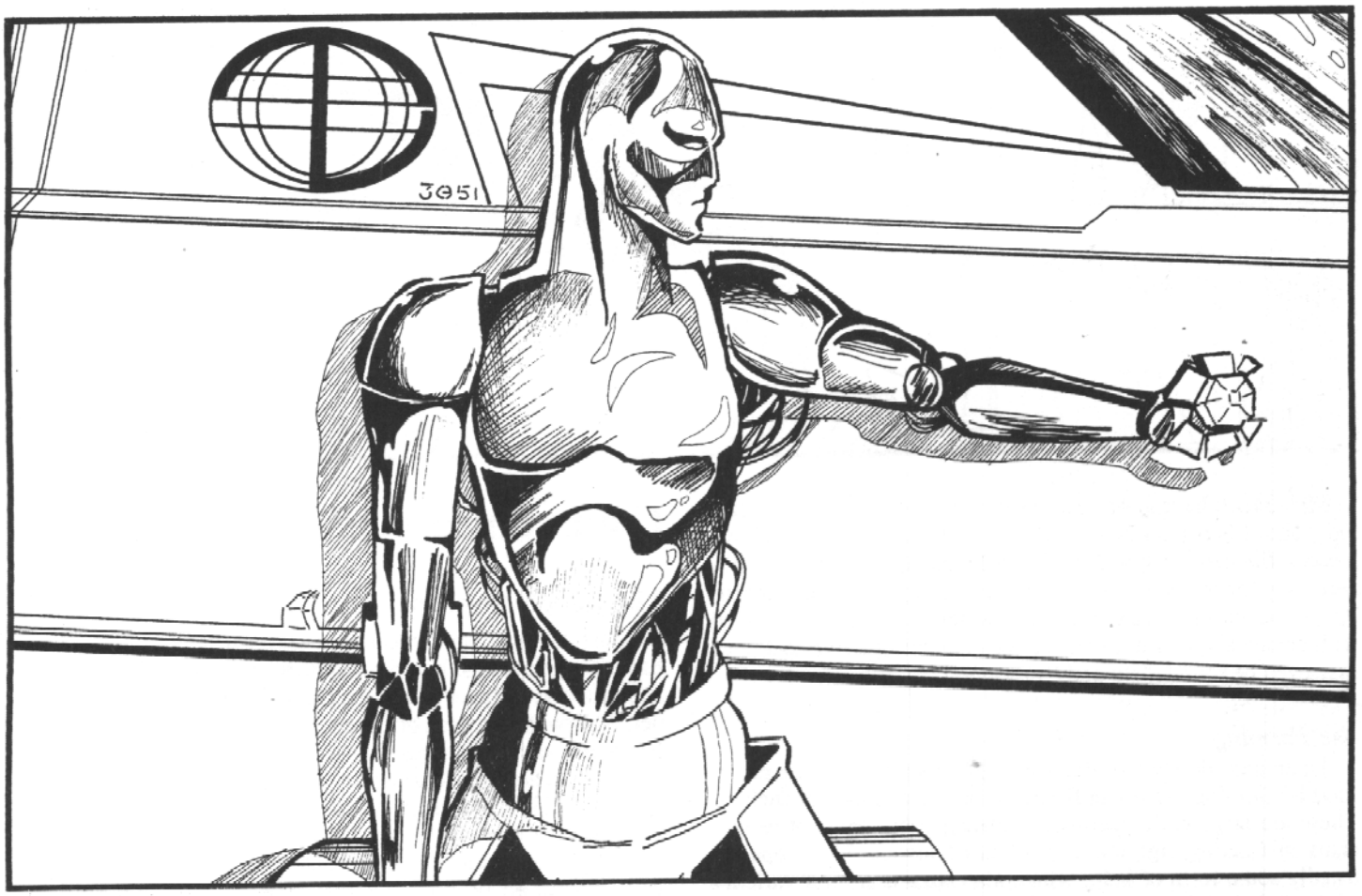
Historically, privateers were privately owned vessels which were authorized by their government to take part in a military conflict. In the 22nd century, "privateer" has come to mean a spacecraft used in black market smuggling operations. These are usually outdated ships which have been poorly maintained and crudely refurbished with whatever defenses and weapons their owners could lay their hands on. Most are not a serious threat to the ISF's security cruisers, but a lucky shot now and then from a broken-down privateer keeps UPOE's troops on their toes.

Smugglers typically specialize in one leg of the journey between the Moon and the Earth. Earthside smugglers are often legitimate middlemen for Terradyne products who operate their smuggling business on the side to avoid import quotas. Because of the expense, very little is smuggled up from the Earth's surface — most of the traffic goes *down* in small, hard-to-trace *mayflies* (see p. 94). Smugglers operating from the surface of the Moon are either Terradyne employees on the take, or they have stolen or rebuilt an old Lunar shuttle to get their "stuff" to orbit. The third group, which is the hardest hit by the ISF, transfers goods from Lunar orbit to Earth orbit using small stolen or privately-owned OTVs.

Mailbag OTVs

One of the most common orbital vehicles among the smugglers is an OTV which went out of production nearly 30 years ago. These OTVs, nicknamed "Mailbags," are 35 feet long, mass 700 tons, and take up 1,500 cubic yards. The hydrogen-LOX drive provides .3 G thrust for 20 minutes, using 490 tons of fuel.

The original design had a small fuel cell (1 MW-h), room for a crew of 2 on limited life support, and could handle 180 tons of payload. Most of the surviving Mailbags have been heavily modified — some have been outfitted with full life support for up to 6 people (same living space), solar panels, energy stores and light lasers.



Tech Levels

Terradyne and the UPOE are both TL8 societies. Assume that any equipment of TL8 or lower listed in either ***GURPS Space*** or ***GURPS High-Tech*** is available, although some items — such as military equipment — aren't necessarily available to the general public. There may also be TL9 items available or under development, but if there are, neither side is saying.

Individual nations on Earth are anywhere from TL7/8 (The United States, the USSR) to TL5 (several Third World nations). Many show wide gaps in tech levels; Guinea-Bissau, for instance, is TL8 in information technology thanks to the presence of GeoComm, but only TL5 in medicine and agriculture.

Prices given are in UPOE Standards ($). Unless otherwise noted, assume all TL8 items are manufactured by Terradyne on the Moon, or at L4.

Cheap Copies

Many corporations produce copies of Terradyne products on Earth. These are generally single user items, sometimes outwardly hard to distinguish from the real thing — but they don't work as well. For every 10% less than Terradyne's price the copy sells for, apply a -1 to any skill roll involving the device (e.g., a $160 version of a $200 item would operate at a -2). A roll of 16 or more is *always* a critical failure!

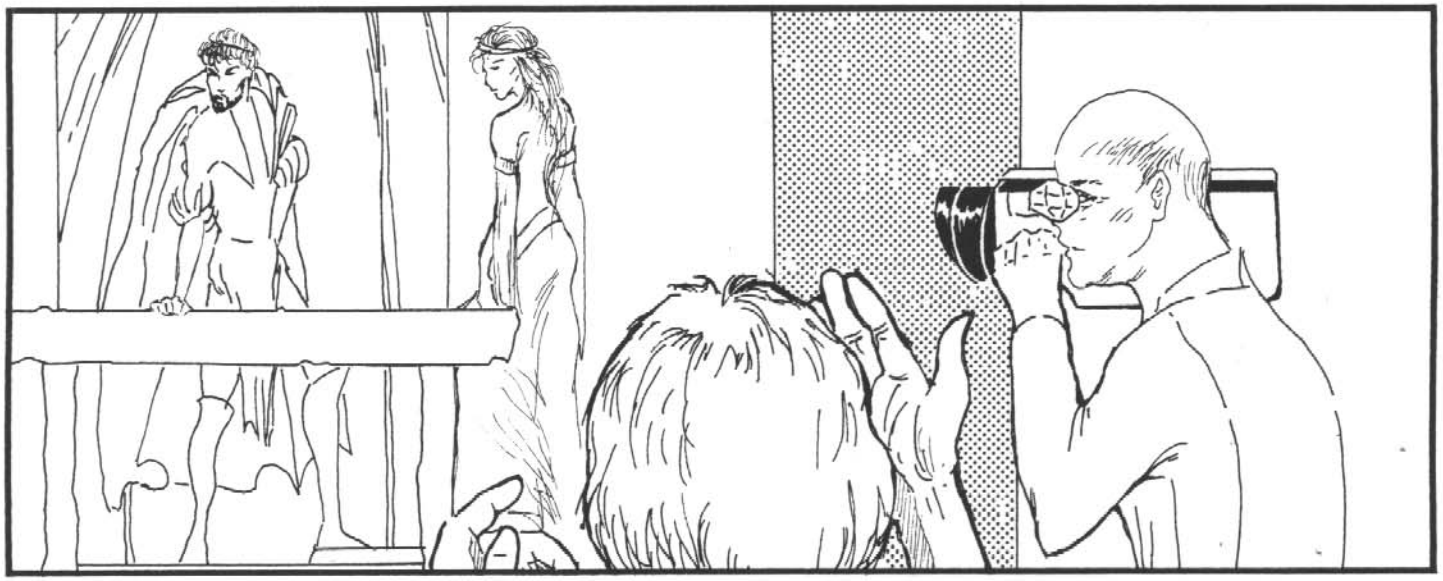
The GM should roll against the appropriate skill area to see if a user recognizes a cheap copy. For instance, a roll against Computer Operation (Security Systems) is required to recognize a cheap copy of a scanlock. Cheap copies sell for as low as 60% of the cost of an equivalent Terradyne item.

Agriculture

People of the 22nd century still have to eat — all 11 billion of them. With the world population growing and the amount of unpolluted rural land shrinking, improvements in agricultural technology are necessary to keep the human race alive. There are also a significant number of humans in space stations and on other worlds who *cannot* use traditional agricultural methods.

Modern farms are company-operated, highly automated and huge compared to the family-owned farms of the past. Giant robotic vehicles roam over thousands of acres of crops under the control of central computers. They plant genetically engineered seeds which have twice the yield of those planted only 20 years ago. The plants are watered and chemically treated for weeds, pests, etc., through an impressive network of irrigation pipes and ditches (also built and maintained by robots), then harvested quickly so a different crop can be planted.

Crops are stored and livestock processed at the farm's central complex, usually connected to a larger shipping facility (up to 200 miles away) by an elevated maglev system. The farm's central complex also contains workshops where the robots and machinery are repaired, and quarters for the handful of agronomists, robot technicians, and mechanics who run the place.



Most farms have at one serviceable road to their central complex, and it is dangerous to leave it. Automated machines have sensors for detecting and avoiding humans, but these are not necessary for operation, so they are not always well maintained. People out in the fields risk being watered, fertilized, sprayed with chemicals, or run over. Intruders entering a livestock area may even be rounded up and "processed."

Sea Farming

Japan and the United States now get a significant amount of food by farming the ocean floors along the continental shelves. These are large-scale operations, managed by teams of technicians in floating rigs the size of small towns. The crops are usually some form of kelp, which also attracts several varieties of small fish. The protein produced when this combination is harvested is higher than most surface crops.

Remote control of the robotic planting/harvesting machines is difficult. Poor underwater radio reception requires a communication cable back to the main rig or an antenna buoy on the surface. This is avoided in the Japanese farms by having humans operate all of the sea floor equipment, sometimes for days at a time.

Off-World Agriculture

The most dramatic developments in agricultural technology are *hydroponics* and *gludinoncorpus*, or free growth. These techniques have been used extensively in space stations, the colonics and extended life support systems aboard ships.

Hydroponics (or tank farming) is the cultivation of plants outside of soil. The roots of the plant are suspended in a wire grid or bed of gravel and flushed with a solution containing all of the nutrients they need for growth.

Free growth is a similar process applied to animal products. Genetically engineered muscle cells from livestock are artificially supplied with the nutrients they normally get from the animal's bloodstream and grow into an amorphous mass of muscle tissue. Individual cells from this mass now become the "seeds" for the next.

Both of these methods are expensive, but they save a great deal of space over traditional farming methods. They work well in the confines of space stations and colony facilities.

Communications

The Data Networks

Most of the communication equipment and computers on Earth are linked together in a single dynamic web of optic cables and microwave links called the Data Network, or simply "the net." Networks in each of the colonies are also connected to the Earth net and each other by laser or microwave links (with appropriate delays), forming an interplanetary net.

Any building constructed within the last 50 years will have at least one net hookup for its central computer and one or two auxiliary connections. Remote areas will have a microwave or laser link to an orbiting satellite. The devices on the net are referred to as *nodes*, and the connections between them as *links*. Each node charges a fee to the originator of the information it passes along and usually adds in a billing surcharge for first-time or infrequent users, so users generally want to find the fastest and least expensive path to a destination node. But the layout of the net is always changing, and comparing all reasonable paths can be time-consuming and expensive. There is also little security built into the basic structure of the net, so individual nodes must protect themselves with expensive security software which must execute continuously.

Service Nodes

Databases: Each of these nodes provides access to information in a broad area — medicine, weapons, or general news, for instance. Most databases cost $10 per hour to access, with an additional charge of $1 per megabyte to download material.

Few users require the raw data that accessing a database generates, and in fact find it much easier to get information through a *query service* (see p. 101).

Expert System: This is a specialized database of knowledge and advice regarding a particular skill. Access costs $100 per hour for Mental/Easy skills, $200 per hour for Mental/Average skills, and $500 per hour for Mental/Hard skills (all at level 12). Better expert systems exist on the net, but their access cost is *doubled* for each +1 to skill level. The best have +3 skill level for eight times the cost.

Time required depends on the task. Simple tasks, like foren-

sic analysis of a bullet wound (Forensics skill), take 1d minutes. Complex tasks, like plotting a course and exact thrust program for an interplanetary spaceship (Astrogation), take 1d hours. Very complex tasks, like developing the basic plans for an office building (Architecture), take 1d days and generally require the help of other expert systems.

Software Rental: Almost any software which can be purchased can be rented off the net. Some software rental nodes prefer to run their programs *remotely* on their own computers, while others actually send the software over the net to run *locally*, on the user's system. Remote rentals are handy for users with low power computers, but they cannot be used for tasks which require real-time response, like Driving or Gunner. Local rentals can only be run on a system of appropriate complexity with enough storage capacity.

Rental software is specifically designed to erase itself when the rental period expires. Programs exist to defeat this, but in general it's much less expensive to buy software than to try to steal it — "cracker" programs are fairly expensive, copy-protection methods change on an almost daily basis, and some programs are "booby-trapped" to inform law-enforcement agencies when a user is attempting to steal a piece of software.

Renting a piece of software for three days costs 2% of the purchase price for a remote rental, or 4% of purchase price for local rentals.

Research: This is a special type of expert system which specializes in gathering and organizing information about specific topics. A Research node could be instructed to find the relative merits of different rocket fuels, report on all experiments dealing with a specific topic, or gather public information on an individual or corporation. The basic services of a research node with skill level 12 cost $100 per hour, but it may have to access a number of databases and expert systems to complete its task. This can easily raise the total cost to $200 or $300 per hour. Some query services have built-in Research systems.

Entertainment: Some nodes specialize in leisure software, text, video and virtual realities. Software and virtual realities cost $50 per hour, video costs $.10 per hour per gigabyte ($2 for a two-hour video), and text costs $.05 per page (about 200 words). There are also several *live channels*, which operate somewhat like the television networks of the pre-net era.

Query Services

Most people find the bewildering maze of protocols, access codes and languages (not to mention bills) difficult to navigate. *Query services* help manage the information a user might need.

Query services are based on the premise that many people are going to want a particular piece of information from a database or expert system, and that it can share the cost among them. So, if it costs $100 to download a copy of a particular database, but 50 people want copies, the cost per copy per person is reduced to $2. Most query services charge flat fees for service (usually $100 per month); occasional, extraordinary services cost a bit more, and a user is always notified before an extra fee is charged.

In addition, query services can be used as specialized "clipping services" to collect or reject particular pieces of information. For instance, a user might request his query service to automatically forward all information on Terradyne activities in Venus orbit, financial news relating to Australian mining corporations and ice hockey, and to present a menu of other major news stories *except* South American news and any sport other than soccer.

Large corporations often have their own query services which are provided to employees as a perk.

Communication Using the Net

People communicate over the net by voice or electronic mail. Mail messages can be via text, voice, video or any combination, and can be interactive — they often ask the receiver questions to determine which parts of a message should be presented.

Users communicate directly by voice or video, or by shared virtual reality (see *Interfaces*, p. 103). All computers of complexity 2 or higher have a built-in *Recorder* (see p. S48) and can handle voice communication. A *Digital Camera* is required for video communication.

