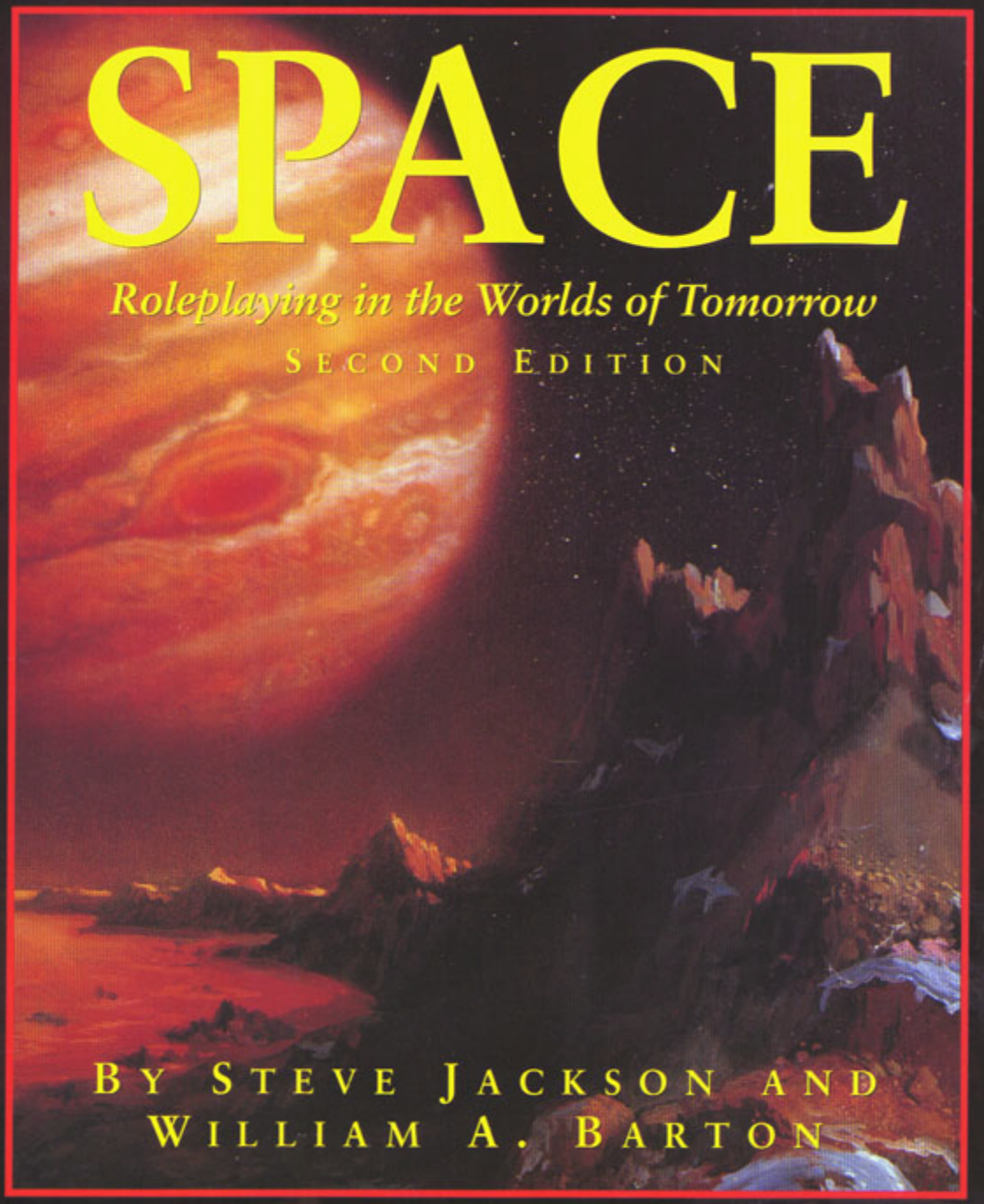
GURPS®

SPACE

Roleplaying in the Worlds of Tomorrow

SECOND EDITION



BY STEVE JACKSON AND
WILLIAM A. BARTON

STEVE JACKSON GAMES

G U R P S ®

SPACE

Roleplaying in the Worlds of Tomorrow

By Steve Jackson and William A. Barton

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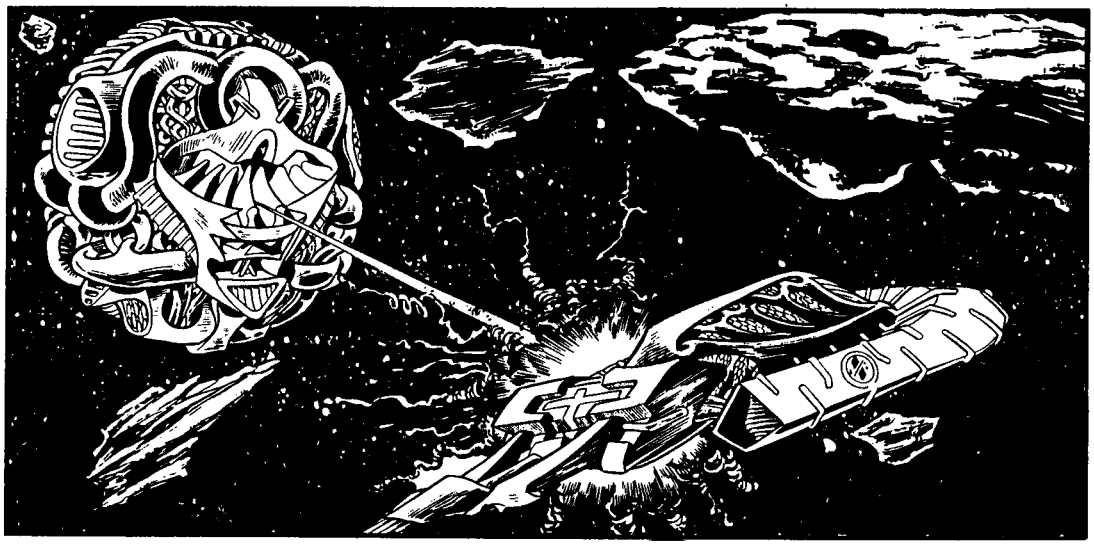

STEVE JACKSON GAMES

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INTRODUCTION

There's this about space: It's big. Sometimes entirely *too* big. This project was tough and long-delayed. But when the first edition hit the stores, it was worth it. And when it was named Best Roleplaying Supplement at Origins 1989, we were overjoyed. Now ***GURPS Space*** is the first ***GURPS*** worldbook to go into a second edition.

The project seemed to take forever, because there was so *much* to cover. In fact, this book "spun off" several other projects. Bill's original manuscript included over 30 complete world descriptions, enough to be a book in their own right. We solved that problem by *giving* them their own book — our first ***Space Atlas.***

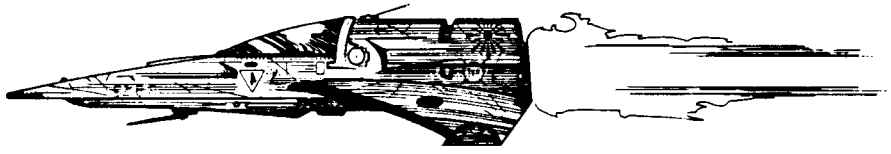
Several other subjects that got chapters in this book deserved full-length treatment, too. We now have separate books for ***GURPS Ultra-Tech,*** with gadgets for TL8 and above; ***GURPS Aliens,*** with alien advantages and disadvantages; and the ***Space Bestiary.*** Still on the drawing board are a whole book, and possibly a whole separate-but-compatible game, about tactical starship combat.

One common question has been "Will ***GURPS Space*** be hard-SF or space opera?" Actually, it's both. We have *not* included a pregenerated universe background. Instead, the book tells you how to create your own. Want detailed, state-of-the-art scientific guidelines for building star systems? They're here. Want quick random tables that give believable results? They're here, too. Descriptions of zap guns and aliens? No problem.

In some chapters, we've given very detailed information on (for instance) the way the Galactic Survey works, or the politics of an Interstellar Federation. But, again, this is resource material . . . suggestions. We don't expect the GM to feel locked into these names, or these details, for his own campaign.