Shared virtual realities are only possible if both nodes have virtual reality hardware and software. It is possible to mail a virtual reality to someone, but the processing time required to generate one makes it impractical.

Communication through a query system costs nothing extra if the destination node and user is known. If the user's current node address is unknown, the query service will have to consult a Communication node to find it. This takes 1d minutes and costs $5 per minute. Even if the user is on the net, the search

may fail because of the limitation of Privacy Laws — he might have the net equivalent of an unlisted number.

Remote Communicators

Standard communicators transmit digital data using radio waves, microwaves or lasers. They are usually used to link computers together or broadcast data from a camera or sensor. Voice communication capability comes standard. Laser and microwave communicators have special tracking equipment to "lock on" and maintain links with other communicators.

The transmission rate for radio communicators is 100 megabytes per minute. Microwave links can transmit 10 gigabytes per minute, but must be within sight of the receiver or be linked with a wave guide. Laser links can transmit 1,000 gigabytes per minute, but require a direct, *unobstructed* line of sight to the receiver, or an optic cable of some sort. For example, retrieving a complete, 10-gigabyte database would take 100 minutes using radio frequencies, 1 minute using a microwave link, and only 0.6 seconds with a laser link! All three frequencies can support voice communication and live digital camera transmissions.

Implant Communicator: A miniature communicator implanted against the skull. Voice communication can be subvocalized. Only radio frequency model available (no lasers or microwaves). Range is 10 miles. Powered by one A cell, which lasts 100 years. Costs $500 for implant and $500 for surgical process. No Master Unit is required.

Micro-Communicator: Extremely small radio communicator used in micro-robotics. Less than 1/100th of an inch across. Range is 10 yards. Built-in power supply lasts for 10 years.

Short-Range Communicator: Hand-held communicator about the size of a cigarette lighter. Range is 10 miles. Powered by one A cell which lasts a year. Radio version costs $50, microwave version costs $500 and laser version costs $2,000.

Medium-Range Communicator: Palm-sized communicator. Range is 100 miles. Powered for one year by a B cell. Radio costs $200, microwave version costs $1,500 and laser version costs $5,000.

Long-Range Communicator: Communicator the size of a camera case. Runs for 3 months on a B cell. Radio version costs $600 and has a range of 1,000 miles. Microwave version costs $4,000 and has a range of 10,000 miles. Laser version costs $15,000 and has a range of 100,000 miles.

Directional Receiver: Hand-held radio receiver which can give the direction of a signal to within one degree. Samples taken at different locations can give approximate location of transmitter. Can receive signals out to the transmitter's normal range. Commonly used to track criminals fitted with a special version of the implant communicator. Cost is $100 and weight is 1/2 pound. Operates for one year on a single A cell.

Computers

The human race is almost completely dependent on computers. There are too many tasks in the Solar System which are beyond the capabilities of any individual or group. It is difficult to imagine human aerospace traffic controllers trying to route 10,000 flights a day in and out of the Washington, D.C. area, or human mathematicians trying to calculate and adjust the trajectory of interplanetary spacecraft. Dr. James Washu, of Lunar University, estimates that the availability of computers and the resources of the data nets has multiplied the effective brainpower

of an individual by a factor of 200 since the year 1950. If computers were to suddenly disappear or break down, most of the human race would die within days, and the rest would enter a new dark age.

Contact Lens Display

One of the most convenient innovations in computer display technology is the contact lens display. For $2,000, the user can have a normal computer screen displayed on a lens — to the user it appears to float 3''-6'' in front of his face. A careful observer (-4 to Vision roll) will notice a tiny flickering of light across the surface of the user's eye. The display is powered by heat from the wearer's body; no batteries are required! This is *not* an implant — it receives data via RF.

If the contact is also required to correct for Bad Sight, double the price.

Complexity and Cost

The computers of the 22nd century are TL8 as described below and in ***GURPS Space***, pp. 51-52. All computers except wristcomps and implants can be plugged directly into the data nets or linked to a query service.

Implant Computer: Special type of Dedicated Computer (p. S51) which consists of an Implant Communicator and a Complexity 1 software. Commonly used to drive personal interface devices like the Contact Lens Display (see above) based on input from a larger computer. Costs $1,000 plus $500 for implant surgery and runs on one A cell for 100 years.

Wristcomp: Complexity 2 computer which can be worn like a large wristwatch. It has no display, but uses verbal interface. can be linked to a communicator or directly to a larger computer to download data. ⅛ pound, costs $300.

Personal Computer: Pocket sized system with small display and verbal interface. Complexity 2, weighs 2 pounds, costs $1,000.

Minicomputer: Briefcase sized. Complexity 3, weighs 20 pounds and costs $15,000.

Microframe: About the size of a small file cabinet. Complexity 4, weighs 200 pounds and costs $40,000 plus $2,000 per user.

Mainframe: Full cabinet-sized (10 cubic feet). Complexity 5, weighs 500 pounds and costs $200,000 plus $1,000 per user.

Interfaces

All computers of Complexity 2 or higher have built-in Recorders and at least a rudimentary understanding of a spoken language. So most instructions are given verbally, and the computer usually responds in kind. The GM should roll against Computer Operation skill, with an appropriate difficulty modifier, whenever instructions are given. The GM need not roll for very simple instructions like ''Turn out the light in my office.'' or ''Did anyone call while I was out?''

More sophisticated interface software can make instructing the computer easier. A computer with Personality Simulation software gives a +1 modifier to Computer Operation skill, and a fully trained Personality Expert System (see p. 105) gives a +2 modifier. It usually isn't practical to rent one of these programs, because it takes 24 hours of interface operation before they ''get to know'' a particular user and the modifiers take effect.

Keyboards, touch panels, subvocalization and other silent input methods are still used to prevent confusion when users are in close proximity to each other. They also come in handy when computer access must be kept secret. The computer can respond through small ear plugs, an implant, a display or a contact lens.

Virtual Reality

This is the most complex form of computer interface. The computer simulates the sensory input of a complete environment and presents it to the user through a full or partial *VR suit*. The environment could be anything — a board room, a crater on the moon, or a beach in the Caribbean. VRs are *the* most popular form of entertainment, especially within the confines of spacecraft and the colonies. They are also very useful for training and as a means of generating symbolic representations of complex information (see *Symbolic Net Interface*, p. 104).

Passive virtual realities, in which the user's actions do not affect the simulation, can be played out by a Complexity 3 computer or higher. Fully interactive VRs can only be generated by a Complexity 4 or higher computer with appropriate software (see p. 105). Of course, all of the VR software can be rented off the net and run on another node, but the computer which the VR suit is hooked up to must be at least complexity 3. Virtual realities may eventually develop into full *Neural Interfaces* and *Dreamgames*, as described in ***Ultra-Tech***.

VR Suits

The full VR suit consists of goggles, a helmet, and a ''wired'' body suit. The goggles block out all light and display 3-D images constructed by the computer. The helmet covers the ears to provide VR sound and places microscopic probes against the user's scalp to provide direct stimulation of the remaining senses. When the suit is activated, it holds the user's body rigid and numbs the tactile nerves. The suit senses the pressure of any attempts at motion and simulates them in the virtual reality.

For example, the user may try to raise his arm to point at some feature in the simulation. The suit senses the pressure, and the user actually sees his arm go up. In the absence of sensation from his arm, he subconsciously accepts the visual cues as feedback and thinks he has actually raised his arm. If events in the simulation actually required that the user feel something (a firm handshake for instance), direct stimulation is provided by the helmet.

A full VR suit is TL8 and costs $3,000. Each suit is slightly different and must be calibrated for each user, which takes two hours. One suit can be calibrated for any number of users.

The tactile stimulation provided by a VR suit and helmet is still rather crude and can seem very strange at times. Most users avoid it and use only a partial VR suit — a pair of goggles which wraps around the face, covering the ears, and a set of a dozen small movement ''tracers'' which attach to various points on the body. With a partial VR suit, the user can physically move around, and those movements will be reproduced in the simulation. The computer also represents all real, physical obstacles as appropriate simulated items.

Partial VR suits are more common than full suits because they are easier to put on and take off. They are TL8 and cost only $1,200. Because of their obvious limitations, however, partial suits are only used for virtual realities which require very little movement. This doesn't stop thousands of Earth's business executives from using them to practice their golf swings, though!

Shared Virtual Realities

When two or more people need to hold a conversation over the net, they often meet face-to-face in a shared virtual reality.

Long-distance lovers can meet in a simulated park, fathers away on trips can go to baseball games with their sons, and businessmen can meet with clients without leaving the office.

Most shared virtual realities are experienced through partial VR suits, so a whole new etiquette of non-touching human interaction has evolved. It prevents unsettling occurrences, like accidentally walking *through* another person. Handshakes are not a problem; businessmen are reluctant to meet without shaking hands, so a special glove, similar to the right hand of a full VR suit, has been developed to supplement the partial suit.

Symbolic Interfaces

Virtual realities are often used to provide symbolic representations of complex problems. There is a limit on how much sensory input the human brain can process, so computers sort through it all and select just the important information to present to the human operator. A pilot of an aircraft, for example, sees only computer-generated representations of obstacles, other aircraft and landing fields. Additional information, such as airspeed, mechanical status, and ideal flight path, are superimposed on the scene.

Symbolic Net Interfaces

Without the aid of a query service, the complexity of the data net would quickly overwhelm the average user, so a special form of symbolic VR interface is used. Each node and link on the net is represented by an appropriate symbol (possibly a bank building for a credit bureau, or a library for a database). There are even symbols for known security software and devices (fences, guards, etc.) It is also possible to be accompanied by an "expert" or AI. Movement from node to node is triggered by a flick of the wrist or nod of the head.

For more information on computers and virtual reality, see *GURPS Cyberpunk.*

Computer Security

Security has been an important concern ever since the computer was invented, and every year more critical information is being stored on computers and more devices are controlled by them. Without effective security measures, activities like copying software, changing a credcard balance or sabotaging a power plant would be child's play.

Some computer security is provided by limiting access to systems using *scanlocks* which recognize authorized users. Failure to pass one of these checks could prevent the user from physically reaching a terminal, limit the functions available, or deny access to the system. Extremely confidential information may not even be kept online — its users may keep it on disk, locked in a safe until needed.

If an unauthorized intruder has gained access to the computer, he must find a way to be accepted as a legitimate user of the system to access information. These intrusions are usually blocked by sophisticated security programs. See *Data Penetration* for details and descriptions of security-related software.

Security Levels

Both Terradyne and UPOE classify their secret information and grant clearances by *security level*, and as a result many nations use this system as well. The lowest level is S1 and the highest is S6, but only a handful of politicians, scientists and agents ever see anything above S4.

Level S1 and S2 information is available to anyone with equal or higher clearance. S3 information is only available to people with high enough clearance and a "need to know." This is an informal judgment, which in practice means you just need to know someone else who knows the information and can tell you where to find it. At level S4 and higher, the need to know distinction is formalized in a system of *compartments* and *billets*. Information is divided into compartments by subject, project, or office, and there are a limited number of clearance billets, or slots, for that compartment.

When all of the billets are taken, no one else can be cleared for that compartment until someone else loses their billet. For example, information on Borova's Butchers, a secret group of Terradyne-backed mercenaries, may be classified S5 and have its own compartment with only 25 billets. This means only 25 people are authorized to access this information at any one time. One or two billets are generally left open in case outside consultants have to be brought in on short notice.

Compartments are given code names to hide their subject, and the list of people who hold billets is also classified within the compartment. A person can hold billets from more than one compartment.

Databases which contain classified information are generally protected by security software that imposes a penalty of the same magnitude as the highest security level it contains. For example, a database containing information up to level S4 would normally have security software which adds -4 to any data penetration attempts. Passive defense programs are also very common on systems containing data rated S3 or higher.

Data Penetration (Computer Hacking)

Adventurers may want to break into a computer system to steal information. They must first gain access to the computer system itself, whether through the data nets or an actual terminal. To break in, the character must make a Computer Programming roll at -5. If the intruder has inside information about a particular user of the system, perhaps gathered through personal contact or monitoring the net, the GM can apply an additional bonus of up to +5. Interface software bonuses may also be used. Note that a totally self-contained system (with no data net links) cannot be penetrated from the outside.

Once an intruder is accepted as a legitimate user of a system, he can try to gain access to its databases and programs. Any attempt to gain access to a secure database or program requires another Computer Programming roll, modified by interface software and the quality of any other software the intruder is using. Secure databases may have Security programs attached to them, generally with a negative modifier equal to the classification level (see above). For example, a database which requires an S3 clearance for access will have a Security program which provides a -3 modifier. The GM may allow an additional bonus of up to +5 if the intruder knows passwords or codes which give partial access.

A successful role gives access to the database or program. Databases can be read, erased, or modified (see below), and programs can be executed, or reprogrammed (with another skill roll). If the roll is missed, no access is gained, but the intruder can make another attempt at no penalty. If the roll is missed by 3 or more, the computer's defense programs (and physical alarms) are activated. Each attempt to break into a computer system or access a secure database takes one hour.

See p. 105, *Computer Intrusion and Security Programs.* ***GURPS Cyberpunk*** has a more detailed treatment of "hacking."

Database Searching

After gaining access to a database, either through proper clearance or data penetration, a character may search for information. To make a search, determine the size of the database being examined (p. S52) before rolling against the user's Computer Operations skill. Penalties are -1 for a database of up to 10 gigs, -2 for 11 to 100 gigs, -3 for 101 to 1,000 gigs and so on.

Each search attempt takes 10 minutes. If the user is unauthorized, failure by 3 or more activates the system's defense programs (if any). On a legal search, each attempt still takes 10 minutes and has the same penalties for database size. Failure means no information was found. A long enough search will find any piece of information that actually exists in the system — but of course no search will find information that doesn't exist!

Copy Protection

Most software can be copied freely with no adverse effect, but purchased software is generally configured to run on only one computer system, and rented software polls the rental node every minute to see if it should continue execution.

Purchased software which has not yet been configured can be copied and run on many different computers. The first time it runs on a computer it will configure itself.

A Computer Operation-4 or Computer Programming-2 roll is necessary to disable polling on rented software or reconfigure purchased software for a different computer. Once polling is disabled, rented software can be copied freely, but any programs valued at $20,000 or more will have built-in *defense* software which can notify the authorities across the net. Especially devious rental nodes have even put delays in their defense software to catch anyone *receiving* illegal copies.

Software

All of the software described in ***GURPS Space*** and ***GURPS Ultra-Tech*** is available in TL8 versions. TL9 versions are under development, but reportedly still have a few "bugs." Programs can be accessed or rented over the net, or they can be purchased on disk.

Disks come in two different sizes. The most common holds 10 gigabytes of data, costs $5 and is about the size of a dime. The large capacity version is about 3" across, costs $20 and holds 100 gigabytes. Any computer larger than a Personal Computer should be able to read both formats, otherwise a disk reader for either format costs $200.

A Complexity 2 program generally takes up 1 megabyte of disk space and mass storage, not including any required database. Increase this by a factor of 10 for each +1 increase in Complexity (a Complexity 4 program takes up 100 megabytes, for instance). These sizes can be important when software is being transferred over the data nets. Computer systems generally have more than enough local mass storage to run their maximum number of programs.

Interface Software

Personality Simulation: The computer can simulate emotions, quirks, etc., and use highly idiomatic speech. It can be programmed with a specific personality (even duplicating a real or fictional person) or left to develop its own. A Complexity 5 Personality Simulation gives a +1 bonus to any Computer Operation rolls it assists.

Personality Expert System: This is a special form of Expert System which has detailed knowledge used for communication with particular individuals. After 24 hours of normal conversation with a specific user, this program gives a +3 Computer Operation modifier. It builds a 100-megabyte database for each user it knows about. The basic program can handle up to 10 users, is Complexity 3, and costs $10,000. Add $2,000 to cost for each additional 10 users.

Virtual Reality Controller: This software is required to run virtual realities. Each program can handle up to 10 users in a single simulation. A program which can only play out *passive* VRs, in which the users actions have no effect on the simulation, is Complexity 3 and costs $1,000 plus $500 for each additional user. Software which can control fully interactive VRs is Complexity 4 and costs $5,000 plus $100 for each additional user.

Virtual Reality Database: Each specific VR simulation requires an extensive database of recorded sensations, images, and behavior models. They generally take up 1 gigabyte for every 12 minutes of simulation and cost $5 per gigabyte. Training VRs and those containing very recent or very valuable information can cost a great deal more. VR databases are generally copy protected.

Computer Intrusion and Security Programs

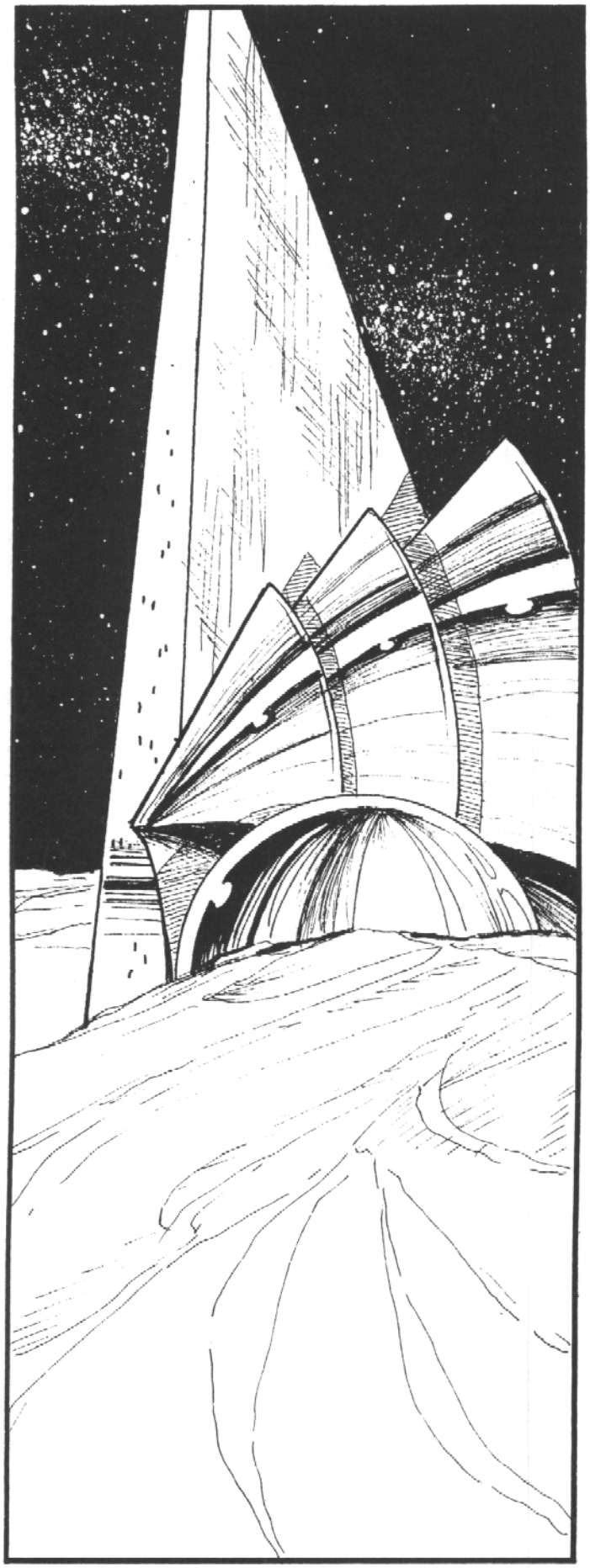
These specialized programs are used to protect against data penetration — or to facilitate it. More expensive (and complex) versions of these programs can provide higher skill levels. Each additional skill point doubles the cost and increases complexity by 1.

Worm: A worm program adds 2 to any Computer Programming roll for a data penetration attempt, or provides a skill level of 12. They are only effective against a specific "brand" of computer system or security program, and are obsolete in 1-6 months (or sooner if used extensively). Complexity 3, $1,000-$10,000. Worm programs are illegal in some areas (Legality 3).

Security: A security program is assigned to a particular program or database in a computer to protect it against unauthorized access. Any data penetration attempt is at a -2 penalty. More effective programs can be found — each additional -1 modifier doubles the cost and increases complexity by 1. Complexity 2, $10,000.

Defense: A defense program does not prevent intrusion — but if an intruder fails his skill roll by 3 or more and is detected, it goes into action. Whenever a player tries to break into a system, roll a Quick Contest of Skills between the Defense program (14) and the Computer Programming skill of the intruder. If the intruder wins, he escapes and may try to reenter the system again later. If the Defense program wins, it pinpoints the location of the intruder's terminal and alerts human authorities. The GM may want to apply modifiers to the Defense roll if the path to the intruder's terminal passes through many nodes on the data net. An *Active* Defense program may also attempt to get past security on the intruder's system (effective Computer Programming skill of 14) and insert a virus (see below). Active Defense programs are illegal *everywhere* (Legality 1). Passive Defense programs are Complexity 3 and cost $5,000. Active Defense programs are Complexity 6 and cost $250,000.

Virus: These are special programs that may be used to infect other programs or databases. If an infected program is loaded into a computer, or a virus is inserted into the system by an Active Defense program, all programs on that computer will become infected (and can pass it along if copied!) Some time after the virus has been released it activates its programming. Typical programs erase everything stored on the computer, or change random pieces of information (-4 to all skill rolls aug-



mented by the computer), or can even cause the computer to physically damage itself. $1,000, Complexity 2.

Target Virus: This virus is written to get into a specific type (brand) of computer system and change a particular program or piece of information. Otherwise it functions as a normal virus. A sophisticated Target Virus might subvert the target computer, turning it into a spy for the virus creator. $10,000 (in custom programming fees), complexity 3.

Public Domain Software

Free versions of many programs up to Complexity 3 are available on the net, and query services can usually find them. Searching takes 1d minutes, costs $2 per minute, and succeeds on a roll of 12 or less for common programs, 9 or less for uncommon programs, and 6 or less for rare programs. Data retrieval costs should also be calculated for complex programs or programs which require a large database. If a search fails, the user can wait one month and try again, or use a different query service.

Public domain programs are only TL7 and more difficult to use than commercial software (-1 on Computer Operation rolls). Improved-skill versions are not available.

Common: Accounting, Datalink, Desktop Publishing, Electronics Repair, News Demon, VR Databases (with commercials).

Uncommon: Astrogation, Damage Control, Engineering, Expert Systems (common skills), Internal Security, Personality Expert System, Security, Virtual Reality Controller.

Rare: Environmental Analysis, Expert systems (uncommon skills), Targeting, Worm, Virus.

Power

Man's technology depends on his access to electricity. Fifty-five percent of the energy used on Earth comes from fusion power plants, 30% comes from solar power and 15% from hydroclectric, geothermal and other sources.

Fossil Fuels

Fossil fuels were once a major source of pollution and, in the form of automobile fuels, the major cause of greenhouse warming. They have not been widely used for energy production since the middle of the last century, and are now only used to produce synthetic materials. Coal is mined in the United States, Canada, and the Soviet Union, and low-grade oil is produced by genetically engineered algae, or "petro-bugs," in huge areas of ocean sectioned off by floating retaining walls.

Fission

Large-scale nuclear fission plants were abandoned even earlier than fossil fuels because of the potential for dangerous accidents and lack of effective waste disposal procedures. Some spacecraft which require less than 10 megawatts of power still use fission reactors and will continue to do so until a smaller fusion plant is developed.

Fusion

Power plants which fuse hydrogen into helium to generate energy are easy to fuel and relatively clean. A large, 10-GW plant needs to fuse just 10 pounds of deuterium per day, which it obtains by filtering 200 tons of seawater. Fusion of two deuterium isotopes produces a stable helium isotope and mildly

radioactive tritium, which is stored safely in metal drums until it also decays to helium (80-100 years).

Fusion is the major source of energy in most of the developed world. The capital investment required to build a fusion plant in the early 21st century made the solar power supplied by Terradyne more attractive to developing nations. But today, a 1-gigawatt facility would cost these nations less than 200 million Standards and pay for itself in less than two years. Terradyne's solar power is no longer quite as attractive.

Solar Power

The direct energy of the sun is used very effectively on a small scale all around the solar system, and on a very large scale in Terradyne's Solar Power Satellites (SPSs). On Earth, many buildings are roofed with photoelectric materials. Living facilities in the colonies are also powered by solar panels and manufacturing furnaces are heated by solar reflectors. Efficient energy storage, in the form of superconductors and photonic loops, has also made some forms of solar powered transport practical.

There are 60 Solar Power Satellites in geosynchronous orbit around Earth. Each is 10,000 feet wide and 20 miles long, generating 40 gigawatts of power. The energy from each SPS is beamed as microwaves to a 5-mile-wide wire mesh suspended a few hundred feet above the Earth's surface. Very little of the energy gets through the mesh, so the area beneath it is safe for farming.

Developing nations have begun to switch to fusion power, and demand for energy from the SPSs has leveled off and begun to decline. Terradyne has lowered its rates, but fusion power will probably win out because it offers these nations energy independence. The SPSs gave Terradyne the capital it needed to gain the technology lead it now holds, but their usefulness to Earth is waning and they may soon be dismantled and moved to L4 or L5 to power the colonies there.

Energy Storage and Transmission

Storage Loops

Advances in high-temperature superconductor electronics and photonic loop technology have made long-term, efficient storage of energy possible, and most distribution systems are virtually lossless. All the energy an average household needs for a month can be stored in a device the size of a kitchen cabinet.

These storage devices are usually kept away from living areas, because they can be very dangerous. If a storage loop (superconducting or photonic) should be damaged in any way, it could release all of its energy in a large explosion. Even a tiny fracture would disrupt the flow and generate enough heat to trigger the explosion within seconds.

Storage loops are generally encased in solid aluminum or some other non-ferrous substance, and have DR 10 and 120 hit points. If this shielding is penetrated, treat the resulting explosion as a fragmentation grenade, doing 2 dice of concussion damage and 3 dice of fragmentation damage for every megawatt-hour currently stored (see pp. B121-122).

Hydrogel Fuel Cells

Because of the potential for explosion, storage loops are not practical for use in many applications. One alternative is the hydrogen fuel cell. Electrical energy is used to produce hydrogen from water. The hydrogen is then stored in a jelly-like form called *hydrogel*, inside a honeycombed tank, so it won't explode if the tank is ruptured. In oxygen-poor environments (anywhere but Earth), the oxygen is also saved, in liquid form. One megawatt-hour of energy can be generated from 90 lbs. (1 cubic yard) of hydrogen jelly, plus 720 pounds (0.3 cubic yards) of liquid oxygen. The entire process, including separation of the hydrogen and combustion to generate electrical or photonic power, is 90% efficient.

Power Transmission

Energy is generally transmitted over superconducting electrical wires or photonic cables. Both use "circuits" from the power source to the energy consumer and back, but there are important differences.

When the photonic energy is not being used, the circuit is closed so unused photons can flow back to the source and be redistributed. To use the photonic energy, the circuit must be broken and the photons intercepted. This is the exact reverse of an electronic circuit, which must be closed to deliver electricity.

This means an accidental "short," which is a dangerous occurrence in electrical circuits, is harmless in photonic circuits. And an open circuit, which is harmless in an electrical circuit, can release dangerous amounts of energy in a photonic system.

Environmental Engineering

Computers and space-based observation platforms have enabled scientist and engineers to model, predict, and even alter environmental processes. Systems ecologists create complex computer models of a planet's meteorological, geological and biological systems. These are refined through constant observation and controlled testing. The result is a better understanding of the environment and a model which can be used to predict and manage environmental crises and evaluate large environmental engineering projects.

Observers on orbital earth monitoring stations collect data on environmental trends world-wide, while field workers go to important sites to get detailed information. Controlled testing fills in the gaps and confirms or discredits questionable theories. Environmental models of Earth have also benefited from some of the very basic meteorologic and geological discoveries being made in the giant laboratory of Mars.

This knowledge about the environment is used to predict (and control) natural disasters, study the effects of introducing genetically altered life forms and monitor species diversity and demography. It also helps engineers reverse the harmful effects man has had on environmental systems — problems such as global warming, water depletion, ozone destruction, endangered species and the destruction of rain forests and the continental shelves.

Martian planetary engineers use a very similar model refinement approach to understanding their environment, but their models must account for more and different geological effects, as well as the meteorological effects of a single Hadley cell (see p. 70) and a very dry southern hemisphere.

Manufacturing

Factories of the 22nd century are completely automated. The designs for a product are fed into a manufacturing computer which controls the machinery and robots which do the physical work. Most factories can be categorized as *material shops*, which specialize in forging parts out of a small set of materials, or *assembly shops*, which combine the parts to form products.

Material Shops

Material shops create complex parts with extreme precision through a combination of molding, forging and cutting with lasers. The process is so flexible that a factory producing hundreds of different parts can be instructed to make an entirely different set of parts, and the transition takes only minutes. These are generally large operations, with huge stockpiles of raw materials and fusion reactors to power the machines and fire the furnaces.

Assembly Shops

Assembly shops take designs for products, pass on the plans for any non-standard parts to a material shop, and put the items together. General purpose shops are only limited by availability of plans and the maximum product size and weight they can handle. Note that factories are rated by maximum product *weight*, not mass, so they can be much more effective in low or zero gravity. The largest general purpose factories are rated at about 5 tons and 25 cubic yards. Larger shops generally specialize in one class of products. (See ***GURPS Ultra-Tech***, p. 83, *Robofacs, Minifacs.*)

Assembly shops are expensive to operate. Even a small general-purpose shop (rated for 1 ton, 10 cy) with a handful of robots can cost $1,000,000 to build and $10,000 or more per month for power and maintenance.

Designs

Designs — full instructions for a computer factory — can be developed by an Engineering expert system, or by an engineer with access to Engineering software. They are also available on the net at the cost of a standard text database, but those of TL7 or above require the manufacturer to pay royalties on each item produced. This is usually about 5% of the price of the product for TL7 items and 20% for TL8 items.

The designs for small, simple devices like recorders or radios use mostly standard parts and take up only 10 megabytes. Designs for simple vehicles, weapons, and complex electronic devices take up 100 megabytes. The design of an Earth shuttle or OTV can take up 100 *gigabytes*.

Lunar Industry

Most of the raw materials processed on the moon come from its upper layer of dusty rock, or *regolith*. Areas of the Lunar surface have been set aside for "strip mining" by huge mobile processing plants. These plants creep along at about 1 foot per minute, scooping out a trench 15 yards wide and 3 yards deep. The rocky soil is crushed, mixed with hydrogen, and heated by a small fusion torch to release oxygen and aluminum. The powdered regolith is dumped back into the trench behind the factory, and the hydrogen is recovered by electrolysis. Each factory can process 35,000 tons of soil per day, producing 500-1,000 tons of liquid oxygen and 200-300 tons of aluminum.

Each oxygen field has up to ten of these factories plus a dozen or more tracked oxygen tankers which provide transport to a nearby maglev terminal. Each mobile factory is powered by a fusion reactor which also recharges fuel cells in the transports while the oxygen is being loaded. The oxygen extraction process frees trace amounts of hydrogen — about .5 tons per day, which is enough to fuel the fusion reactor, but not enough to make up for hydrogen lost during processing. Each factory "burns up" about 2 tons of hydrogen per day, which must be imported from Mars at $2,700 a ton!

Besides oxygen and aluminum, the regolith contains high concentrations of silicon. Like the mobile factories, stationary processing plants a few kilometers from Luna City crush the rocky soil and remove as much aluminum and oxygen as possible. The remaining powder is melted by a fusion torch or solar furnace to form molten silicon, from which pure silicon crystals are slowly extruded. These crystals are heated again in the lunar vacuum to remove any trace volatiles and formed into silicon wafers. In the clean environment of the lunar surface, they can be used to produce microchips ten times smaller and ten times as powerful as those produced on Earth.

Raw Lunar soil is also a versatile construction material. The domes of Luna City are made of indigenous concrete with an aluminum frame and covered with 30 feet of loose soil to protect against solar flares. The glass observation domes are evacuated during flares, but this is usually an unnecessary precaution — the glass, also made directly from the soil, is over 8 feet thick. Many lunar furnishings and internal structures are also made of a darker (obsidian) version of this glass.

Clean Factories

Many of the factories on the moon are open to the lunar vacuum, far away from the nearest settlement, and seldom visited by humans. The vacuum actually helps draw impurities out of metals. Factories are almost completely automated, but a few jobs are done by remote operators in a nearby settlement. Humans visit the factories as little as possible; the respirator waste of a single visitor and the dust he kicks up can destroy weeks of production.

Orbital Industry

Factories in the zero-G environment of Earth orbit produce many materials which are difficult to produce on the Moon, and nearly impossible on Mars and Earth. Most of this production takes place in the cluster of space stations at the Earth-Moon L4 point. L4 produces the highest temperature superconductors, grows perfect crystals for a variety of uses, and mixes precision alloys 20 times stronger than Earth-forged titanium. L4 gets most of the raw materials for its factories from the Moon — it is the capture and distribution point for materials launched by the Lunar mass driver. It also receives a relatively small, yet vital supply of heavy elements from Earth.