Instead, we're doing whole worldbooks for specific SF backgrounds. ***GURPS Autoduel, GURPS Humanx, GURPS Riverworld*** and ***GURPS Uplift*** are already out. So is ***GURPS Cyberpunk,*** covering near-future "high-tech low-life" roleplaying. Coming soon is ***GURPS Terradyne,*** about man's conquest of the solar system. But this book is something else: the (pardon the expression) generic rules. It's a *general* sourcebook. You can use it to adventure in your own SF universe, or that of your favorite SF author — or even that of the SFRPG you used to play (before switching to ***GURPS,*** of course).

We had a lot of fun developing the technical material — but reality testing had to go right out the viewport this time. Not too many blasters or stargate generators available to test, even at Frederick's of Altair VI. So if you disagree with any of our specifications — change 'em. We've done our best to keep the science straight in the *Stars and Worlds* section, but astronomy is a fast-evolving field; today's "facts" may be discredited next week. Until then, take it and run.



Where Credit is Due

We were certainly influenced by previous efforts in SFRP gaming (good or bad), and even more by that vast body of SF literature that has accumulated since the golden age of the '30s.

Our own favorites include the work of authors such as Robert A. Heinlein, H. Beam Piper, Andre Norton, Poul Anderson, Arthur C. Clarke, Larry Niven, Robert Silverberg, Philip José Farmer, Isaac Asimov, Jack Vance, Roger Zelazny, and many more. Overt influences from the SF gaming world would include that old favorite, GDW's ***Traveller;*** the works of Don Rapp and Chuck Kallenbach of Paranoia Press (which published some of the best ***Traveller*** supplements); and Richard Tucholka, designer of the too-often overlooked ***FTL: 2448.***

And, finally, our sincerest thanks to the many who commented on the various stages of the manuscript. If this book holds together well, it is only because of the dedicated pickiness of all those rules-readers and playtesters. Whatever is missing is the fault of the authors . . . but let us know what you want, and we'll deal with it. After all, we've got a whole universe out there.

Hot jets!

— William A. Barton and Steve Jackson

About GURPS

Steve Jackson Games is committed to full support of the ***GURPS*** system. Our address is SJ Games, Box 18957, Austin, TX 78760. Please include a self-addressed, stamped envelope (SASE) any time you write us! Resources now available include:

Roleplayer. This bimonthly newsletter includes new rules, new races, beasts, information on upcoming releases, scenario ideas and more. Ask your game retailer, or write for subscription information.

New supplements and adventures. We're always working on new material, and we'll be happy to let you know what's available. A current catalog is available for an SASE.

Errata. Everyone makes mistakes, including us — but we do our best to fix our errors. Up-to-date errata sheets for all ***GURPS*** releases, including this book, are always available from SJ Games; be sure to include an SASE with your request.

Q&A. We do our best to answer any game question accompanied by an SASE.

Gamer input. We value your comments. We will consider them, not only for new products, but also when we update this book on later printings!

BBS. For those who have home computers, SJ Games operates a BBS with discussion areas for several games, including ***GURPS.*** Much of the playtest feedback for new products comes from the BBS. It's up 24 hours per day at 512-447-4449, at 300, 1200 or 2400 baud. Give us a call!

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 the ***GURPS Basic Set*** — e.g., p. B102 means p. 102 of the ***GURPS Basic Set,*** Third Edition.

About the Authors

William A. Barton is employed as copy editor for *Endless Vacation* magazine in Indianapolis, where he lives with his wife and three cats. His interests include roleplaying, science fiction, Sherlock Holmes and the Cthulhu Mythos.

Steve Jackson is the designer of the ***GURPS*** system and founder of SJ Games. When he's not working on a new game design, he's usually reading science fiction, attending an SF convention, or taking care of his tropical fish. Once in a while he has time to *play* something.

1 CREATING A UNIVERSE

A "universe" is the game background created by a GM. Much of the excitement of a star-spanning campaign comes from a detailed, believable background.

These rules are not tied to any single vision of the future. This worldbook is not intended to impose a background on the game; rather, it gives the creative GM the tools to develop *any* type of outer-space campaign.

Designing a complete space campaign involves five decisions:

Type. What will the players do in your campaign? Are they the Stellar Patrol, intrepid surveyors, or greedy merchants? Would they rather engage in combat or diplomacy?

Scope and FTL Technology. How much space does your campaign cover? Will it be set within a single star system, around a few dozen local stars, or in a whole spiral arm of the galaxy? This decision is tied to your choice of stardrives; the faster the drive, the more territory can be covered. Are habitable worlds rare, common, or innumerable? And how close are they in terms of *travel time?* The more quickly you can travel between worlds, the likelier they are to interact on a large scale — fighting wars, sharing governments, extraditing criminals, and so on.

Other Technology. What is the campaign's tech level? What sort of FTL communication, weaponry, etc., will be available?

Races. In your universe, are the "good guys" all human? Are there allied races? Are there "bad guy" races? What about vanished races?

Habitable Worlds and Society. Do your characters live in a massive Empire, or a loose-knit Alliance? Is the government restrictive? Are the police and military effective? Are there many societies, or just one large civilization? Note that this decision is tied to the scope of the campaign. Also, what interstellar organizations are important? And what is the *history* of interstellar civilization?

Campaign Type

What will your campaign be about? Will the characters be planetbound or spacefaring? Good citizens, or nefarious pirates? Are they after money, adventure, knowledge . . . or something else?

Strange New Worlds

The theme of the campaign is the search for new worlds — the thrill of discovery, and the adventure that it brings.

Character Roles: Characters can be private explorers or members of the Survey (p. 16), making contact with strange worlds. Scout crews include scientists and rangers; diplomats might even be present if the world is inhabited, merchant representatives may be present.

Things to Do: Scouts are expected not only to discover and survey worlds from orbit, but to land on the planet to discover any potential dangers to the colonists who may follow. There are dozens of things to find on an unfamiliar planet — strange, threatening animals or aliens, mysterious ruins, a lost human colony, an unsuspected pirate base.

Campaign Advantages: PCs who work for a government or private survey organization will have a powerful Patron who supplies equipment and a ship. But they will often be in remote space — away from daily control by their superiors. The variety of new worlds provides campaign diversity. This campaign can be ideal for small groups — a scout crew can be as small as one person.

Campaign Disadvantages: If they work for the Galactic Survey Service or a private (probably merchant) organization, they will probably explore worlds by assignment. On the other hand, PCs might be exploring on their own — in which case, their ability to keep a starship fueled and supplied depends on finding profitable worlds. For the GM, a scout campaign means constantly generating new systems (and new surprises).

References: Rendezvous with Rama by Arthur C. Clarke; *Ringworld* by Larry Niven; the Tschai books by Vance; the *Star Trek* television series.

Recommended References

Science References. A few good popular-astronomy books will be a tremendous aid in building a universe and filling in details on planets and stars. Many of these books have beautiful illustrations — both actual photos and artists' conceptions. This is a "must" for a pre-starflight campaign in our own solar system!

Rather than a technical book, look for something by one of the popular science authors. Isaac Asimov has written several that are both entertaining and informative. Check out the astronomy section at your local bookstore or the public library.

Jerry Pournelle's *A Step Farther Out* is a very valuable reference to TL7 and TL8 space travel technology.

Star and Planetary Maps. If you're interested in running campaigns in areas within 15 parsecs of Sol, a good star map will be useful. It should tell you at least a star's spectral type, approximate location, and name. Such maps can often be found in the astronomy books or through special order listings in magazines such as *Astronomy* and *Sky and Telescope.*

Planetary maps are also available from many of the same sources. Fairly detailed maps of the Moon, Mars and Venus exist, based on data from space probes, and these could easily be translated into the surfaces of other worlds.

Science Fiction Novels. These are obvious sourcebooks for a ***Space*** campaign. Those series set in consistent universes can make excellent campaign backgrounds. And lesser-known works make good scenario inspirations; there's less chance the players will have read them already.