Orbiting factories also build space ships and space stations which are not designed to land on a planet's surface. Because of its special relationship with the moon, L4 turns out to be the most efficient place to do this. Its shipyards are impressive — a huge superstructure of aluminum beams and cables restraining the lifeless hulls of dozens of new OTVs, sailships and security cruisers.

Martian Industry

The colonists of Mars split their attention between an industry which is possibly the simplest in the solar system, and another which is definitely the most complex. The former is the production of hydrogen through electrolysis; the latter, the transformation of an entire lifeless planet into a lush world of oceans, rivers and forests, hospitable to human life.

While Terradyne colonists on the Moon and in Earth orbit try desperately to conserve every precious molecule of hydrogen, Martian colonists live at the edge of one of the largest hydrogen sources in the inner system — their great northern ocean. Electrolysis plants line the coasts near the largest of the domed settlements, separating hydrogen and oxygen using the power from huge fusion reactors. Some of both elements are kept to fuel spacecraft and replenish life support systems in the domes, but

the majority of the hydrogen (thousands of tons per day) is shipped into orbit on jet shuttles. The remaining oxygen is just released into the atmosphere. Because of the low gravity of Mars and the efficiency of the jet shuttle, Martian hydrogen costs less than half as much to ship to the Lunar surface as Earth hydrogen. There is no such market for the oxygen, which can be produced at much less cost from the Lunar soil — and in any case, it's necessary for the terraforming of Mars!

Heavy Elements

Terradyne is still dependent on Earth for most of the heavy elements it needs for production processes and life support, which neither Mars nor the Moon can supply. Mars was formed farther out in the Solar System, where the heavier elements are scarce. The Earth and Moon formed from a common pool of materials (binary accretion), but like a mini-Solar System, the heavier elements congealed in the central body — Earth. It is also significant that neither Mars nor the Moon has the geological history of surface water activity which has concentrated heavy elements on Earth into easily accessible veins.

Heavy elements are required for a variety of applications. To produce its aluminum alloys, Terradyne must import large amounts of copper, manganese and zinc, as well as smaller amounts of nickel, iron and titanium. Cadmium and mercury are used in some types of sensors and as propulsion mass for ion drives. Most important, however, are the heavy elements needed to set up and maintain enclosed life support systems — the calcium, iron, potassium, manganese, nickel, zinc, molybdenum and iodine needed to sustain life.

Throughout Terradyne's history, these elements have come up from Earth. Certainly Terradyne would like to find new sources for these elements; at present, a complete break with Earth would mean that production of the strongest, most heat-resistant alloys would stop and colonists would suffer from chemical deficiencies.

Some relief has come from an occasional heavy asteroid, but current company officials believe the long-term solution lies on Mercury. The average density of the innermost planet is similar to Earth's, but it contains a much higher *concentration* of heavy elements — they just haven't been compressed as much by gravity. Studies by the System Survey unit and pilot mining operations seem to indicate that Mercury could meet all of the colonies' heavy element needs.

Security Equipment

The best modern security systems are nearly impregnable, but they are also very inconvenient for authorized personnel. A technology firm might keep intruders out of secure areas by using scanners, but legitimate workers would also be held up waiting in line to be scanned every time they entered. Most systems are a compromise between security and ease of use.

Often, the simplest method of fooling an electronic security system is to convince the human component of the system that the electronic element is malfunctioning. After several false alarms, a human operator or AI-controller may ignore input from a sensor or just turn it off.

Security Camera

A simple closed-circuit video camera, connected to a monitor, is one of the best security systems available. Constant monitoring by a human being or a computer running Optical Recognition software is required. Computer-controlled systems which have to distinguish between authorized and unauthorized users by sight may also require software for friend-or-foe identification (Complexity 4, $35,000) similar to that provided by the Gunner program. It is lighter then the standard digital camera, but produces lower quality images. Cost is $150 and weight is ½ pound.

Locks

Secure areas can be protected from unauthorized personnel by controlling all entry points with electronic locks or scanlocks. The most sophisticated locks can provide nearly foolproof identification.

One way to gain entry is to convince an authorized user that you are authorized too and just follow them through. "Damn! I hardly ever need to get in here, and I can never remember the combination!" Another way is to somehow tap into the controlling security computer and add yourself to the authorized user

list. More extreme measures, like cosmetic surgery, can also be used.

Electronic Locks

Electronic locks use a numeric keypad for combination entry, or a small electronic key containing the encoded combination. Invalid entries may not trigger an alarm immediately — even authorized personnel will occasionally push the wrong button or use the wrong key, so a "second chance" may be allowed. Runs on building power or one year on an A cell. Weighs ½ pound and costs $100 for the keypad model and $200 for the encoded key model (-2 on Lockpicking rolls). Picking an electronic lock requires at least an electronic mini-tool kit or an electronic lockpick (see p. S46).

Scanlocks

For highly secure areas, identity-scanner locks, which can't be picked, may be used instead of standard electronic locks. All scanlocks require a datalinked computer running Internal Security software. Identity verification takes 3 seconds. Access is denied if the scanned individual is not a legitimate user. The controlling computer may also sound an alarm or engage automatic defenses. Databases containing scanned patterns of authorized users will generally be encoded and well protected by security software — to prevent unauthorized access and protect the privacy of legitimate users.

Scanlocks run for a year on a B cell or indefinitely on building power. The following types of identity scanners are available:

Voice-Print Analyzer: Checks the subject's voice pattern. The scanner asks the subject to state his name and/or ID number, then matches the voice against a stored pattern. Verification may fail for legitimate users who have an illness or injury affecting their voice. Standard recordings are not good enough to fool this analyzer, but high quality recorder/playback systems, which weigh 20 pounds and cost $1,200, will fool the system on a 12 or less. Cost is $100; weight is ½ pound.

Palm Scanner: Checks the user's palm print. The subject's palm is placed against a flat plate, and the print is checked against those in the authorized user database. Can be fooled through cosmetic surgery on a 12 or less. Cost is $200 and weight is 1 pound.

Retina Scanner: Scans the vein pattern in one or both of the subject's eyes. The subject must look directly at the laser scanner. Cost is $500; weight is 2 pounds.

Investigation/Surveillance Equipment

A modern investigator can find out almost everything about another person by accessing data stored on computers and using the right surveillance equipment. This could eventually cause a complete loss of personal privacy and is the main reason modern Privacy Law exists (see pp. 39-40). While it is difficult to regulate the equipment needed for computer hacking, it is possible to control the physical devices required for surveillance, so many of those listed below have low Legality Class numbers.

Comm Tap: This device taps into any optical or electronic cable line — including the world-wide data net. It is a 100-yard-long hair-thin optical cable ending in a clip. The cable is connected to and stored inside a briefcase-sized unit which includes both a video monitor and recorder (for voice or video) that uses standard computer media. The case also contains a standard jack for connecting to a computer to monitor network traffic. An Electronics Operation (Communication) roll is required to succeed without damaging the line being tapped (roll at -3 when tapping optical cable). Comm taps use A cells and cost $3,000. Weight is 4 pounds.

Chemsniffer (TL8): This is a hand-held scanner dedicated to finding contraband by analyzing chemical traces in the air. It has a range of five yards and can detect many different forms of narcotics and explosives. An Electronics Operation (Security) roll is required to operate. It works six months on a B cell. Cost is $700; weight is 2 pounds.

Criminology Kit (TL8): This is a portable forensics lab with a dedicated computer capable of detection and chemical analysis of physical evidence. In addition to ballistics, fingerprinting and voice pattern analysis, the lab is capable of identifying and classifying hair, flesh scrapings and blood samples. It is normally linked through local net access to a central database containing data on known criminals. This kit adds +3 to any forensics skill roll, and includes an Expert System program with skill 10 in Forensics. It runs on a B cell for six months, costs $3,000 and weighs six pounds.

Laser Listening Device (TL8): This device bounces a laser off of a solid surface, detecting and reproducing the vibrations set up in that surface by nearby voices or other sounds. It can be used through a window and can be linked to a recorder or computer. One C cell gives eight hours of surveillance. Cost is $1,200; weight is 12 pounds.

Lie Detector (TL8): This item uses bioscanner technology to monitor the subject's body functions and determine when he may be deliberately lying. Range is five yards. Gives +4 to Detect Lies skill or a base skill level of 12. A simpler version, which only analyzes the subject's voice patterns (live or recorded), gives only a +2 bonus and has a base skill of 10. The standard lie detector runs on a B cell for two months, costs $1,200 and weighs 2 pounds. Voice lie detectors costs $400, weighs 1 pound and runs on a B cell for a full year.

Military

The armies of the 22nd century tend to be smaller, but better equipped, than those of the 20th and 21st. The lone combat soldier is still the most vital asset in any territorial conflict or limited raid. Technology has not decreased his role — in fact, it's made him more important. A single soldier can easily carry surveillance equipment and weapons powerful enough to find and destroy a heavily-armored vehicle.

Weapons

Assume that any weapon of TL8 or lower in ***GURPS Space***, ***GURPS Ultra-Tech*** or ***GURPS High-Tech*** is available to military and private mercenary groups. TL5 and lower weapons may take time to order, though some outfits carry them routinely; the United States Marines include sabers in their battle dress, for instance, and most services issue knives to their members.

Personal Weapons

Anywhere but on Earth and the independent settlements of Mars, slugthrowers of any kind are Legality Class 0. The reason for this is simple: a slugthrower can put a hole in the dome and let the air out! Outside the domes on Mars, slugthrowers, modified to operate in the Martian atmosphere, are the weapon of preference. They're cheap, easy to carry and don't need to be recharged.

In the colonies, laser pistols are the weapon of preference, for civilians as well as military. Gauss needlers, tanglers and grenades are only available to soldiers.

Personal Armor

Kevlar and Monocrys (see pp. S61-62) are the main forms of personal armor in use, both by law enforcement personnel and the military. Kevlar is used in low-tech or poor nations, and as a less expensive armor for very large armies. Monocrys is used by law enforcement agencies and elite military units of the wealthier nations and Terradyne. Both types of armor are commonly covered with a coating of reflec.

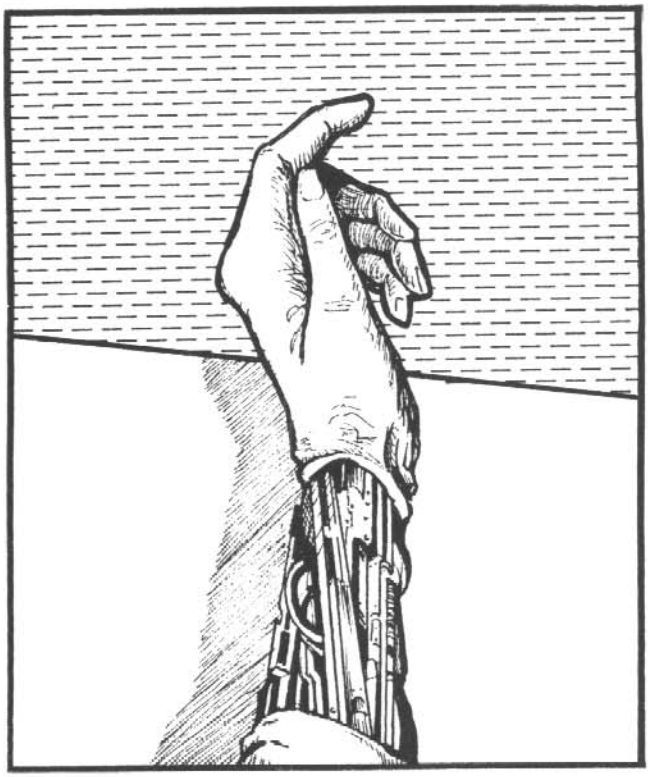
Medicine

Overall, medical technology has reached TL8, but some medical facilities in the poorer areas of Earth are barely TL5. Most TL8 medicine and medical equipment listed in ***GURPS Space*** and ***GURPS Ultra-Tech*** is available. Braintaping technology does *not* exist yet, which makes "quick" cloning impossible.

Drugs

The following drugs are available, as described in ***GURPS Space*** (pp. 67-69): Adders, Antirad, Genericillin, Hypercoagulin, Revive Capsules, Superstim and Suspend. Drugs which are absolutely necessary for a patient's survival are usually provided free of charge under national health care plans or corporate medical benefits, but there may be a limit on how much they will pay.

Another drug, *Ursaline*, prevents atrophy of bone tissue (*osteoporosis*) and muscles in low gravity. It is named for the place it was originally discovered — in the blood of hibernating bears. Anyone living in environment of .2 G or less must have a constant supply of this drug and do one hour of exercises every day. If the drug is not used, a HT roll must be made every 2 weeks to avoid permanent loss of a point of ST. The maximum ST which can be lost due to atrophy is 1 point for every .1 G difference between the low-gravity environment and the character's home gravity, but ST will never drop to zero. A character may regain these points normally, by spending additional time exercising or possibly by ultra-tech surgical operations. Comes as a skin patch which lasts 2 weeks. Cost is $50/dose.



Medical Care

Medical care is provided by a variety of hospitals and small clinics. Hospital stays are only necessary for incapacitating injuries or diseases which require constant attention. Most conditions can be treated in a few hours or less.

The equipment and training of most doctors is TL8, which allows a doctor to make two healing rolls a day for each patient and handle up to 50 patients.

Medical Care Quality and Cost

Most nations on Earth have national health care programs. Corporate employees also benefit from comprehensive health benefits. This doesn't mean medical care is free, however; these plans only cover injuries and illnesses, so they cannot be used for cosmetic or elective surgery. It may also be necessary to find an underground doctor and pay for treatment of injuries which may appear suspicious to the government or corporation. Privacy laws don't stop a government doctor from reporting a bullet wound to the authorities.

In theory, national and corporate health care plans provide equal care to all eligible members, but in practice the best care goes to those with money and prestige. The skill of the physician provided under these plans is 12 plus the character's Status rating. If characters attempt to bribe officials to get a better doctor, it will cost them about $100 per day for each additional point of skill.

If a character *has* to, or simply *wants* to, pay for medical care, the GM should use the guidelines in ***GURPS Space***, p. 64.

Aging

At TL8, aging rolls are made yearly, beginning at age 70 (see p. B83). Frequency changes to every 6 months at age 90 and every 3 months at age 110.

There is quite a difference between the expected life span of a worker in a remote Chinese factory and a colonist in the controlled environment of Luna City. Tech level has a large impact on life span, but so does the availability of anti-agathic drugs. The standard anti-agathic give a +2 bonus on all aging rolls, but the extremely good health and youthful appearance of Jodo San and a number of other top Terradyne executives has sparked rumors of an even more effective anti-agathic.

Bionics

Missing limbs, as well as some organs, can be replaced with mechanical ones in most Earth hospitals and all large Terradyne settlements in the colonies (see p. S67).

Non-standard bionics which give more than the basic bonuses are only available at medical facilities which have a human or expert system specializing in that particular type of replacement. For example, a standard +1 DX hand can be installed in most hospitals, but a +2 or better hand requires a specialist. A large medical facility will have a given specialist on a roll of (Tech Level) or less on three dice. Very large hospitals get a +2 bonus; small hospitals get a -2 penalty. Also see ***GURPS Cyberpunk***, pp. 29-38.

Cosmetic Surgery

Anyone can improve or change their appearance through cosmetic surgery. These techniques have long been used to reconstruct damaged tissue and improve appearance, but modern medicine enables the cosmetic surgeon to totally rework a patient's looks. The character must pay point costs for any improvement in appearance due to surgery.

Reconstruction: Patients who have had severe tissue damage, especially on the head and neck, will have reconstructive surgery as part of their basic treatment. Severed or permanently crippled limbs are not reconstructed, but can be replaced with bionics. Modern reconstructive surgery is very good; a successful roll brings the patient's appearance to within one level of its original value. Cost is included in daily medical costs (p. B64). Reconstruction can be done on an outpatient basis.

Patients who heal naturally, with no help, may suffer permanent damage to their appearance (GM's discretion).

Appearance: Improving appearance without changing basic features takes two weeks and costs $1,000 to be Attractive, or two weeks and $5,000 to be Beautiful (-1 to Surgery roll), or three weeks and $25,000 to be Very Beautiful (-3 to Surgery roll). Appearance can be *reduced* to any level for $500. Character points should also be paid for improvement or removal of any limiting disadvantages, like *Skinny*.

General Disguise: A minor change to features, requiring casual acquaintances to make an IQ roll to recognize the subject, costs $500 and takes one week. A change that makes the subject unrecognizable costs $5,000 and takes two weeks. A change from one sex to another takes one month and costs $30,000 — reproduction is impossible.