GURPS Supplements. ***GURPS Ultra-Tech,*** listing TL8+ weapons and gadgets, and ***GURPS Aliens,*** with over 20 non-human races, are both useful GM aids. Two ***Space Atlas*** volumes, listing inhabited and/or interesting worlds, are out; another is in progress. Several assorted space adventures are also available.

Other ***GURPS Worldbooks.*** Plugs are in order here for ***GURPS Humanx,*** based on the excellent *Humanx Commonwealth* series by Alan Dean Foster, and ***Riverworld,*** based on the creation of Philip José Farmer. Other worldbooks for specific universes are forthcoming. The ***Autoduel*** worldbook and its supplements have some good TL7 gadgetry, too.

Selling the Moon — Wholesale

The characters are merchants — free traders, or employees of a merchant company. Profit is the name of the game.

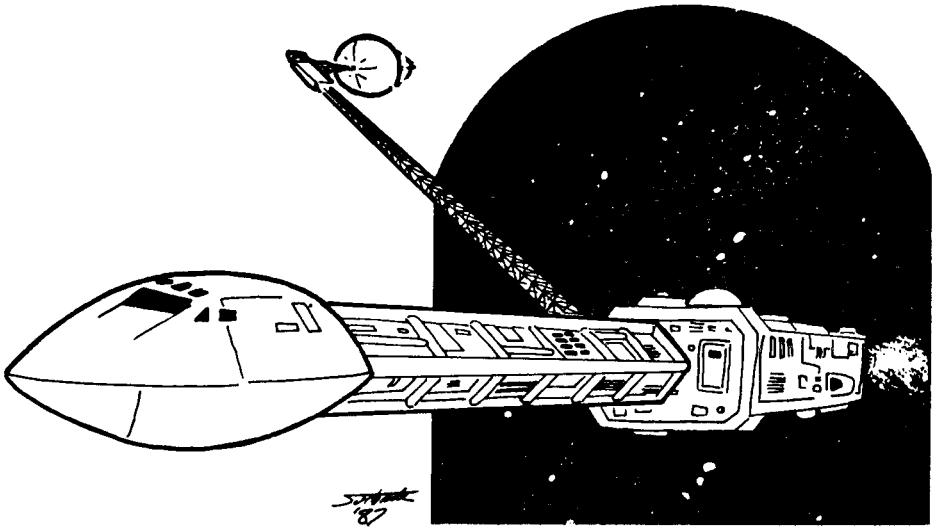
Character Roles: PCs are merchant ship crew members. Some should have mercantile and shipboard skills; a few ex-military types might be handy.

Things to Do: This campaign is about getting cargo from origin to destination — despite the hazards of travel, competitors and alien menaces. An added dimension comes if players must develop their own markets: evaluating new worlds for profit potential, making deals with alien civilizations, finding new cargo and ways to sell it. They can ride the coattails of survey vessels — or even explore on their own. Variety can come from special charter runs or passengers.

Campaign Advantages: If a merchant makes money, he usually feels that the ends justify the means — PCs who can't do things "by the book" may enjoy this campaign. Free traders have many options on where to go and what to do, while company men may well be allowed to break regulations if they turn a profit. Company men have a Patron in their employer.

Campaign Disadvantages: Free traders are on their own when it comes to equipment and a starship. They will constantly have to keep an eye on their finances and will be in big trouble if they run out of money. (Impoverished free traders may try to skip out on their payments and go criminal . . . becoming pirates.) Company men may be restricted by regulations, specified trade runs, and other forms of corporate control.

References: Andre Norton's *Solar Queen* novels; Poul Anderson's Van Rijn/Falkayn stories; A. Bertram Chandler's *Commodore Grimes* series; Robert A. Heinlein's *Citizen of the Galaxy;* C.J. Cherryh's *Chanur* series; *Cascade Point* by Timothy Zahn.



Star Soldiers

Characters in a military campaign might be infantry, mechanized troops (tanks, hovercraft, aircraft or other), or crew of a stellar warship. They may be employed by a government, or they may work for a mercenary organization.

Character Roles: Characters should be part of the same organization — and usually the same unit. PCs should have the skills within their group to perform their unit's duties. PCs might be on the fighting end (in which case they will probably be enlisted men and junior officers), or they might be in command (senior officers and staff officers, with commands of their own).

Things to Do: If it's wartime, Marines will be "bug hunting" in their battlesuits, while spacers are repelling boarding parties on their starships. Fighter pilots will scramble when they are given the signal. If the campaign is on the frontier, or if the interstellar government is weak, fighting will continue in peacetime — especially for mercenaries.

Campaign Advantages: Government troops don't have to buy their own weapons, armor and equipment. Since the PCs are under the command of their officers, the GM can direct the campaign without PC actions surprising him.

Campaign Disadvantages: Military PCs have a Duty to their organization and its officers. Military regulations might be enforced. Unless the PCs are the elite squad that always performs the crucial assault, their individual actions will seldom influence entire battles and wars. Eventually, all the battles may begin to look — and play — the same.

Other Military Campaigns

There are several "sub-genres" of the military campaign, including:

Skull & Crossbones

Characters are crew of a pirate corsair. This campaign is ideal for those who enjoy space battles, boarding actions, and divvying up the loot afterward.

Character Roles: PCs must among them have the skills to operate their ship or base. Combat skills come in handy, as do mercantile abilities (to evaluate the booty). Disregard for danger, and the law, are musts. Scurvy old space dogs fit in well.

Things to Do: Pirates usually attack merchant ships or raid prosperous colonies. They may or may not have a hidden base, and they may pay visits to civilized worlds for rowdy R&R. In wartime, pirates may become privateers (privately-owned warships), serving under *letters of marque.* Pirates have an enemy in the Patrol — if their base is discovered, they may need to explore new worlds to find a safe hideout.

Campaign Advantages: PCs are under no obligation to obey the law. They're already wanted criminals, so anything goes.

Campaign Disadvantages: Pirate PCs usually must provide their own starship, or start without one. The Patrol is their Enemy; other pirates may be hostile, too.

References: Space Viking by H. Beam Piper. E. E. Smith's *Lensman* books. The film *Ice Pirates.*

Rebels Against the Empire

Characters are struggling to overthrow a government they dislike (usually an oppressive Empire).

Character Roles: Characters are noble freedom fighters, or rogues with hearts of gold who decide to help when the chips are down. (Or Imperial double agents?)

Things to Do: They'll spend a lot of time raiding hostile bases and battle stations, brandishing force swords and rescuing captured allies. Many operations will be covert spy or guerrilla missions rather than military operations. Rebel forces are often short-handed — PCs might be star pilots one day and ground troops the next.

Campaign Advantages: A powerful rebel organization might be a Patron. PCs can have a great effect on the success of the rebellion, acting in military, espionage and diplomatic operations all at once.

Campaign Disadvantages: Taking on the entire Imperial armed forces, often in nothing much more heavily armed than an interstellar garbage scow, is seldom safe.

References: Certain SF movies that take place a long time ago in a galaxy far, far away. F. M. Busby's *Star Rebel* and its sequels.

Continued on next page . . .

Other Military Campaigns (Continued)

Agents of Terra

The espionage campaign focuses on intrigue, covert operations, and double-dealing among the stars.

Character Roles: PCs had better be deadly and capable. They may be suave and sophisticated, or look and act like interstellar scum — it doesn't matter as long as they can work undercover and kill efficiently when necessary. (PCs also might be "specialists," brought in when needed for specific assignments.)

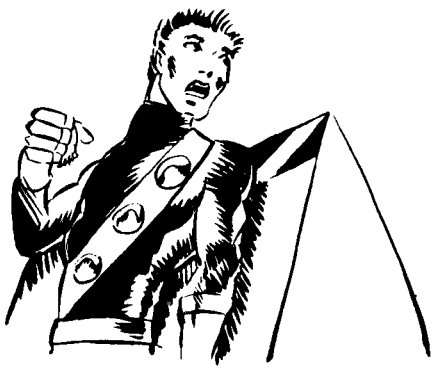
PCs don't have to be traditional "secret agents" — they might work for Military Intelligence, the Patrol Covert Office, a corporation's Industrial Intelligence bureau, or an obscure regulatory or law-enforcement agency. They might even work for the Other Side. Or they may be private detectives.