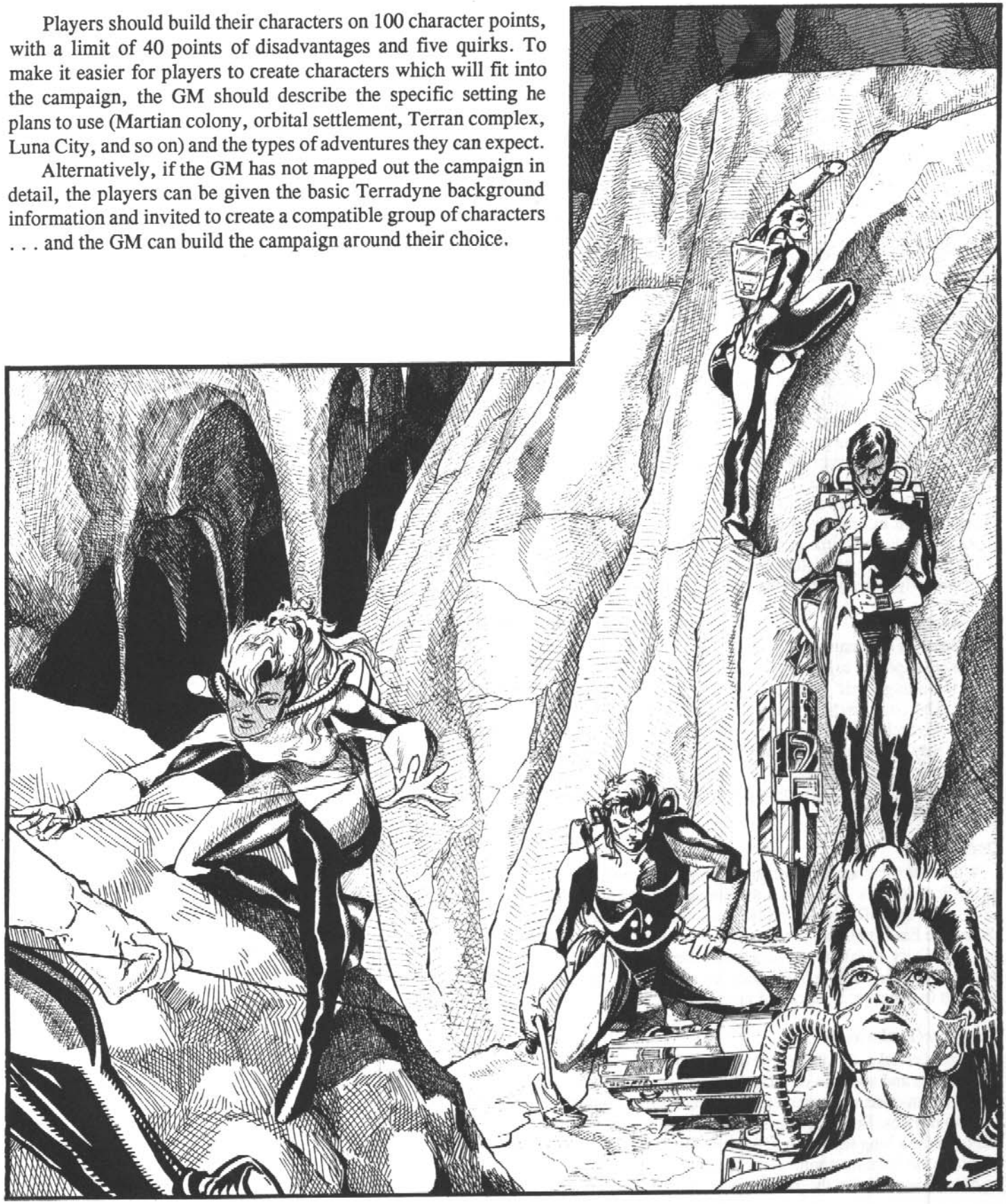
Specific Disguise: A cosmetic surgeon can even change one person's features into an accurate copy of another's. This requires a roll versus Surgery-4, unless the surgeon *specializes* (see p. B43) in cosmetic surgery, which makes this a straight roll against Surgery skill. The operation takes three weeks and costs $25,000. Treat this as a disguise (p. B65), but use the *surgeon's* skill in contests of skill. Note that Acting skill will still be needed to pass successfully as another person.

Normal cosmetic surgery does not affect unique personal features, like voice-prints or palm prints. But some illegal clinics (and most espionage groups) can even change these. A palm print can be cloned from a small tissue sample and grafted to someone else's hand; this takes six weeks and costs $10,000 per hand.

CHARACTERS 8

Players should build their characters on 100 character points, with a limit of 40 points of disadvantages and five quirks. To make it easier for players to create characters which will fit into the campaign, the GM should describe the specific setting he plans to use (Martian colony, orbital settlement, Terran complex, Luna City, and so on) and the types of adventures they can expect.

Alternatively, if the GM has not mapped out the campaign in detail, the players can be given the basic Terradyne background information and invited to create a compatible group of characters . . . and the GM can build the campaign around their choice.



Academician

Some university professors and students are involved in the latest research in areas like anti-agathics, maneuver drives or weapon technology. Others study human society and psychology, taking sabbaticals to travel throughout the Earth and the colonies, observing people firsthand. University populations are also sources of rebellion and civil unrest in many parts of the world. Many academicians are members of activist groups like the Red Planet Brigade and Academy of Earth Scientists.

Colonist

Anyone living in an extraterrestrial settlement could be considered a colonist. Some live there because Terradyne has the best jobs. Some were born there and know nothing else. Still others have lived so long in the low gravity that they physically cannot return to Earth. The true colonists, however, are those who are there to push back the frontiers. They *want* to be in space, so they get the education they need to qualify, they pay their own way with their life savings, or they sign on for two hard years with a road gang on Mars. A good HT score and an understanding of survival technology are essential.

Computer Scientist

Information is the most valuable commodity in the solar system, and most of it is stored in computers. So computer specialists are in high demand, especially those who understand the details of the latest security systems. These "hackers" are used heavily, both offensively and defensively, by intelligence agencies like UPOE's RMA, Terradyne's Corporate Research, and the U.S. CIB. But they are also important to other organizations which rely on information, such as law enforcement agencies, large corporations, crime syndicates, and news services. Many of the best security specialists realize their own value and work independently, hiring themselves out for one job at a time.

Corporates

Executives and managers in many large, international corporations are expected to be loyal to their company over everything else, including their family, their country, and their home world. The company's prestige and profits are all-important. Clever research and last minute, giga-standard wheeling and dealing may become a matter of life and death for the company *and* the character. Members of the Japanese *zaibatsu* are model corporates. Administration and other social skills are helpful, as is a loyal staff.

Doctor

Wherever there are large enough groups of people there will be medical doctors. Even the most remote settlements on Earth are visited by MDs occasionally. And there are many living aboard the Earth stations, in the colonies on Mars and the Moon, and at military installations throughout the solar system. Some practice forensic medicine as coroners, and others do medical research in genetics, bionics and new drugs.

Engineer/Technician

Engineers take the theory developed by scientists in their laboratories and use it to develop designs for real, working devices. Technicians understand the construction and operation of existing devices. Both engineers and technicians must specialize and train for a long time to be effective. They might operate and maintain sea farming equipment, become free-fall technicians, or be responsible for the life support systems aboard a large space ship. Technicians have the Mechanic skill in their specialty areas.

Entertainer/Celebrity

As communication technology improves, media celebrities become more influential. Celebrities generally have wealth and some amount of influence in high places. On the other hand, they are hounded by the media and will have little privacy. Artistic skills such as Acting, Singing and Writing are often prerequisites for fame, but charismatic religious leaders and politicians also qualify. Disguise skill may come in handy.

Environmentalist

Environmentalists range from the scientist who works late in a laboratory to test the effects of a new insecticide to the activist eco-guerrilla who stalks through the Amazon jungle to blow up a half-constructed dam. Some are agents of UPOE's Department of Environmental Sciences or scientists working for Terradyne's Environmental Research unit. Others belong to the Red Planet Brigade, dedicated to stopping the terraforming of Mars, even if they must resort to violence.

Free Trader

These are merchants and space ship pilots who make trade runs, mostly along the legs between Earth and the colonies. They are not affiliated with UPOE, Terradyne, or any other large organization. Most free traders are members of the Free Trade League, a cross between a guild and a credit union. They spend a lot of time hanging around spaceports and orbital stations waiting for cargo; Gambling is a common skill.

Gang Member

Many of Earth's young, aspiring criminals are too independent or too impatient to work their way into a syndicate, so they join with other kindred souls to form gangs. Gang members broadcast their gang affiliation with some special signal; the way they walk, the color of their clothes, perhaps their haircut. Gangs which are very successful in the crime business or control a key territory may be "adopted" by a local syndicate or become syndicates themselves.

Intelligence Agent

This includes intelligence analysts, cryptographers, undercover spies, and covert operatives. The most visible intelligence agencies are the U.S. CIB, UPOE's RMA, and Terradyne's Corporate Research unit, but most national governments and large corporations employ a group of intelligence agents. Thief/Spy skills are important, as are Acting and a cover skill.

Investigator

Trained investigators work as detectives for law enforcement agencies, or independently as private investigators. Detectives generally deal with mysteries involving criminal activity, while private investigators follow unfaithful spouses, search for missing persons or items, expose fraud and catch petty thieves. Investigators need Interrogation, Stealth and Streetwise, as well as a good understanding of local privacy laws.

Journalist

Reporters and photojournalists (see p. 26) are always where the action is. They travel extensively to document the news. Writing, Bard and Photography are valuable skills. Many jour-

nalists also have implant computers or communicators to give them immediate access to the data nets.

Law Enforcement/Security

Every Earth nation has its local police officers, and the colonies have the Corporate Security Forces, the Colonial Militia (on Mars) and the generally disdained ISF. Each patrols within established jurisdictions, stopping crimes and arresting criminals. This class of character could also include Interplanetary Trade Commission inspectors and some of the more overt employees of the Regulatory Monitoring Agency. A typical patrol officer will have Legal Enforcement Powers, Sense of Duty, Law, Unarmed Combat and a weapon skill.

Lawyer

Lawyers do not just represent clients in court. They often investigate their own cases, sometimes discovering evidence and witnesses the police missed. Some lawyers are consultants for corporations, helping them to work within the law in other words, exploiting loopholes. Others help politicians draft new laws. Characters with a low Law skill might be legal assistants or researchers.

Lobbyist

A lobbyist for a big corporation — *especially* Terradyne — may be much more than a glad-hander. A really successful lobbyist must be able to investigate, bribe, blackmail, coerce and threaten . . . and somehow stay friends with the people he's using. See p. 22. Lobbyists make good player characters, but they are also excellent NPCs, as Patron, Contact or Enemy. But with a lobbyist, your Patron may not be your friend, and an Enemy may not always work against you . . .

Mercenary/Paramilitary

Mercenary units (see p. 28) carry out missions ranging from theft to assassinations to sabotage. Some groups sell their services to the highest bidder, and some are loyal to a particular group as long as they continue to receive their pay. Some work for drug lords and camp out every night in jungles; others live normal lives with steady jobs and comfortable homes, possibly hiding their occasional mercenary activities from friends and family. Thief/Spy skills, Tactics and weapon skills are important. Mercenaries are likely to have Enemies. Part-time mercenaries with normal lives may consider this a Secret Identity.

Researcher/Scientist

These are the ones who do the basic research which leads to a better understanding of the world. Most of this is aimed at developing new technology: new power sources, drugs, weapons, cell grafts, computers and software. Many leading technology researchers work for Terradyne's Basic Research unit or at Lunar University. But there is growing competition from Earth-based universities and corporations, and from members of the Academy of Earth Scientists.

Privateer/Black Marketeers

Privateers deliver illicit merchandise such as drugs, weapons, technology, software and databases to black marketeers. Some privateers are only part-time smugglers, making legitimate runs until a good smuggling opportunity presents itself. Black marketeers sell the smuggled items or act as middlemen and money launderers in ports and on the Earth stations. Some use legitimate businesses as fronts; others work from remote locations where law enforcement is unreliable. Privateers should have Piloting, Computer Operation and any other skills necessary for spacecraft operation. Black Marketeers should have Merchant and Streetwise skills.

Soldier

Armed services are maintained by UPOE and many nations on Earth. Their members range from the grunt who signed on with very little education to the officer who graduated from a military academy with an advanced degree in military history. The armies of northern India have seen action recently, and there are always a few small nations around the world who are ruled by the military or on the verge of a military coup attempt. Soldiers should have weapons, unarmed combat and Survival skills; the Military Rank advantage is useful.

Spacecraft Crew

Modern spacecraft crew must have many different skills, including Pilot, Computer Programming and Mechanic (life support, power systems, drive systems, etc.). Most of the routine work is done by the on-board computers, so the human crew is only needed to make general decisions and fix things when they break. Terradyne's main fleet, System Survey and Resource Development units, UPOE's diplomatic fleet and the members of the Free Space program are all in constant need of skilled crews.

Stockholder

Larger stockholders of major corporations, especially Terradyne, are the idle rich of the 22nd century. They travel around the world or even the colonies. Terradyne stockholders living on Earth may want to make their investments a Secret disadvantage. The value of stock owned should be reflected in the character's Wealth advantage. See p. 23.

Syndicate Criminal

The job of a syndicate criminal (see p. 29) may resemble that of a corporate executive more than the independent criminal surviving on the street. Syndicates are usually run like corporations and may have legitimate businesses as fronts. Low-ranking syndicate members might act as couriers or be assigned to spy on rival mobs. Members who have demonstrated their loyalty may be assigned to guard a key syndicate figure, harass uncooperative locals, bribe police or make important hits. High-ranking mobsters will find themselves shuffling papers and sitting in meetings most of the time.

Physical Appearance

Players must decide on their character's appearance as described on p. B15, But in the 22nd century this choice is by no means permanent. Cosmetic surgeons (see p. 112) can make a character look better, worse, *different* or like someone else.

Where the character grew up will affect his overall appearance. The average child raised in the low gravity of the Moon or Earth stations grows taller and is thinner than the average Earth child. Moonbabies (see p. 118) are an extreme case. For all other characters, the growth differences are reflected in the Low-G Height/Weight Table (Moon and Earth stations) and the Martian Height/Weight Table.

Low-G Height/Weight Table

ST	*Height*	*Weight*
5 or below	5'9"	130 lbs.
6	6 feet	140 lbs.
7	6'2"	145 lbs.
8	6'4"	150 lbs.
9	6'6"	155 lbs.
10	6'8"	160 lbs.
11	6'10"	165 lbs.
12	7 feet	170 lbs.
13	7'2"	180
14	7'4"	195
15	7'5"	210
16 or more	7'6"	230

For each inch of height over 7'6", add 15 lbs. to average weight.

Martian Height/Weight Table

ST	*Height*	*Weight*
5 or below	5'6"	130 lbs.
6	5'7"	135 lbs.
7	5'8"	140 lbs.
8	5'10"	145 lbs.
9	6 feet	150 lbs.
10	6'1"	155 lbs.
11	6'2"	160 lbs.
12	6'3"	165 lbs.
13	6'4"	175 lbs.
14	6'5"	185 lbs.
15	6'6"	195 lbs.
16 or more	6'7"	205 lbs.

For each inch of height over 6'7", add 10 lbs. to average weight.

Languages

As the world media and global marketing move the world toward one large, homogenized society, most Earth nations maintain their cultural heritage by using their traditional languages. This does not create the communication problems it once did, thanks to modern *interpreter* software.

Some international standards exist; technical papers are usually written in English, French or Russian, and literature intended for worldwide audiences is typically written in English or Spanish.

The primary languages in the Terradyne colonies are, not surprisingly, English and Japanese. *Janglish*, a hybrid of the two, has grown up in the chambers of Luna City and is a language in its own right (defaults to English or Japanese at -3).

Advantages, Disadvantages and Skills

Many of the existing ***GURPS*** advantages, disadvantages and skills can be interpreted in a new and interesting manner when applied to a campaign in the Terradyne world. In addition, several new abilities are appropriate for this background.

Advantages

Legal Enforcement Powers *see p. B21*

Earth has many different kinds of police and government agents; Terradyne has both Corporate Security Forces (CSF) and colonial militia. All these different organizations have different powers, and — especially on Earth — overlapping jurisdictions and local politics can create interesting problems. See *Law Enforcement*, p. 40.

Patron *see p. B24*

Society is very structured in the 22nd century, and much of that structure comes from strong groups with loyal members. A character must belong to a group and draw on its collective power to prosper — there are very few successful loners.

The GM should be careful not to permit PCs who do not have an appropriate Patron advantage to call on large groups, like Terradyne, for help whenever they're in trouble. A character who actually expects assistance from Terradyne should expect to pay about 40 points (multi-national, supplies equipment, appears on 9 or less).