Things to Do: Spies work to preserve their organization, and cripple or destroy hostile spy networks. They infiltrate criminal or enemy organizations, while eliminating moles and double agents in their own outfit. Important people and vital secrets must often be rescued, kidnapped or stolen. Most importantly, spies must discover and stop the latest insidious plot to take over the universe — and the Galactic Illuminati are everywhere.

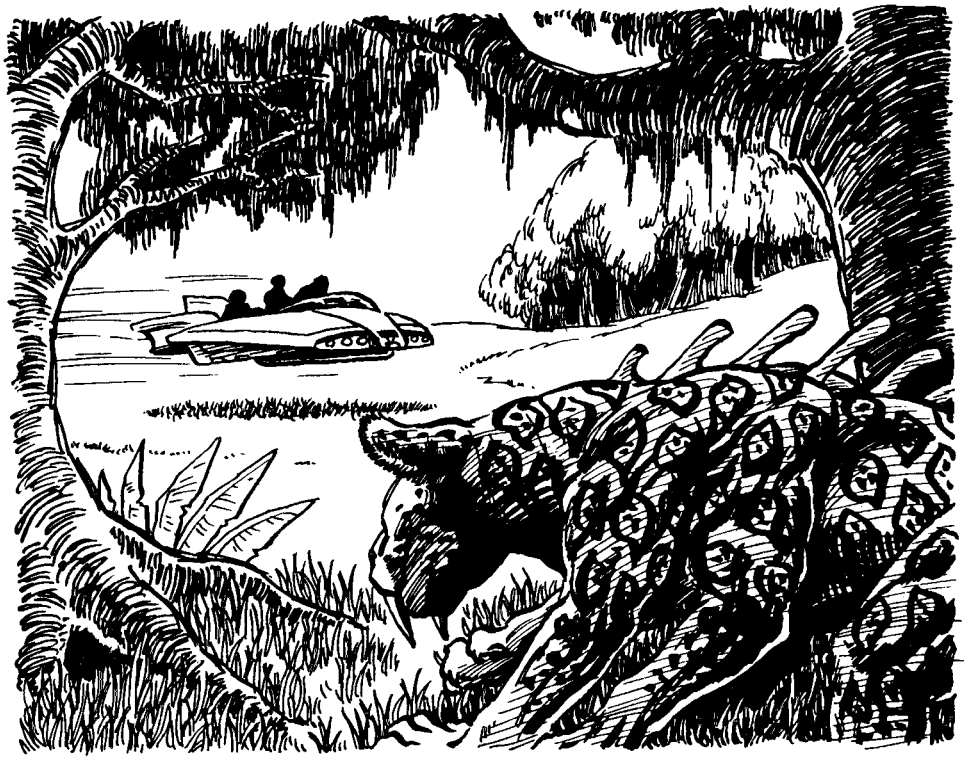
Campaign Advantages: Spy agencies are often Patrons, providing specialized and expensive equipment, and friendly law enforcement organizations may be cooperative (or jealous, or traitorous). Except when on assignment, PCs will usually be free to do what they wish. Many agents are paid well. This campaign works well for a small group.

Campaign Disadvantages: Spies have a Duty to their Patron, and will often be sent on dangerous missions. Both the individual PC and his Patron will have Enemies. There is also a lot of double-dealing — PCs might be sent on suicide missions, fingered by informers, or targeted by opposing assassins.

References: The *Stainless Steel Rat* series by Harry Harrison; the *Flandry of Terra* novels by Poul Anderson; Keith Laumer's *Retief* stories.



References: *Starship Troopers* by Robert A. Heinlein; *The Forever War* by Joe Haldeman; *Hammer's Slammers* by David Drake; the *War Against the Chtorr* series by David Gerrold; *Space Viking* by H. Beam Piper; *The Mote In God's Eye* by Larry Niven and Jerry Pournelle; the *Cobra* and *Blackcollar* books by Timothy Zahn.



Colony Alpha

The characters are colonists, settling a newly-discovered world.

Character Roles: All of the PCs *should* be rugged survivors. Characters with good craft and outdoor skills will do best. However, colonists may also include political or religious refugees, criminals and minorities — and not all of these will be survival types. Some specialists may be needed to operate equipment, exploration vehicles or weapons. There might be a government representative.

Things to Do: The basic idea is to tame and settle a hostile world. Many twists can be added — do the colonists have access to FTL drive, or are they "stranded" colonists arriving by generation ship? Are they the first colonists, or the follow-up team? (If they are the follow-up team, are the original colonists still there when they arrive?) Are there hidden surprises such as a bizarre ecosystem, unknown aliens, Precursor relics, or a smuggler base? Are the colonists unified, or will there be strife between factions? Is this a peaceful colony, or an outpost in disputed territory? Are there menacing pirates, aliens or hostile Earth governments? The colonists may not even have a world at all — they may be on a "lost" generation ship, perhaps with regressed technology.

Campaign Advantages: Colonists won't need a starship. The GM will need to design only one star system, though great detail will be required. Many players enjoy the challenge of organizing settlements and exploring the frontier. This campaign might be at TL8 or even lower, especially if the PCs arrived on a sublight "sleeper" ship.

Campaign Disadvantages: If the colony is isolated, there will be a limit on available equipment — and its use may be controlled by government authority. The GM also has the burden of keeping the campaign interesting, rather than "build another hut / explore another valley."

References: Farmer in the Sky and *The Rolling Stones* by Robert A. Heinlein, *Tau Zero* by Poul Anderson, *A World Out Of Time* by Larry Niven, Harry Harrison's *Deathworld* series.

Stop In The Name Of The Law

Characters are valiant members of the Interstellar Patrol, patrolling the spacelanes against human and alien menaces.

Character Roles: Characters are Interstellar Patrolmen or Rangers, probably assigned

to a ship. They should have the skills to perform their duties; one may be the Patrol leader. (Or PCs might work for any peacekeeping force — including interstellar diplomatic agencies.)

Things to Do: Aside from patrolling interstellar borders and spacelanes, Patrolmen are interstellar policemen, investigators, rescuers and the all-around do-gooders of the galaxy. If there are pirates to be fought, smugglers to be tracked down, an alien invasion to be blunted, a mystery to unlock, or a distress call to answer, the Patrol gets the call. In times of war, the Patrol and the Rangers are called to duty — whether on covert missions behind enemy lines, escorting convoys, or serving as light combat forces.

Campaign Advantages: The Patrol is a powerful Patron, providing equipment and a ship. Patrolmen also have a great range of adventures. This makes a wonderful "space opera" background.

Campaign Disadvantages: Patrol PCs have a Duty to their organization and its officers — and, depending on the campaign, they might operate under tight supervision. The Patrol represents interstellar law; it can't go around shooting indiscriminately. Patrolmen often have the privilege of dying in the line of duty.

References: There are lots. The archetypal Patrols are found in the *Lensman* series by E.E. Smith and Andre Norton's SF novels.

Races

Nothing affects the flavor of a science fiction campaign as much as the presence (or absence) of alien races. Four sample races are described on pp. 43-44. Campaign possibilities include:

One Race

There is only one sentient race, and all characters must belong to that race. However, widely variant forms are still possible. A human-only cosmos can still be diverse and exciting. Many stories of galactic sweep, such as Herbert's *Dune* books and Asimov's *Foundation* series, have included no alien races.

A Few Races

There are only a handful of star-traveling life forms. Almost anyone will recognize each race, and know the important facts about it.

Many Races

There are many, many intelligent races in the universe. Unless a race is dominant or exotic, only those with Area Knowledge of its region of space will recognize it on sight. The various races mingle, and there may be true interspecies civilizations. Types of races will include:

Dominant. One or more races may dominate others; their power may be military (conquerors or peace-keepers) or economic (manufacture, trade or exploration). Dominant races are well-known near their regions of space. The opposite is *subordinate* races that are dominated by others.

Common. A race that is older, fast-breeding, or aggressive in exploration may be encountered often. Such races are also well-known in their localities, regardless of dominance. The opposite is *rare;* such races may be new to interstellar civilization, secretive, or slow-breeding.

Exotic. Races may be well-known because they have odd customs, bizarre reputations, unusual biology, or control of a particular technology.

Advanced. Some races might have a higher TL than the rest of the campaign — or they might monopolize a particular technology (perhaps a certain FTL drive). The opposite is *primitive,* a race that is technologically backward.

Precursor. Many SF novels have been written around the mysterious Precursor or Forerunner races, once-great civilizations which have disappeared, leaving only puzzling ruins and artifacts behind.

Subrace. A race may include several subspecies or offshoots. These may exist within a single society, perhaps with a caste system. Separate societies of subspecies might also exist; perhaps they separated millennia ago.

Descendant. A popular theme in SF literature is the "fallen" race, descended from a once-mighty civilization. Or space might contain several subraces, all descended from the original Precursors (or the lost First Human Empire).

Unknown. The GM may create one or more races — potentially friendly or hostile — that are unknown to interstellar society at the start of the campaign.

Writing History

When you know what your present-day universe looks like, you should fill in some of its history, with special attention to the area the PCs will be operating in. These notes may be detailed or sketchy, but the players will certainly want information about what happened last month, last year, and last century.

Important points to cover in a future history:

First FTL drive. Who reached the stars first, and how?

First interplanetary colonies. Who discovered habitable planets of other stars? Who colonized them, and how? (If colonies were launched by generation ship or sleeper ship, then colonization could take place before the discovery of FTL travel.)

First contact with aliens or extrasolar humanity. And if the First Contact was with humans from other planets, what are they doing out there?

Interstellar wars. Did they happen? When and why?

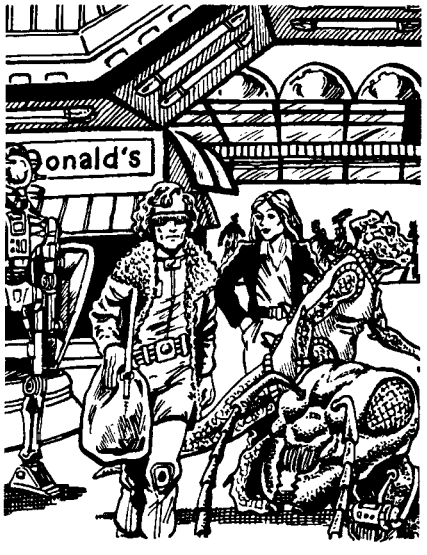
Advances in technology. Was the original FTL drive superseded by something later? When and why?

Formation and dissolution of interstellar nations and empires.

History of organizations to which the PCs are likely to belong.

History of important planets. Date of colonization; who colonized them, and why; subsequent development.

In some universes, of course, it may be impossible to answer all these questions. Perhaps humanity has populated the whole Galaxy, interacting with hundreds or thousands of other races, and Earth itself is lost in the dim past. In this case, the important history will be that of the territory where the campaign is set . . . who are the friends and enemies, where does the money come from, and what the politicians are likely to do next.



Languages

Any multi-species society will have to deal with the problem of language (see p. 35 for language skills). Some options:

Designate an official language. A common language ("Galactic Basic") may be designed, with a simple grammar and sounds that can be pronounced by the culture's major races. If different races have widely-different methods of communication, there will be several official languages. Of course, a Galactic Empire may just require everyone to learn the rulers' language.

Develop a "shorthand" or "trade" language. Interstellar traders often devise their own language. This is usually a simple, pidgin tongue — heavily augmented with gestures — for use between vastly different cultures and races, where the most complex ideas that must be conveyed are: "What do you have to trade?" and "How much is it?"

Find a technological solution. If a universal translator device is possible — based on advanced psionics or "miracle" technology — then a common language isn't needed: communications are possible without it. Of course, translator devices might be unreliable . . .

Whatever the translation system, it will work best with aliens whose thought processes are like ours, and worst with the *really alien* aliens.

The Precursors

Many future histories incorporate Precursors — alien civilizations that died out before mankind reached the stars. They are also known as Forerunners, Ancients, Elder Ones (or Gods), Progenitors, Predecessors. Or they may be called by the name of a world on which their remains have been found. In most cases, who they were and why they disappeared is a mystery. There might have been a single race of Precursors, or dozens.

The discovery of new or different ruins or — especially — of working artifacts is a celebrated event. Study of Precursor technology might change a whole campaign's TL. (Or the poor Precursors might have had technology *inferior*, overall, to that of the campaign!)

Adventuring possibilities: A campaign might center around the search for Precursor artifacts, ruins or knowledge. A find can make the PCs rich beyond their wildest dreams — or hunted by half the galaxy. A Precursor involvement can spice up any adventure (for instance, the pirate base might turn out to be a Precursor installation). The Holy Grail of the campaign would be the chance of finding the Precursors themselves, or learning the Precursors' Secret.

Societies

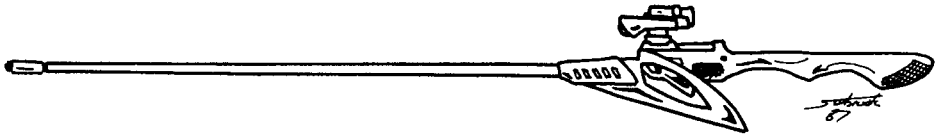
SF literature describes dozens of different kinds of interstellar nations. (We'll use the term "nation" to mean any interstellar government.) The most important things about an interstellar nation are *size* and political *type*.

Size is largely determined by the speed of FTL travel and communications, which will be discussed in detail in the next chapter. In general, the faster the ships can travel, the larger an interstellar nation can be. Central control is difficult when the borders are more than a month's travel from the capital.

The most common political types are the Alliance, Federation, Corporate State and Empire. Examples of each can vary greatly. Look at the differences between the empire in Isaac Asimov's *Foundation* series and that in *Star Wars*, or the federations in *Star Trek* and Andre Norton's *Solar Queen* books.

Of course, names may vary greatly; some alternate names for each type of government are provided below, to add variety to galactic maps. And governments, especially repressive ones, can have deceptive names — the iron-heeled empire that calls itself an alliance, or the fragmented mini-state that puts on the title of Empire. After all, is the U.S.S.R. *really* a union of republics?

Designing your interstellar government(s) is a great creative exercise, and shapes your whole campaign. Here are four general outlines:



The Alliance

An alliance is a group of autonomous worlds. Its key feature is that its members are genuinely *self-governing*. The alliance controls only interstellar policy — primarily defense policy and foreign relations — and not any member's domestic affairs. Citizens have no direct influence on an alliance, but influence their world government which is represented on the Alliance Council.

H. Beam Piper's Sword-Worlds formed an Alliance (the individual worlds had feudal governments). The human worlds of Larry Niven's *Known Space* series might be considered a very loose alliance, at least in wartime.

Government

The governing body is a council, made up of delegations from each member world. If a world has multiple governments, all must be represented in the delegation. In some cases, an alliance may give special power to important members — extra votes or veto power.

Normally, the Council may only pass laws affecting relations among its members, and seldom intrudes on a member's internal affairs. A majority of the Council — usually two-thirds — must favor any measure before it can be voted into law. A world can disregard Alliance laws by seceding, or by becoming an associate member — losing its vote on the Council but gaining full freedom in interstellar policy, yet retaining many benefits of membership.

The Council also acts as a court or mediator among member worlds.

When it comes to politics, an alliance is wide open. Member worlds can practice assassination, war among themselves, bribe Alliance officials — and until the Council comes up with a two-thirds majority, the Alliance will be powerless to stop it. Each member world, jealous of its own sovereignty, is loathe to allow the extra police powers — including counter-espionage or expanded military forces — that would allow an alliance to maintain order among its members. Only an outside threat is likely to unify the Council to legislate the needed action.

However, there won't be large interstellar rebellions fomenting in an alliance — there isn't that much to rebel against. Rebels are more likely to fight member worlds than the alliance, often covertly backed by other member worlds.

The Military

Alliances typically maintain a small interstellar navy, while member worlds maintain their own defense forces. If member worlds are stingy, the Alliance military may be desperately underfunded until actual war breaks out; if not, they can be small but formidable forces.