New Advantages

Contacts *Variable*

A Contact is an NPC, like an Ally or a Patron. However, the Contact only provides *information*. Contacts may be anything from a wino in the right gutter to the Chief of State of a country, depending on the character's background. The Contact has access to information, and he is already known to and guaranteed to react favorably to the character. The Contact may want a price, in cash or favors, for the information. The Contact is always played and controlled by the GM and the nature of the price must be set by the GM.

The GM may assume that a Contact is, in general, well-disposed toward the PC. However, the Contact is *not* an Ally or Patron, and is no more likely to give special help than any other generally friendly NPC!

A Contact doesn't have to be created when the PC is first developed. Contacts may be added later. When appropriate, the GM can turn an existing NPC into a Contact for one or more players, possibly in lieu of character points for the adventure in which the Contact was developed and encountered.

Whatever the case, the Contact can provide information only about his own area of expertise. The technician at the forensics lab probably has no information about currency transfers, and the VP of the local Bank of Tokyo branch probably can't do a ballistics comparison. The GM assigns a skill (Streetwise for a minor criminal, Forensics for a lab tech, etc.) to the Contact. All attempts to get information from him require a secret roll by the GM against the Contact's "effective" skill. Note that the effective skill is not necessarily the NPC's *actual* skill; the actual skill can be set by the GM if the NPC comes into regular play. For instance, the president of a local superfarm might actually

have business-related skills of 16-18, but he has an *effective* skill of 21, making him worth 20 points, because he himself has good connections!

Point values for Contacts are based on the type of information and its effective skill, modified by the frequency with which they can provide information and the reliability of the information. Importance of information is relative and the list of possible Contacts is virtually endless; a few are listed below as a guide to help the GM determine value.

Type of Information

Street Contacts. These are minor criminals, derelicts, street thugs, gang members, small-time fences and other streetwise NPCs who provide information on illicit activities, local criminal gossip, upcoming crimes and so forth. Base cost is 5 points for "unconnected" Contacts (not part of the local criminal organization; Streetwise-12) and 10 points for "connected" Contacts (Streetwise-15). If the Contact is a major figure in a criminal organization (the Don, Clan Chief, or member of the "inner circle" of the family; Streetwise-21), the cost doubles to 20 points.

Business Contacts. Executives, business owners, secretaries — even the mail room flunky — can provide information on businesses and business dealings. Base cost depends on how much the contact can be expected to know: 5 points for a mail boy or typist (effective skill 12), 10 points for the president's secretary (effective skill 15), 15 points for an accountant (effective skill 18) or 20 points for the president or Chairman of the Board (effective skill 21).

Police Contacts. This includes anyone connected with law enforcement and criminal investigations: beat cops, corporate security, government agents, forensics specialists, coroners, etc. Cost depends on access to information or services. Beat cops and regular private security officers are 5 points (effective skill 12),; detectives, federal agents, or record clerks are 10 points (effective skill 15); administrators (lieutenants, captains, Special Agents in Charge, Head of Departmental Security, etc.) are 15 points (effective skill of 18) and senior officers (sheriffs, chiefs of police, District Superintendents, Security Chiefs, etc.) are 20 points (effective skill 21).

Frequency of Assistance

Frequency refers to the chance that the Contact can be found when needed. When creating the character, the player must define the way the Contact is normally contacted! Regardless of the chosen frequency, a Contact cannot be reached if the PCs could not reasonably speak to him. No Contact may be used more than once per day, even if several PCs share the same Contact. Multiple questions may be asked each day, at a cumulative -2 for each question after the first.

Available almost all of the time (roll of 15 or less): triple cost.
Available quite often (roll of 12 or less): double cost.
Available fairly often (roll of 9 or less): listed cost.
Available rarely (roll of 6 or less): half cost (round up).

During the adventure, if a PC wants to talk with his Contact, the GM rolls against the availability number for that Contact. A failed roll means the Contact is busy or cannot be located that day. If the Contact *is* available, then the GM must roll against the Contact's effective skill for each general piece of information the PC requests. A Contact can *never* supply information outside his particular area of knowledge. Use common sense. Likewise, the GM *must not* allow a Contact to give information that short-circuits the adventure or part of it!

If a PC gets a critical failure when trying to reach his Contact, that Contact can't be reached during that entire *adventure.*

Reliability of Information

Contacts are not guaranteed to know anything useful, and are not guaranteed to be truthful. Use the following modifiers (cumulative with frequency modifiers).

Completely reliable: Even on a critical failure, the worst response will be "I don't know." On an ordinary failure he can find information in 1d days. Triple cost.

Usually reliable: On a critical failure the Contact will lie; on any other failure he "doesn't know now but check back in 1d days." Roll again at that time; a failure then means he can't find out at all. Double cost.

Somewhat reliable: On a failure the Contact doesn't know and can't find out; on a critical failure he will lie; on a natural 18 he will let the opposition or authorities (whichever is appropriate) know who is asking questions. Listed cost.

Unreliable: Reduce effective skill by 2. On any failure he will lie; on a critical failure he will notify the enemy. Half cost (round up).

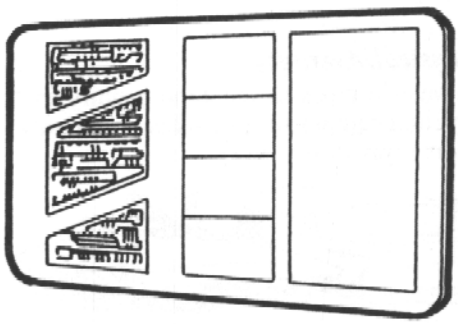
Money Talks

Bribery, whether cash or favors, motivates the Contact and increases his *reliability level.* Once reliability reaches "usually reliable," further levels of increase go to effective skill; bribery cannot make anyone totally reliable!

A cash bribe should be about equivalent to one day's income for a +1 bonus, one week's income for +2, one month's for +3 and one year's for +4. Favors should be of equivalent worth. The favor should always be something that the character actually performs in the game. The GM must maintain proper roleplaying — a diplomat or lobbyist might be insulted by a cash bribe, but welcome an introduction into the right social circle.

Panimmunity ***5 points***

This is an artificial, less effective form of Immunity to Disease (see p. B20). Your immune system has been "boosted" to make it more effective. This gives a +3 to all HT rolls when resisting diseases.



Security Clearance ***Varies***

You have a security clearance which allows you to access information classified by a particular government or corporation. Cost is 2 points per level for most nations and corporations, and 5 points per level for Terradyne and world-power nations like Japan, the U.S, India, the EC and China.

No one can receive a security clearance without a thorough background check, so the GM should not allow characters who have Secrets or other suspicious disadvantages to take this advantage.

New Disadvantages

Hereditary Disadvantages

Genetic engineering techniques have nearly eliminated most hereditary disorders, especially in the more developed parts of the world and the colonies. These include Albinism, Dwarfism, Epilepsy, Gigantism and Hemophilia. They should be very rare or appear only in areas where genetic engineering techniques are not used.

Moonbaby ***-30 points***

You were raised in a low-gravity environment with little or no artificial gravity conditioning. Your bones and muscles have not developed fully, leaving you with such a bad case of osteoporosis that you could be seriously injured by a visit to the surface of the Earth or a flight aboard a high-G spacecraft. In game terms, you have a Home Gravity of 0.2 G, a ST limit of 12, Acceleration Weakness and G-Intolerance (.05 G increments).

The GM may allow PCs to buy off these disadvantages. To do this, the character will have to enroll in a vigorous gravity training program, or spend some time in Earth stations' gravity simulators.

Secret ***varies***

A Secret is some aspect of your life (or your past) that you must keep hidden. If made public, the information could harm your reputation, ruin your career, wreck your friendships or put your life in danger.

The point value of a secret depends on the consequences if the secret is revealed: Serious Embarrassment, -5; Utter Rejection, -10; Imprisonment or Exile, -20; Possible Death, -30. See the example secrets below.

If a secret is made public, the negative effects will take the form of disadvantages. You acquire new, permanent disadvantages totalling *twice* the number of character points of your secret. The points from these new disadvantages go first to buy off the secret, and may then (at the GM's option) be used to buy off other disadvantages or (rarely) to buy new advantages. Any unused points are lost.

In general, a secret appears in a particular game session if the GM rolls a 6 or less on three dice. This doesn't mean the secret is exposed, but there is a real threat of exposure which the PC must counter.

Wanted/Escaped Convict. You are wanted for a serious crime, or were already imprisoned for a serious crime and have escaped. -20 points.

Secret Identity. You have an alternate persona, or a past life which must be kept secret. You might be a mild-mannered Terradyne accountant who, unbeknownst to his family and friends, is really a deep cover agent for the RMA (-20 points). Or you may have testified against a drug lord in the past and now have a new identity under some type of witness protection program (-30 points).

VR Addiction ***-25 points***

This is a special form of psychological addiction. You prefer artificial, controllable virtual reality sessions to the experiences of your own life. So you enter VR whenever you can, even if it will cause you to lose a job or alienate your friends. You must make a Will roll whenever you have an opportunity to VR. This addiction is legal, incapacitating, highly addictive and costs under $100 per day — -25 points.

Skills

In general, all of the skills listed in the ***GURPS Basic Set*** and ***GURPS Space*** are available in Terradyne. The exceptions are those skills dealing with magic, psionics and any technology not yet developed.

Many skills can be augmented by appropriate expert systems (see p. S52).

Driving (Physical/Average) ***see p. B68***

Common vehicle types in the 22nd century include hovercraft, construction equipment, ground cars and tracks. G-Increment modifiers apply (see p. S71).

Engineering/TL (Mental/Hard) ***see pp. B60 and S35***

New specialties include: Civil (construction projects); Chemical (materials and chemical processing); Bionics; Fusion Drive; Ion Drive; Plasma Drive; Solar Sail; Ramjets; FTL (experimental, choose either *hypermass conversion* or *implosion drive*).

Genetics/TL (Mental/Very Hard) ***see pp. B61 and S35***

This skill represents an understanding of the genetic structure of living beings and the technology available for the manipulation of genes. This skill is used for research, examining and cataloging specific gene sequences and determining the effects of changing them.

Language Skills ***see p. B54***

Most traditional Terran languages are still in use. The most popular for international communication are English, French, Japanese and Russian. Use of Portuguese has also been growing because of UPOE's headquarters in Brazil. Spanish, Arabic, Esperanto and Hindi are also in wide use. Janglish (see *Languages*, above) is treated as an Easy language for native English or Japanese speakers, Average for others. It defaults to English-4 or Japanese-4.

Mechanic/TL ***see p. B54***

New specializations include all types of ground vehicles (hopper, maglev, hydrogel, etc.), ramjets, all types of maneuver drive systems, all types of power plants, life support, bionics and robotics.

Piloting (Physical/Average) ***see pp. B69 and S35***

New specialties include: Hovercraft (when in flight mode, otherwise Driving skill); Hopper; Earth Shuttle; Mars Shuttle; Moon Shuttle; OTV; Ramjet Aircraft.

Survival ***see p. B57***

There are two new terrain types — Mars and the Moon. The Survival (Mars) skill represents the ability to survive on the vast, rocky surface of the Red Planet. It includes knowledge of safety precautions, necessary supplies, weather and dangerous geological formations. Survival (Moon) represents knowledge of the Lunar terrain and life support systems.

New Skills

Artificial Intelligence/TL (Mental/Hard) ***Defaults to Computer Programming-3 or Teaching-5***

This skill represents knowledge of the latest AI technology and the ability to train artificially intelligent machines, including expert systems. To teach an AI, the trainer's skill in the area being taught must be greater than that of the machine. He can work with a subject area expert, but the AI's subject area skill will never be more than two levels above the trainer's, and will never exceed that of the collaborator.

To determine training time, assume the machine's intelligence is equal to its tech level, and each equivalent character point of training takes 1 month. At the end of each month, the AI trainer must make a successful Artificial Intelligence roll, or no character point is gained.

For example, a TL8 expert system is to be trained in the Zoology skill, up to level 11. Zoology is a Mental/Hard skill, so a skill level of 11 (IQ+3) will cost 10 points (see p. B44). Training will take at least 10 months — more if any AI rolls are missed.

Cartography (Mental/Average) ***Defaults to IQ-5 or Navigation-5***

This is the ability to create and interpret maps and charts. In the world of Terradyne it includes knowledge of computer mapping techniques, as well as automatic map generation from sensor information. Characters attempting to map a location as they move through it must make a Cartography roll to determine if the map is accurate.

Cryptography/TL (Mental/Hard) ***Defaults to IQ-6 or Mathematics-5***

This is the ability to encode and decode information. The difficulty modifier for encryption should be based on the complexity of the procedure and how commonly known it is. Some simple encryption schemes are very difficult to break, but they usually involve some sort of keyword which must be kept secret, yet be passed on to the intended receiver.

Deciphering a coded message without the key is difficult, and can take days or weeks, even with a computer. There is no hard-and-fast rule on how difficult messages are to decode; the GM should set the message's difficulty, based on the method of encryption and the equipment available, from +2 (simple substitution ciphers) to impossible (multiple-key trapdoor ciphers).

Low-G Flight (Physical/Average) ***Defaults to ST-6 or Pilot (ultralight or hang-glider)-4***

This is a sports skill (see p. B49), covering human-powered flight in low-gravity environments using nothing more than a set of 12-foot light wings.

Orienteering (Mental/Average) ***Defaults to IQ-5***

This is the ability to locate oneself with respect to terrain (the military calls this "land navigation"). Orienteering rolls are -1 to -10 (GM's discretion) for being in an unfamiliar area. (It is a lot harder to locate oneself in the Martian desert than in downtown Cleveland.)

Photonics/TL (Mental/Hard) ***Defaults to (other Photonics)-4 or (same Electronics)-4 Prerequisite: Mathematics***

This is an engineering skill very similar to Electronics, but it deals with fiber optic, or *photonic*, equipment. The properties of photons moving through a fiber are very different from those of electrons through a wire (see *Energy Storage and Transmission*, p. 107).

Photonics is primarily used for storage and transmission of both electrical power, but its use in fields such as communications and mainframe computer design.

Jobs and Wealth

The average starting wealth in *GURPS Terradyne* is $8,000. For Terradyne employees, most of this will be in Terradyne credits, safely re-invested in the company until retirement.

Besides starting wealth, each character has a *credit rating* equal to $2,000 plus twice his monthly income. This is the amount of money the character can borrow from banks or other lending institutions without collateral. When the character is applying for a loan to purchase something which can act as collateral, such as a home or space ship, the credit rating should be multiplied by 10, up to the value of the collateral.

Credit ratings increase as a character's monthly income (from any *legitimate* source) increases. A credit rating will *decrease* (at the GM's discretion) when payments on existing loans are not made or are consistently late.

Social Status and Cost of Living

Status (p. B18) determines a character's monthly cost of living. The costs are the same whether someone is living on Earth or in the colonies, but the two lifestyles will be very different. A wealthy homeworlder might spend his extra money on a large yacht or a summer home, while a wealthy colonial might just rent larger living quarters, pay for a higher food and water allowance, or import cultural treasures from Earth. In the end, a colonist will appear to have much less than a person of the same status living on Earth.

Level		*Monthly Cost of Living*
-2	Homeless, complex resident	$100
-1	Poor, smuggler, Mars work gang	200
0	Ordinary citizen	500
1	Research engineer, UPOE official	1,000
2	City mayor, Terradyne manager	2,000
3	State/Province governor	4,000
4	National bureaucrat, senator	7,500
5	UPOE assembly member, corporate president	10,000
6	National president, colonial director	20,000
7	Terradyne president, UPOE Prime Minister	50,000

Buying and Selling

Most purchases are made with transaction cards (see p. 36), sometimes on credit (see p. 35). Small amounts of cash are still in circulation, and are used to make untraceable transactions — a right guaranteed under privacy laws.

Price Variations

The prices of items given throughout this book are their cost on Earth, in UPOE standards. Prices vary in the colonies, and some items which have a negligible cost on Earth, like air and water, are very expensive.

The Price Table gives the cost of some items on Earth, the Moon, Mars, and in orbit (Earth or Mars). Prices in the colonies are given in Terradyne scrip credits.

The cost of Earth products in the colonies can be calculated by adding the normal cost on Earth and transport costs to the point of sale (see p. 95) — Terradyne has no significant tariffs or taxes. For example, a 600-pound mahogany desk which costs $12,000 on Earth would cost $2,200 to transport to the surface of Mars. The total cost of the desk on Mars would be $14,200 scrip credits.

The prices given throughout this book for Terradyne products include import tariffs and taxes. These items cost about 55% less than the listed price when purchased in the colonies. Savings are even greater for items with significant transport costs.

The costs of services also vary throughout the solar system, based upon availability of resources. Transportation is relatively inexpensive on Earth, where convenient, portable energy sources like hydrogel are available. But transportation is expensive on the Moon — fusion reactors are too large to carry around, hydrogen is very expensive, and vehicles using combustible fuels must carry their oxidizer along with the fuel.

Prices

Lodging

Earth	
Capsule hotel (per night)	$10
Average hotel (per night)	$50
One-room apartment (per month)	$300
Five-room apartment (per month)	$600
Colonies	
Standard single quarters (per month)	$1,000
Expanded single (per month)	$1,500
Standard family quarters (per month)	$1,500
Expanded family (per month)	$2,500
Executive suite (per month)	$4,000

Life Support, per person, per month

Breathable air (Moon, orbit)	$1,250
Breathable air (Mars)	$500
Water purification (Moon, orbit)	$300

Food, Drink, Etc.

Earth	
Average meal	$10
Local drink	$1
Imported drink	$3
Concentrated rations	$50/week
Colonies	
Local meal, processed	$10
Local meal, fresh	$20
Imported Earth meal	$40
Local drink	$2
Imported drink	$10

Medical

See pp. 111-112

Communication/Information

Query service access	$100/month
Software rental	see p. 101
Full VR suit, rental	$10/hour
Text database	$1,000/gigabyte
VR/video database	$25/hour
Interplanetary mail	see p. 14
Worldwide mail	$2 per pound

Weapons

The prices listed on the *Weapon Table*, p. S55, are for purchases made on Earth. These prices also apply to TL7 and TL8 weapons manufactured and sold in the colonies. For example, a hand stunner, which costs $800 on Earth, would cost only $360 in the colonies. Weapons past TL8 are not available.

Power

Megawatt-hour	$30
Power cells	See p. S53
Solar panels	See p. S53

Planetary Transportation

Ramjet aircraft, transcontinental (Earth, Mars)	$400
Slidewalks (free in colonies)	$1
Hydrogel taxi (per 10 miles)	$5
Maglev train (per 100 miles)	$10
Lunar hopper (per 100 miles)	$30

Space Transportation

Spaceport costs	See p. 95
Interplanetary passage	See p. 95
Fuel costs	See p. 93-97

Job Table

The Job Table given here is intended as a supplement to the table in ***GURPS Space*** (p. S39). Jobs already listed on that table are only repeated here if clarification is needed or the original statistics do not fit the Terradyne universe. The "colonist" job is too broad a category and should not be used; characters become colonists by working for one of the Terradyne business units, performing similar tasks for Earth-based corporations as independent colonists, or by paying their own way in one of the colonies.

If PCs want to work for a specific agency, the GM should check the description of that agency in Chapter 1 for any special employment requirements. If a PC wants to work for Terradyne, the GM should also review the "Getting Hired" section on p. 19.

Colonist Income

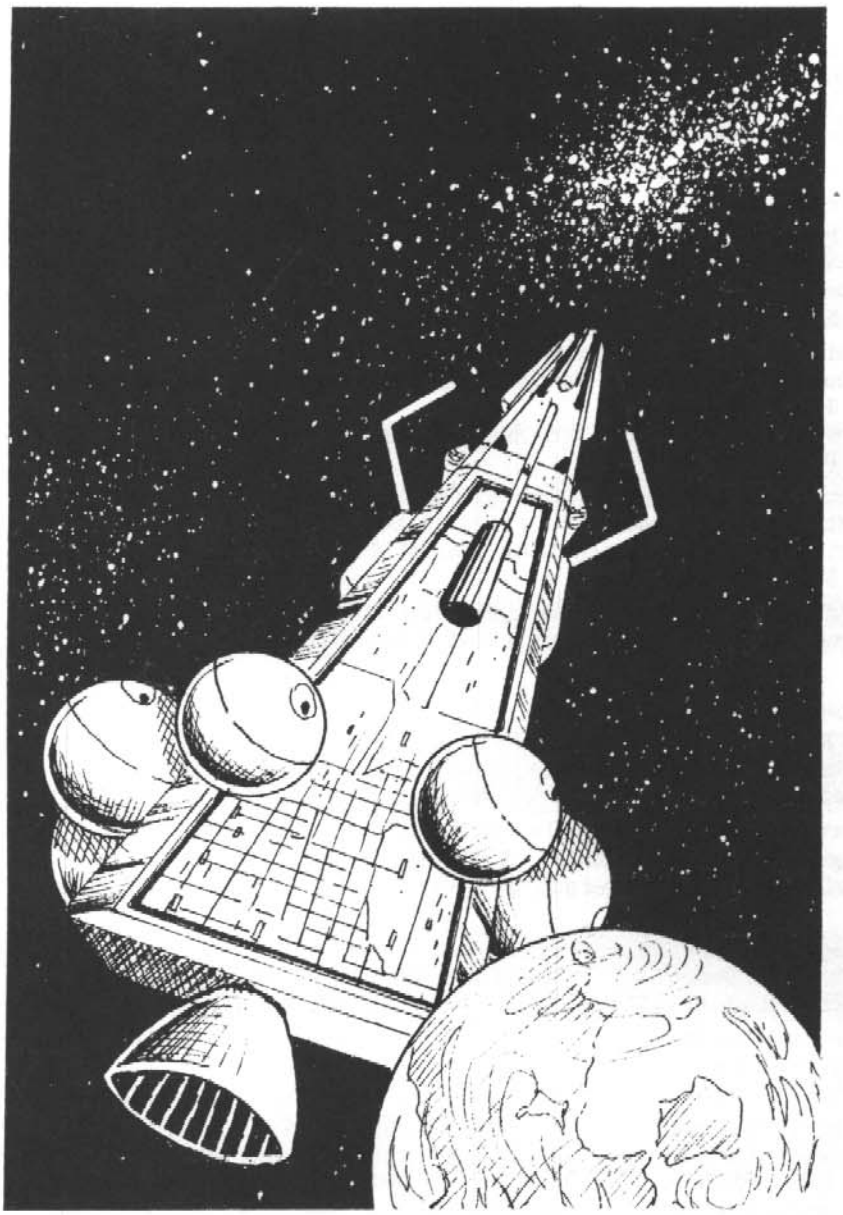
Workers in the colonies are generally provided with quarters, life support and access to recreational facilities and the data net. These items, which Earth workers pay for out of their salaries, must be paid for by the colonist's employer. They are considered part of the colonist's compensation, and their actual salaries are reduced by $500 to compensate.

Jobs (Required Skills), Monthly Income	*Success Roll*	*Critical Failure*
Poor Jobs		
*Gang Member (Streetwise 13+, any combat skill 10+), $350	Worst PR	-1i, 2d/-1i, 6d
Complex Resident/Homeless (no qualifications), $100	10	-1i/-2i,2d
Struggling Jobs		
Construction Worker (Construction 11+), $60 × skill	PR	-2i, LJ/LJ, 3d
Enlisted Soldier (appropriate combat skill 10+), $600	PR	-2i/LJ,5d
Environmental Activist (Diplomacy or Bard or Politics 11+), $500	PR	-2i/LJ,2d
Security Guard (ST 10+, any combat skill at 11+), $700	PR	-1i, LJ/LJ, 4d
Syndicate Criminal (Streetwise 11+, Merchant 11+), $75 × Merchant	Worst PR	-1i, 1d/-2i, arrested, 2d
*Thief (Streetwise 11+, DX 11+), $475	Worst PR	-1i, arrested/-2i, arrested, 3d
Driver (Driving 11+, Area Knowledge 10+), $550	Worst PR	-1i/-2i, lost license, 2d
Average Jobs		
Bodyguard (one combat skill at 12+, ST 11+), $1,000	ST	-1i, LJ/-1i, LJ, 4d
DES Agent (appropriate Science skill (see p. 15) 12+, Survival 10+), $90 × Worst PR	Worst PR	-2i/LJ, 3d
Free-Fall Technician (Mechanic or Electronics or Photonics 12+, Free Fall 12+), $100 × Worst PR	Free Fall	-2i/LJ, 4d
Intelligence Analyst (Intelligence Analysis 13+), $80 × skill	PR	-1i/-2i, LJ
*Journalist (Research 12+, Bard or Photography or Writing 12+), $70 × best skill + $500 per +1 Reputation	Best PR	-2i/LJ, 2d
Law Enforcement Officer (Criminology 11+, any weapon skill 11+, Legal Enforcement Powers), $1,400	Worst PR	-1i, 2d/-1i, suspended for 1d months, 4d
Mechanic/Technician (any Mechanic skill at 12+), $120 × skill	PR	-1i/-1i, LJ, 2d
*Mercenary (any 3 combat skills at 11+), $1,000	Worst PR	-1i, 2d/-21, 5d
Port Inspector (Electronics Operation (Sensors) 12+, Detect Lies or Forgery 11+), $80 × Worst PR	Worst PR	-1i/-3i, LJ
Soldier — NCO (Tactics 12+, Leadership 10+, Military Rank 2), $1,400	Worst PR	-1i, 2d/-3i, 4d
Translator (2 additional languages at 12+), $100 × skill	Best PR-2	-2i/-3i, LJ
Comfortable Jobs		
AI Trainer (Artificial Intelligence 13+, subject area skill 12+), $250 × Worst PR	Worst PR	-1i, LJ/-3i, LJ
*Black Marketeer (Streetwise 12+, Merchant 10+), $300 × Worst PR	Streetwise	-3i/-5i, arrested
Coroner (Forensic Medicine 13+, Criminology 11+), $300 × Best PR	Worst PR	-2i/-3i, 3d
Doctor (Physician 13+, Status 0+), $350 × skill	PR	-3i/-10i, lose license
Engineer (any Engineer skill 12+), $200 × skill	PR	-2i/-4i, LJ
Intelligence Agent (any three thief/spy skills 12+, Savoir-Faire 12+), $375 × Worst PR	Worst PR	-1i, 2d/-2i, captured by enemy, 4d
Lawyer (Law 12+, Status 1+), $300 × skill	PR	-2i/-2i, LJ, 2d
Life Support Technician (Mechanic (Life Support) 13+), $200 × skill	PR	-2i/-3i, LJ, 2d
Lobbyist (Fast-talk or Diplomacy 12+, subject area skill 11+), $300 × Worst PR	Worst PR	-2i/-3i, LJ, 1d
Military Officer (Strategy 12+, Leadership 11+, Military Rank 3+), $1,000 + $250 × rank	Worst PR	-1i, 1d/-3i, 3d
Pilot (Pilot 11+), $200 × skill	PR	-2i, LJ/-2i, LJ, 5d
Police Detective (Criminology 12+, Law 12+, Legal Enforcement Powers), $2,500	Worst PR	-3i, 2d/LJ, 4d
Politician (Politics 12+, Bard 11+, Administration 10+, Status 1+), $1,000 × (Politics-11)	Worst PR	-2i, LJ/-4i, LJ, 2d
Orbital Shipyard Supervisor (Shipbuilding (Starship) 13+, Administration 11+), $250 × Worst PR	Worst PR	-1i, LJ/-3i, LJ, 3d
Planetologist (Planetology 12+), $275 × skill	PR	-3i, 1d/-5i, LJ, 2d
*Privateer (Streetwise 12+, Fast Talk 12+, Pilot 10+), $400 × Worst PR	Worst PR	-3i/-5i, arrested, 5d
Wealthy Jobs		
Crime Syndicate Boss (Streetwise 14+, Administration 14+), $25,000	Worst PR	-4i/-6i, arrested, 5d
Important Politician (Politics 15+, Status 3+, Fast-Talk or Bard 13+, Charisma), $15,000	Worst PR	-1i, -1 Status/-3i, LJ, -2 Status
Important Stockholder (Very Wealthy), $50,000	10	-2i/-5i, -1 level of Wealth, 2d
Media Celebrity (Acting or Bard or Singing 14+, Status 3+), $40,000	PR	-2i/-4i, Status -3, LJ

*indicates a freelance job (see pp. B193-194)

9 CAMPAIGNING

With nine planets, dozens of moons and uncounted space stations, not to mention the empty space between them all, there's lots of room for adventure in the universe of Terradyne. Where to start? Here are some hints and ideas.



Other Societies

In ***GURPS Space*** terms, the world of ***GURPS Terradyne*** is a Federation campaign; the nations of Earth are in effect participants in a strong central government. Here are some ideas for fitting ***GURPS Terradyne*** into non-Federation campaigns:

Alliance

Terradyne was created by the Alliance as a holding company for space technology firms. As it grew, it found that its position in outer space effectively forced it to act as a government for its employees, and allowed it to act with autonomy from the Alliance.

In this background the UPOE is more of an advisory board than a world government. It does not have the authority to send troops into trouble spots, though coalitions of nations often do so on their own initiative.

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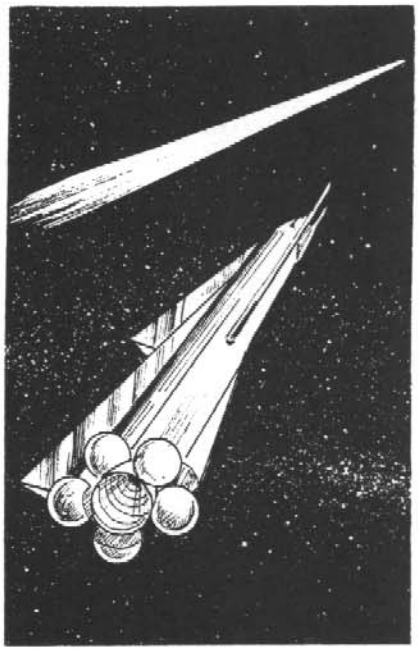

Scope

The GM should first decide what kind of campaign he plans to run and how much territory it will cover. If the characters design a party of moonbaby VR stars based in Luna City, they'll have a hard time fitting into a mercenary campaign based in South America.

The next decision should be the *slant* of the campaign. In the Terradyne universe, there aren't any clear-cut good guys and bad guys. Terradyne sees itself as mankind's greatest hope, and whether the average Terran knows it or not, is actively looking for solutions to the Earth's problems. It is also faced with the realities of business — it can't help *anyone* without turning a profit.

UPOE, for its part, is stuck with a dirty, overcrowded planet full of peoples united in name only. It sees Terradyne as stingily doling out only as much of its technological products as it has to when it could be sharing its wealth for the betterment of mankind.

How do the characters view the solar system's two major organizations? It depends on who employs them. If they work for either UPOE or Terradyne, they're likely to see the other as an adversary. Agents of national governments will likely see both as necessary evils. Smugglers and privateers will probably see them as either a source of income or an obstacle to get around.

Finally, the GM should populate his world. Creating the NPCs the characters will butt heads (or cooperate) with will go a long way toward defining the scope of the campaign.

Adventure Seeds

Are We There Yet?

Getting the party lost in the middle of the Martian desert is a good way to introduce them to the planet. Before they land, arrange to have a native guide meet them and drive them the 20 miles or so to their destination, a small mining camp near the equator. Five miles away from the destination, the crawler breaks down. To make things interesting, the crawler's radio broke several weeks ago and the guide hasn't had a chance to have it fixed yet. The group has to hike the three miles to the camp.

This situation will allow the GM to show off Mars' many interesting features — sinkholes, chaotic terrain, the lack of a magnetic field (standard compasses won't work), soil that explodes when wet (see p. 76) and of course a mangala. The characters who survive should be rewarded with Survival (Mars) at their IQ level — they've just had a crash course.

Road Gang

Another way for the characters to become familiar with Mars (and perhaps to meet each other) is to have them sign on with a road gang. The requirements are a strong back and a willingness to work; in return, the PC gets everything he needs to survive on Mars — primarily a respirator and an education.

Over time, the characters will get to know each other and will develop a common background which will make their teaming up more plausible (rather than the old "You meet at a tavern . . ." method of building a party). Their exploits may also become part of Martian legend — which could figure into a long-term Terradyne campaign.

This setting also lends itself to adventure possibilities other than fighting the Martian landscape. One example: The road gang wakes up one morning to find the foreman dead, his face buried in the sand. (An autopsy would show that he died of an extreme case of red lung.) He wasn't a nice guy, but he wasn't paid to be, and no one knows of any reason why anyone would want to kill him. To make matters worse, an identification medal stolen from one of the PCs several days before is found in the foreman's hand. Yes, this is an obvious plant, but it's also the only obvious lead. The accused has to exculpate himself (with the help of the other PCs) before he too becomes a victim of frontier justice.

The Big One

The characters are smugglers who never seem to do more than make ends meet. One day a high-level representative from Terradyne meets them clandestinely, flashes a credcard balance high enough to get their attention, and offers them a way to make a lot of money.