Navy operations beyond routine patrols must be approved by the Council. Alliance military forces may not intervene in a member's internal affairs without permission from that member. In extreme cases — if conflict on a world or between member worlds is a clear threat to the Alliance and its other members — the Council may send in a peacekeeping force.

During peacetime, planetary fleets usually restrict themselves to their own star systems. They may also take turns performing border patrols or other routine duties at the request of the alliance. In wartime, the Council can request members to mobilize their fleets to supplement the Alliance Navy. Even then, officers may challenge the nominal authority of the Alliance Admiral, especially when their homeworlds are threatened.

Ground combat forces might consist of a small core group — a Marine Corps or Presidential Guard. It too is supplemented in time of war by member worlds' armies. And mercenary organizations thrive in the loosely-regulated clime of an alliance, and are always available to aid with the defense, for the right price.

Law and Order

There will be an interstellar police force, usually called the Patrol. From a 20th-century perspective, the Patrol is a combination of state police and Coast Guard. It may be the only permanent military space force an alliance maintains. The Patrol has full judicial and legal powers within the alliance, outside of a member world's borders. Anyone arrested by the Patrol is tried in a Patrol court.

Since Alliance laws deal only with interstellar matters, PCs will not be bothered by Alliance law except when operating in space. While within the political boundaries of a member world — which usually extend throughout its solar system — they are subject to local laws and ordinances. And local laws can vary widely from member to member! One world could be a liberal democracy where citizens enjoy great personal freedom, while others might be dictatorial, tribal, theocratic, corporate . . .

Extradition of criminals from member worlds is possible, but never certain. Once a criminal is on a world, he is under its jurisdiction — the Alliance legal system only has jurisdiction in interstellar space *between* member borders.

The Patrol seldom interferes in commerce between member worlds — restrictions are more likely to be imposed by the members themselves. Exceptions may be made if the Patrol is after terrorists or pirates, or if a ship is acting suspiciously, but the Patrol must be careful not to offend member worlds — and delaying cargoes or disturbing tourists is often offensive.

The Patrol exerts more control over travelers from beyond Alliance borders. Patrol ships and border stations carefully screen incoming traffic, even if the destination worlds protest such scrutiny. Passengers are checked against lists of wanted criminals. Cargoes are checked for contraband, dangerous animals or illegal weapon shipments, and routine tests are made for disease or pests. Leaving Alliance territory, on the other hand, is usually simple.

Certain goods may be taxed or banned, either because they're dangerous, or to protect the industry of member worlds. Enforcement is up to the Patrol.

Taxation of individuals is a power strictly held by member worlds, *not* by the Alliance. The Alliance is funded from tariffs, fines, and contributions from member worlds for protection and services. Payment may be made in kind rather than in currency. Worlds which cannot pay their "dues" may be subject to coercion by other worlds, or by Alliance forces.

Terrorist and fanatic groups may exist. If they do, the limited authority of the Alliance may make them hard to root out. Member worlds might secretly shelter terrorist bases, letting them train beyond the reach of the Patrol.

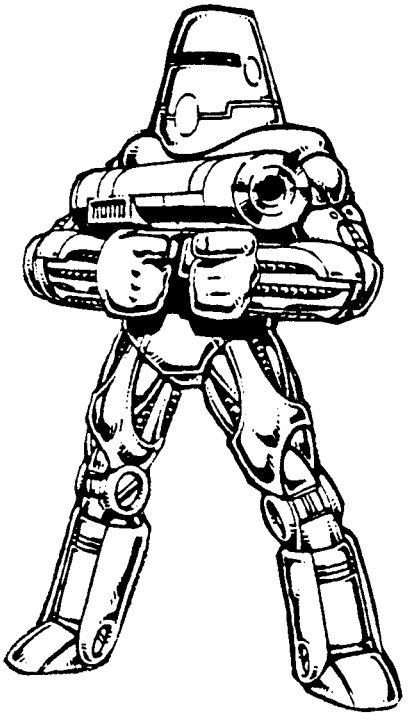
Origin

Alliances may form in response to external threats, or from weakening of a more controlled society. This is a natural first stage for interstellar government. Often, the original members have ties besides geography — common ancestry, trade ties, or similar histories.

Effects on the Campaign

Citizens of an alliance are free to do almost anything — even exploration is unregulated. Unless they violate one of the few Alliance laws, they have little to fear from the Patrol.

Another benefit of adventuring in an alliance is its potential variety. *Any* sort of government or society can exist on a member world, as long as the world is reasonably



Alliances: Variant Forms

Hegemony. This is a society or group of societies in which one member controls the external affairs of the others, without interfering (much) with their internal policies. Otherwise, it is similar to an alliance — or, in its most restrictive forms, an empire. In a Terran Hegemony, for example, Mother Earth would be "first among equals," dominating the other member nations of the state. A hegemony may be repressive or benevolent.

Confederation. This may be just another name for the same political structure described for an alliance. It may also be a loose grouping of worlds for defensive purposes against an outside threat. Other than aid, assistance and cooperation for the common defense, worlds within a confederation may have few ties. They are usually bound by a written defense treaty, and are otherwise self-governing.

Axis. An Axis is a confederation of two or more worlds or societies built around a common philosophy. They coordinate foreign and military policies, usually seeking to draw under their sway dependent or supporting worlds. An axis is often expansionist and highly aggressive. Eventually, one of the worlds in the axis may come to dominate the others, forming a hegemony.

Concordance or Concordat. This type of society is formed when a group of worlds agrees to abide by the terms of ideals, laws and principles for government expressed in a pact or concordance. Often, they will share no military forces and have no common laws; nevertheless, they may be very close allies.

Federations: Variant Forms

Assembly. Just another name for a Federation.

Protectorate. An expansionist federation might come to possess a large number of frontier sectors or colonies. Since the frontier sectors are not judged ready for self-rule, the federation government acts to protect and govern them. Such rule can range from benevolent, to mindlessly bureaucratic, to deliberately exploitative and repressive.

Union. Any nation in which worlds have joined, willingly or unwillingly, into a single political entity may be called a Union or a Unity.

stable in its dealings with other planets. However, this allows more chances for PCs to run into unexpected laws and taboos. And if they get in trouble on a member world, they can expect little help — the Patrol has no jurisdiction.

Resourceful types who are wary around repressive societies, and who aren't adverse to world-hopping when it's time to run, may do quite well in an alliance.

The Federation

Although federations and alliances share many features, they are different in basic philosophy. In an alliance, the individual member worlds dominate the central government. In a federation, the opposite is true — the central government takes precedence over its component worlds. Federations usually take the form of republican democracies — that is, citizens elect the Federation President, and local representatives to a Federation-wide Congress. The typical federation is free but bureaucratic.

Federations are the ruling bodies in the *Star Trek* universe and Alan Dean Foster's *Humanx Commonwealth.*

Government

A federation is composed of administrative areas called sectors. Each sector may encompass one or several star systems. There will be small differences (if any) in different sectors' laws. The sector governor is chosen by popular election; there is also a sector legislature.

The Federation President (or Elector) is selected in a Federation-wide election, and serves for several years. He is responsible for administering the laws enacted by the legislature. He controls foreign relations, with the advice and consent of a Senate. He may sign treaties and declare war. He is supreme commander of the Federation military, and may use them without prior approval by the Senate — although the Senate may call on him to justify his actions.

A typical legislative body is a Federation Congress, elected by individual worlds (delegation size depends on world population); it is usually responsive to the will of the citizens.

There is a separate judicial branch. While the Patrol is responsible for enforcing Federation law, any offender will be brought before a Federation court at the appropriate level.

When a world joins the Federation, it agrees to abide by the Federation charter. For this reason, sector government and law are much more homogeneous than those of an alliance's member worlds — divergence is prevented by swift Federation action, including economic blockade and military invasion.

Secession usually isn't an option to members of a federation, unless several worlds secede at once, or outside military protection is available. Planetary nationalists favoring succession may become rebels or terrorists. In rare cases, politics will allow a peaceful evolution to "special autonomous status" and finally independence.

There may also be *frontier districts.* These are similar to sectors, except that their populations are new (mainly colonists or the newly-conquered) or scattered (a blighted region of space). The district government and officials are appointed by the Federation, and there is no sector legislature.