Other Societies (Continued)

Corporate State

Terradyne was established as a corporation to coordinate the activities of other space technology firms. Its investments and profits on its products enabled it to begin buying stock in the companies which had created it — in effect, taking over its corporate bosses. After a nasty and expensive legal fight, the companies eventually agreed to merge under the Terradyne banner.

In this background, the UPOE is a corporate state. Only national governments are allowed to own UPOE stock; this keeps Terradyne from attempting another hostile takeover. UPOE owns about 20% of Terradyne's stock, purchased from the United States shortly before the Collapse. This gives it a seat on the Board of Directors — a state of affairs Terradyne would like to remedy.

Empire

This is similar to the Federation background, but in this version UPOE is in effect the parliament of a worldwide empire. Terradyne was establish during the reign of an emperor who preferred to let his subjects govern themselves; by the time of Phoebe's impact, Terradyne was already too large and too important to the Empire to confront overtly.

Today the Emperor's strategy is to attempt to infiltrate Terradyne wherever possible so he can control it by placing his people in key positions. The Royal Family owns 20% of Terradyne's stock, and a prince sits on the Board of Directors.

He guarantees them as many delivery runs to Venus as they wish to make at $100,000 each. The only condition is that the money also buys their silence.

If they agree, he is good for his word. The characters are able to pick up their cargo (sealed from their inspection) in Lunar orbit and drop it off at a space station in Cytherean orbit. Though it is obvious they are being watched, the station makes no effort to contact the ship.

After three or four trips, the GM should allow the characters to stumble across the plans to an Artemis engine — either on the net or in someone's office. Soon after, when they are making the trip to Venus, the cover should come off their cargo. On a successful IQ roll, a character will recognize this as part of the magnetic field generator from the plans they saw.

Discreet inquiries will reveal that the generator is worth much more than the $100,000 they are being paid to deliver it, but not so much more that they can't do better by continuing their deliveries. However, another item on the data net should catch the characters' attention: the UPOE is responding angrily to rumors that Terradyne is planning to terraform Venus in contradiction of UPOE space law. The reported method of terraforming is particularly sensitive — Terradyne plans to fit Venus with *several* Artemis engines and move its orbit from .7 to .82 AU, where it will cool down enough to be habitable to Earth-based life.

At this point the characters get to make several decisions. Should they report their activities to UPOE? Will they be marked as collaborators if they do? Should they offer to help UPOE in its investigation? What will happen to them if anyone finds out? (This last could be the most frightening possibility, considering the average Terran's attitude toward Terradyne.)

If the characters don't figure out they're involved in a scheme to kick Venus

Other Campaign Ideas

The world of Terradyne is an extrapolation from the world of 1991 — a look at what might happen, in the words of Robert Heinlein, "if this goes on . . ."

But suppose something *else* happens? No one can predict exactly what the future will hold; the following futures may be equally valid.

Theocracy

As worldwide problems mounted in the mid-21st century, more and more people sought spiritual answers to the questions technology could not answer. Religious leaders promised their followers, first a better life in the world to come, then a chance to change the world they lived in. Many were sincere; some saw religion as the road to power.

Terradyne is still a corporation, market-driven, but its opposition on Earth is now driven by the conviction that it is doing God's will. A few religious bodies denounce Terradyne as a tool of the Devil; they cite as proof the blasphemy that Terradyne committed in moving God's handiwork out of its ordained place in the heavens. Most, however, simply accuse Terradyne of not doing enough to promote a better life for people — often through the agency of the particular church.

World War Three

The civil unrest in northern India, the brushfire wars in the Middle East, two border disputes in Africa and Central America and a revolution in Peru that spilled over into Chile all erupted simultaneously, pushing the world into the first truly global conflict since 1945.

Terradyne is officially neutral in this, and in fact sends humanitarian aid, including medicine and hydroponics technology, to all sides in the conflict. It is also selling arms to smugglers, who are in turn selling them to anyone with the Standards to buy them. Since the smugglers are an amorphous target, world leaders are denouncing Terradyne for selling weapons to anyone at all.

Continued on next page . . .

out of its orbit, the GM can hit them over the head with the information. They are arrested as they attempt to leave Lunar orbit and are held and questioned for several days before the authorities tell them what they're involved in. They then have two options: cooperate, or spend the rest of their lives somewhere where the sun literally doesn't shine.

The Military Option

The civil war in northern India has been mentioned several times, but there are other hot spots around the world: the Middle East, southeastern Europe, central Africa, and Latin America are all potential battlegrounds.

The party could be special forces members on either side of any of these conflicts (or mercenaries hiring out to the highest bidder). Even in an age of high technology, reconnaissance, small-unit missions and the like are still a part of warfare. (For more ideas on such a campaign, see ***GURPS Special Ops***.)

Or they could be running guns to the combatants. Terradyne isn't in the arms business, but there's no reason why an independent manufacturer couldn't rent or build a factory in Earth orbit for the production of high-tech weaponry. This wouldn't even necessarily be lasers and similar weapons; light, strong alloys whose molecular structures couldn't be created in 1G can easily be fabricated in microgravity. Guns made from these alloys would tend to jam and break less often than their Earth-based analogs.

Doing Well By Doing Good

This campaign is for characters with an altruistic bent. The party is a group of smugglers collected by a major Terradyne stockholder. This stockholder, however, has decided he's made enough money from Terradyne and wants to give something back to humanity, so he plans to smuggle Terradyne products to Earth with no thought of whether he will make any money on the venture. His aim is to set up several such smuggling teams; the PCs are the first, a prototype to test the waters.

This gives the GM a wide latitude in his choice of missions, and lets the PCs vent any urge they may have to break the law while simultaneously feeling like they belong to the Good Guys. The items the PCs smuggle in could be anything from shortwave radios (so the recipients can hear news other than the Official Version their government approves of), to medicine, to people (rebel leaders returning from exile).

Just because the characters are doing the Right Thing doesn't mean the GM should make life easy for them. If the UPOE or any of the national governments catch them, their altruistic motives won't count for anything — in fact, it's entirely likely that no one will believe that they are smuggling for any reason but money. (If they are captured, their Patron might bail them out — once — but it should be made clear they can't expect this sort of help often.) Crimelords will want a cut of the nonexistent action. The recipients may be suspicious of their motives — remember, they react poorly to *anything* having to do with Terradyne and may not believe anyone, especially employees of the Blind Giant, would help them out of sheer good will.

In this campaign, each character should take the Terradyne stockholder as a 20-point Patron (single powerful individual, appears on 12 or less), balanced by a 10-point Duty or Sense of Duty (to the Patron and his objectives).

★ ★ ★

The adventure seeds above are only a small sample of what's possible in the world of ***GURPS Terradyne***. The possibilities are endless — from urban warfare between crime syndicates to a Martian version of *The Seven Samurai*.

Other Campaign Ideas (Continued)

The Survivors

A biological weapon developed by an unnamed Asian power in the mid-70s was dropped during a war between Vietnam and Cambodia. The virus, developed from anthrax, was advertised as being self-destructive. It was supposed to die out after 24 hours.

Whoever developed the virus made a critical failure on their Genetic Engineering roll — or, more likely, just plain lied. The virus spread throughout the planet within 72 hours, killing about 75% of the world's population within a week.

Many people blamed Terradyne for the affair, when in fact the corporation had nothing to do with it. (In fact, Terradyne survived intact through a strict quarantine, backed up by shoot-on-sight orders.) Terradyne now faces a world with its technology intact but with fewer people than it has had at any time since the 1970s. These people are desperate for Terradyne's help in rebuilding society, even though many of them blame it for the disaster.

GLOSSARY

Aerobraking — Flying a controlled path through a planet's upper atmosphere to reduce speed and go into orbit.

Ares — Largest of the three Martian continents. Covers most of the southern hemisphere.

Artemis Engine — Giant fusion drive which propelled Phoebe out of its orbit into a collision path with Mars.

Borealis — Uninhabited continent at the Martian North Pole.

CIB — Combined Intelligence Bureau. Capable United States intelligence agency.

Crawler — Tracked or wheeled vehicles used on the Moon and Mars. Most common model carries eight passengers.

Crystal Pyramid — Glass, pyramid-shaped building containing the offices of senior Terradyne management. Located inside Quad A of Luna City, near Town Square.

CSF — Corporate Security Forces. Terradyne's security guards and the closest thing to a police force on the Moon.

DES — Department of Environmental Sciences. UPOE agency responsible for monitoring the Earth's environment and the Terraforming operations on Mars.

Elysium — Island continent in northern temperate region of Mars.

Free Space — UPOE program which subsidizes Earth-based space technology firms. Impetus for development of Payload-90 shuttle.

Glasteel — Flexible glass reinforced with metal alloys.

Hadley Cell — Vertical air circulation pattern driven by temperature differences between a planet's poles and equator.

ISF — Interplanetary Security Forces. UPOE law enforcement agency which enforces UPOE regulations and international law in the colonies.

ITC — Interplanetary Trade Commission. UPOE organization which levies taxes and tariffs for interplanetary trade.

L4 — The Lagrange point preceding the Moon in its orbit. Location of a large cluster of zero-G factories and research stations.

Lagrange Point — Stable locations for small satellites in the Earth-Moon system, where gravitational pulls from the Moon and Earth are equal.

LEO — Low Earth orbit. Any Earth orbit below geosynchronous orbit (23,000 miles).

Lobber — A hopper configured with extra fuel tanks for longer range. Can reach any point on the Moon's surface in a single "hop."

Lowell Station — Large life support station in a permanent low-energy orbit between Earth and Mars.

LSS — Life Support System.

Maglev — Any of a number of vehicle types which are magnetically levitated above a monorail track.

Mangala — Large Martian storm. Appear as heavy rainstorms in the northern hemisphere and hemisphere-wide sandstorms in the south.

Mariner — Region of the Martian continent Ares, east of the Tharsis Ridge and north of Mariner Canyon.

OCA — Office of Colonial Affairs. UPOE agency which handles colonial issues. Advocate of non-Terradyne colonists.

Phoebe — Mars' great northern ocean. Named after the Saturnian moon from which it was formed.

Quads — The four main public caverns in Luna City. The Quads all meet at Town Square.

Quickships — Fusion drive ships used to reach the Saturnian system.

Red Lung — Deadly respiratory disease caused by inhalation of corrosive Martian soil.

Regolith — Lunar soil. Mined for its high content of aluminum and oxygen.

RF-12 — Terradyne's most powerful chemical fuel.

RMA — Regulatory Monitoring Agency. UPOE's intelligence agency. The most effective espionage organization on Earth.

Road Gang — Group of unskilled heavy laborers used in large-scale civil engineering projects on Mars.

SAH — Suspended Atomic Hydrogen. A powerful chemical-drive fuel used in Payload-90 shuttles.

Sinkhole — Area of Martian surface which suddenly sinks as the permafrost supporting it melts.

Scrip — The unit of Terradyne's corporate currency. Not legal tender on Earth.

Solis — Large, dry region of Martian continent Ares. Known for its extensive dune fields.

Standard — Global currency backed by UPOE's World Economic Reserve.

Syrtis Major — Region of Mars stretching northeast from the Hellan Sea to the coast of Phoebe.

Terradyne — Mega-corporation based on the Moon. Dominates high technology markets, including space transportation. Engaged in terraforming Mars.

Tharsis — High Martian plateau containing several of the largest volcanoes.

Town Square — Central area of Luna City where the Quads meet.

UPOE — United Peoples of Earth. Powerful, democratic world government that establishes international law and economic policies.

Uruk — Largest city on Mars.

Volatiles — Chemicals necessary to sustain life, including nitrogen, carbon, oxygen, etc.

VOMS — Venus Orbital Meteorological Sciences Station. Used to study the runaway greenhouse effect on Venus.

Waldo — Working Automaton, Long-Distance Operation. Remotely-operated machine that allows mechanical handling by a human controller.

Water Burst — Eruption of water as permafrost melts and Martian crust collapses.

BIBLIOGRAPHY

The information and ideas found in this book come from several different sources. In order to make the world of Terradyne as realistic as possible, we've based our predictions of the future on the work of published authorities. For additional information, we recommend the following non-fiction sources:

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Encyclopedia Britannica

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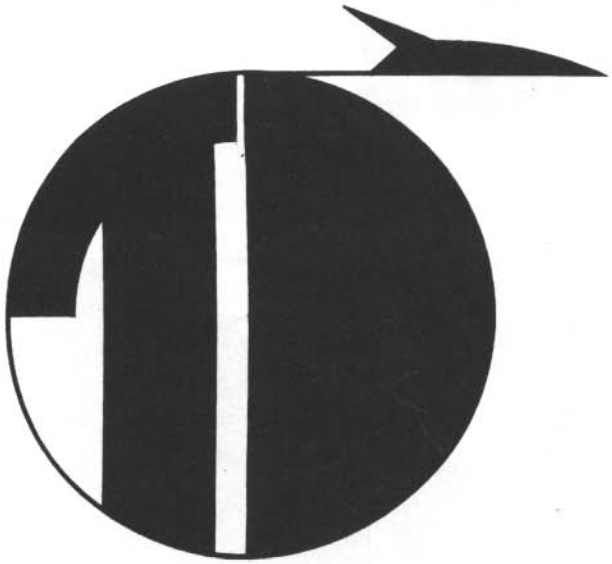
See the Glossary (p. 126) for definitions of unusual terms.



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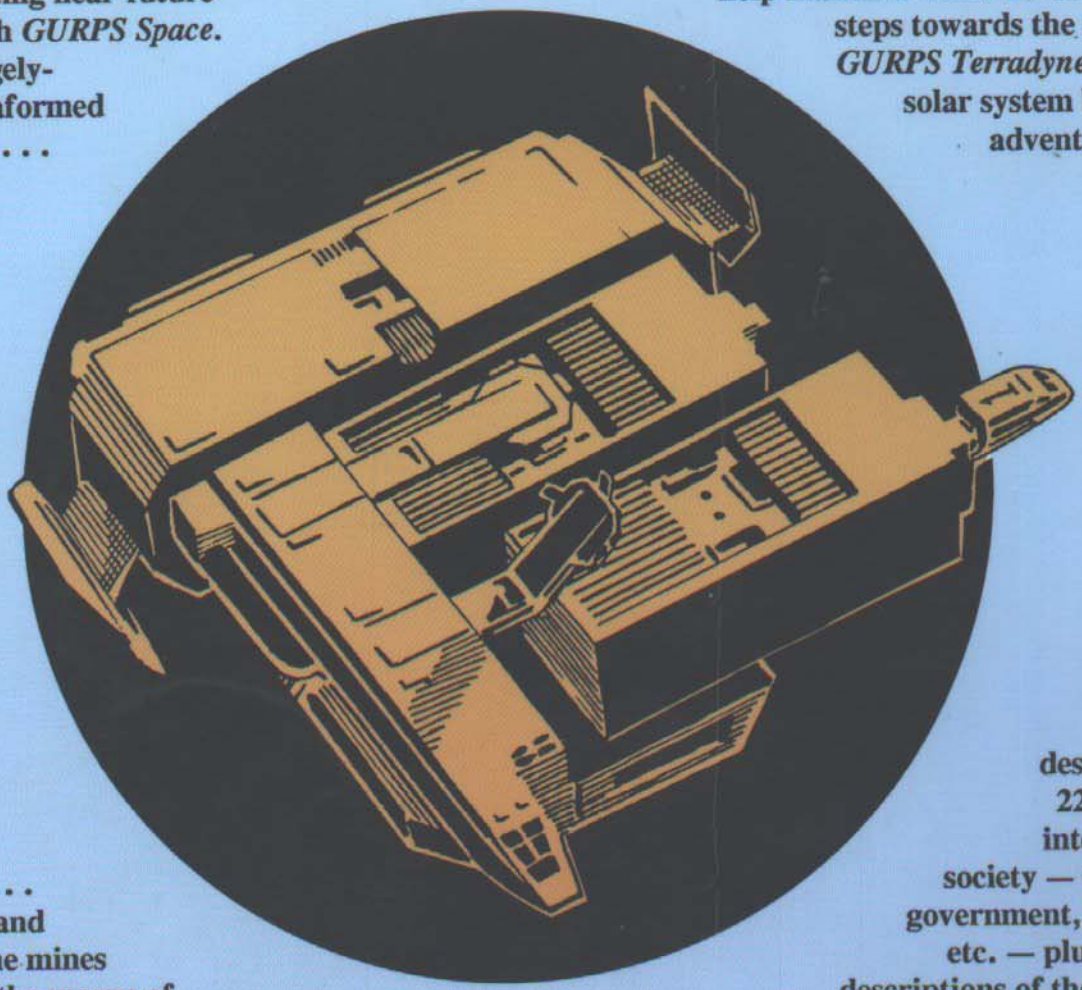

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