The Military

Federation politics recognize that military and political power are linked. The Federation Navy is the only group authorized to have interstellar warcraft. Member worlds must surrender their navies upon joining. Harking back to the days of independence, however, naval vessels may be named after and manned by a particular world — the cruiser *Lotvik,* for instance, is crewed largely by native Lotvikians. Size of the fleet depends on the political will and wealth of its citizens. If the people will tolerate the cost of a major fleet, a federation can be as militant as any less-democratic society.

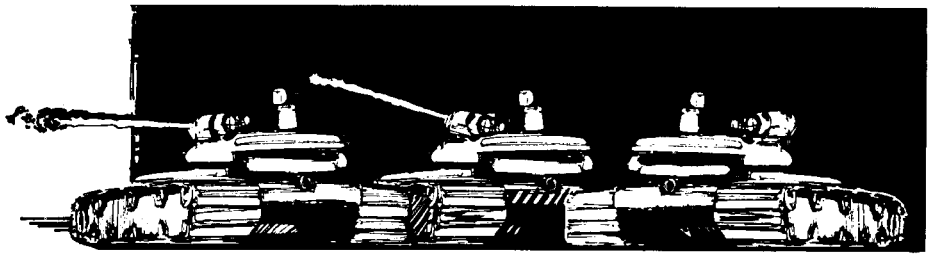
The Interstellar Marine Corps is the Federation's military ground force. Planetary guard troops and draftees supplement the Marines in wartime, but it is the experienced, well-trained Marines who handle the dirty work — planetary invasions and defenses, commando raids and so on. If there is a continuing threat to the nation, federations may institute a draft, requiring young citizens to serve terms in the armed forces.

With Federation permission, individual worlds may establish Planetary Guard units. These include ground troops, and possibly atmospheric and sublight warcraft, but no significant armed starships.

Mercenary companies are rare except in frontier sectors, as the government distrusts

independent military forces in central areas. In times of upheaval, mercs may be called in, but liaison officers will be assigned to ensure that they remain under strict control.

A federation may form its own legion of mercenaries. These troops are useful for prosecuting politically-unpopular wars, especially if they are recruited solely from frontier or foreign worlds — which have no representation in the Congress, and cannot easily complain about combat losses.



Law and Order

Unlike an alliance, which is concerned with the rights of its member worlds, a federation guards the rights of its citizens. The necessities of reelection help to foster this. Federation laws are designed to protect the individual citizen, and to provide security and unity for the society. On the whole, Federation citizens get more benefits, services and protection than citizens of an alliance.

Police functions may be handled by planetary or sector law enforcement organizations or by the Patrol. The Patrol has full authority anywhere in Federation territory, but must cooperate with planetary police — it cannot investigate and arrest independently of local authorities, unless they are obstructing justice.

Extradition of accused criminals between worlds is mandatory under Federation law, provided the requesting world can guarantee a fair trial. Otherwise, the accused will be tried in a Federation court. Federation authorities (such as the Patrol) carry out the extradition process.

Terrorists may be present, but bases must be well-hidden to survive. Any world known to be harboring terrorists can expect swift reprisals from the Federation Marines.

Federations keep tabs on interstellar trade within their borders, routinely inspecting cargoes and travelers. Traffic entering and leaving the nation will be more restricted than that of an Alliance. Passports will be required — especially if the Federation has hostile neighbors — but the emphasis will be on the right of the average citizen to travel, limited by the security needs of the society.

The Patrol is on hand to combat pirates or terrorists and conduct rescue operations when needed. It will also ensure that citizens aren't taken advantage of by unscrupulous transport companies.

Interstellar trade involving Federation worlds is regulated by an Interstellar Trade Commission. The Congress may ban some goods — usually harmful drugs, proscribed weapons, dangerous animals, and so on. Tariffs and duties may exist to control imports that might harm world economies. This means there may be a lucrative business for smugglers in some areas, but that's what the Patrol is for. Customs offices are maintained at all starports in Federation space. Starports are considered Federation territory, and local police do not have jurisdiction there. The Patrol operates these ports, plus any additional posts needed at warp points or along trade routes.

Free news services thrive, restricted only in the name of Federation security.

Taxes may be collected by the Federation, sector and local governments. There may be a personal income tax, or taxes on commerce. Merchants and entrepreneurs will do their best to beat any such tax!

Origin

Federations often evolve when an alliance is forced to strengthen its central government by some threat. Federations last longer than alliances, because their society can quickly meet and deal with external threats, and often has the power and authority to deal with internal ones as well.

Effect on the Campaign

Campaigns set in a federation offer less freedom for those who play fast and loose with the law. However, law-abiding types may find it the safest place of all — if they are Federation citizens. PCs who run afoul of extremist planetary societies might find aid at the nearest Patrol office, unless the Federation approves of the laws they broke.

The Conquered/Insignificant Terrans

In this type of universe, Earth has been conquered or absorbed by a technologically (or numerically) superior stellar state, already in existence when Earthmen reach the stars. Earth may be one of many member (or subjugated) worlds, perhaps even considered a provincial backwater of little significance in the galactic scheme. Humans (or Earthmen, at least, if the existing state is also dominated by humans or humanoids) may be second-class citizens, or worse, especially if Earth has been conquered by an alien-dominated federation or empire.

Even if Earth's absorption was peaceful and the rulers are benevolent, Earthmen may be considered children or primitives. This is especially likely if the overlords have superior technology. On the other hand, if the overlords are *too* civilized, Earthmen may be valued as warriors. (This might be as a great ploy on the parts of the stellar rulers — a way to keep those pesky wolflings busy.)

If the rule of the master state is *too* heavy-handed, however, Earth might be in rebellion. Earth might be in confederation with other worlds — or even other, smaller stellar societies.

The campaign then becomes military. PCs would be members of the Rebel forces, fighting for Earth's destiny. Or, to pose a moral dilemma, the GM could make the PCs members of the overlord forces, preparing for a punitive campaign against one of those insignificant worlds bucking imperial rule. The world's name? Oh, Dirt, or Earth, or something like that. Won't matter once you launch those planetbusters, eh? What an honor!

Corporate States: Variant Forms

The Cartel. Space is controlled not by a single megacorporation, but by a league of several competing corporations. Such a cartel is a hybrid of corporate state and alliance. There is no CEO, and the board of directors is replaced with a League Council whose members are delegates from the member corporations. The council selects a chairman, who has very limited authority — like an alliance, individual member corporations have more power than the central cartel government. Member corporations maintain private fleets, fight among each other militarily and economically, and spy on one another to obtain commercial secrets.

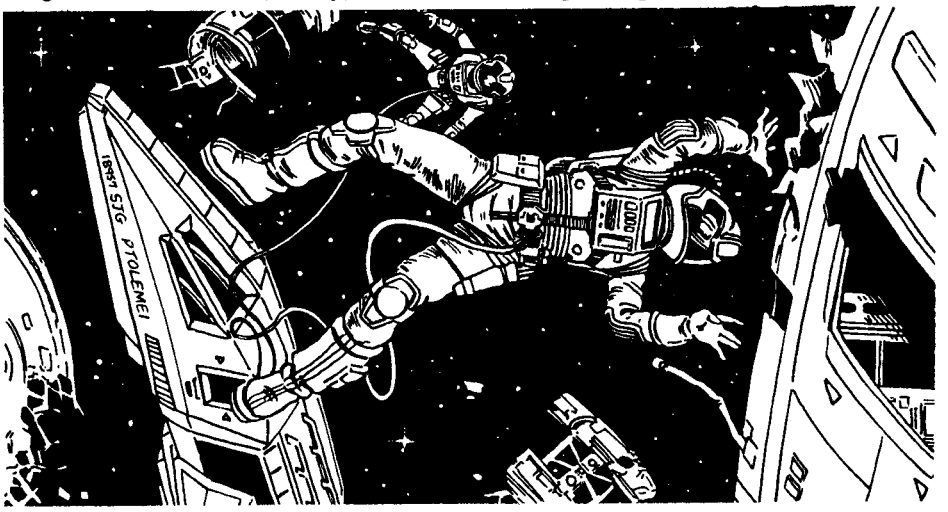
The Enterprise. Citizens in this society follow the political doctrine of free enterprise — they want *everything* done by competing companies. The structure of corporate society remains the same at the upper levels, but everything at middle or low level is contracted out — private companies bid for the contracts to run government services, including the police, custom ports, welfare and prisons. The military consists of hired mercenary and security companies. Competition is enforced and monopolies are illegal.

The Association. A close brother to the corporate state, the association is formed of interdependent corporations. Each corporation performs a function of government — one is Commerce, one is Defense, one is Justice, and so on. Such corporations compete over turf — for instance, there are redundant espionage branches in Defense, Commerce and Law Enforcement — and some would like to establish predominance over the others. The Board of Directors is made up of delegates from the associated corporations; citizens usually own stock in the corporation that employs them.

The Corporate State

This is a society run by *big* business — a huge corporation that controls entire worlds, with a monopoly on commerce among them. Leadership is vested in a Board of Directors and a Chief Executive Officer (CEO).

Dictatorial corporate states are depicted in F.M. Busby's *Star Rebel* stories and (on one world) in *Sten,* by Allan Cole and Chris Bunch. Poul Anderson's Polesotechnic League is an alliance of (usually) fair and well-managed corporate states.



Government

A corporate state is "managed" rather than governed. Leadership follows standard business practice — the CEO directs day-to-day affairs, appointed and supervised by the Board of Directors. As long as the CEO has the support of the board, he has dictatorial powers, and may hire and fire all executive officers.

The Board of Directors is elected by the company stockholders. Directors have no responsibility for the day-to-day operation of the company, but act as a policy council to advise and direct the CEO. The directors elect one of their number as Chairman. The Chairman is the single most powerful person in the corporate state, though he operates behind the scenes.

Minor rules and regulations are set by corporate bureaucrats at all levels. Major policy decisions are made by the Board. The Board also decides the amount of stock available on the market, and possibly its current cost.

The relative benevolence of the corporate state depends on how the stockholders are organized. Citizenship is defined as owning stock in the company. Sometimes a stock certificate is issued along with a birth certificate; sometimes citizenship must be earned. More stock means more voting power, and in a malevolent corporate state the board is dominated by a wealthy minority. But sometimes the "poor" stockholders can band together into "blocs" of common interest, similar to political parties in a democracy. If they have the numbers, they can vote their own representative onto the board.

Stock ownership is power. If a few wealthy magnates control the Board, society will be managed for their benefit and individual rights will suffer. If other voting blocs gain power on the board, interests will be protected; as more blocs gain power, rights are gradually extended to all citizens.

Stockholders also receive dividends, as long as the corporation makes money. Militant stockholders may demand profits, steering CEOs away from long-term investments and toward short-term gains. After an unusually profitable period, the board may declare a Jubilee Year — paying extra dividends and sponsoring celebrations.

Individual worlds are run by middle-management corporate officials, many of whom are working hard to show a profit and earn a promotion. Local management styles may vary from enlightened to dictatorial, and don't have to match overall corporate policy if the Board is far away.

The Military

All military power is in the hands of the company, from local police to interstellar fleets. Local forces will be controlled by planetary directors. Major operations may be ordered by the CEO, and must be approved by the Board. There may also be an elite Security force — possibly a secret police in all but name — under the direct command of the Chairman of the Board.

Law and Order

Company regulations have the force of law. Many rules exist to insure that individuals put company concerns over any of their own.

Personal freedoms are often allowed only to the point where they interfere with job performance. Failure to follow regulations, meet quotas or get along with one's supervisor can result in demotions and salary cuts (and loss of social status), or criminal sentences, or firing. Firing is the ultimate punishment, since there is no other employer — shopping at the company store, banking and credit rights, and health benefits are lost along with employment.

Rebels aren't acknowledged as such. They are instead saboteurs, pirates, socialists, communists or — worst of all — *unionists*, and are to be rooted out at all costs.

There is no judicial branch. Local executives conduct hearings and trials in their localities. There may be a "corporate ombudsman" to see that workers get fair treatment and fair trials. The power of the ombudsman depends on the stockholders. If the Company is repressive, the ombudsman is helpless, or a pawn of management; in a benevolent society, the ombudsman has enough influence that middle management must respect his views.

Travel between worlds is controlled by the company. Travel for corporate reasons is easily arranged. Individual citizens are also free to travel, using their own time and money, though they may be "bumped" from scheduled flights by business travelers. Productive employees are often rewarded with paid vacations to pleasure worlds. Most employees, however, rarely get to leave the worlds of their employ — unless their skills are temporarily needed on another planet.

News is handled by the corporation's public relations or communications department, and reflects the company line. There are many stories about corporate success and happy employees. Failures are seldom reported.

Trade is company-regulated. Company employees must obtain all their goods at the local company store, paying whatever prices the company sets. With the company in control of all commerce, there's no competition and no chance of getting bargains somewhere else. Of course there's a black market, but it's grossly illegal.

Specific taxes in a corporate state are not necessary, since the company makes its "profit" on everything that is bought or sold. Occasionally, in a profitable year, the corporation will even pay bonuses to its workers.

Origin

A corporate state may evolve from the conflict between a super-corporation and a weak government, or when government gives too much authority to business.

If world colonization and exploitation is run by private enterprise, then single-company settlements may result. If corporate rule is unchecked by government, the corporation can expand its power base until it *is* the government on the colonies, while controlling trade with the mother world.

In a far-flung society, corporations may be allowed to form private fleets for defense in remote areas — similar to the East India merchant ships in Earth history. Such military power can allow total despotism in colonial regions, and may give the force needed (perhaps in alliance with other corporations) to secede from or take control of the society.

Or a corporation may come into possession of a technology so valuable — control of FTL travel, for instance — that it can do whatever it likes!

Effects on the Campaign

Corporate societies can be dangerous. Security is watching, all the time! So PCs might be in Security . . . or they can be evil unionists! Good employees will keep their eyes on business, their shoulders to the wheel, and their noses to the grindstone — while watching their backs.

The Long Night

No civilization is immortal — and when an interstellar nation falls, the disintegration will be profound. Natives will clash with colonists suddenly deprived of aid; armies will be left without pay and high command; money will become worthless, and value of off-planet goods will skyrocket. Not a good time to live, perhaps, but a great time for adventure.

A period of turmoil and consolidation follows the collapse. Entire provinces and individual worlds become isolated. Systems or whole sectors may break off and become self-governing. With luck, the collapse ends at this level.

Otherwise, worlds may revert to barbarism, ruled by outlaws, raiders or petty warlords. Technology may be lost — including the ability to travel from star to star. If a province or group of worlds is dependent on supplies from other areas — recently-founded colonies, or settlements in hostile space — entire worlds may die.

This period of galactic history is known variously as "the Long Night," "the Dark Years," "the Interim," "the Aftermath," and so on. The period may last decades or centuries.

The Long Night is followed by reconstruction and consolidation. Any surviving kernel of the original civilization, plus strong new nations, will begin to expand outward again. Smaller states are likely to be absorbed. Eventually the new government may reach the boundaries of the old one and start to expand again.

This cycle may be repeated many times. In a universe where man has been traveling the stars long enough, it may be that so many stellar empires have risen and fallen that Earth itself is only a legend, and no one knows the limits of human space.

Empires: Variant Forms

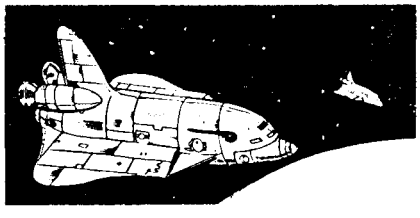
The Realm. This is a more purely feudal system, with less centralized control. The local sector or planetary rulers — possibly known as lords or barons — control significant military forces of their own. The emperor's military is probably the largest and best-equipped, but it is far outnumbered by the combined sector forces. For this reason, the emperor must keep the good will of some of the lesser nobles — leading to a Privy Council, an advisory body of representatives from the major noble families. An emperor who violates council advice may find himself all alone on the day of battle.

The Imperium. An imperium results when an autocracy grows too large to be effectively governed by one man using existing technology. The provinces of an imperium are large self-governing areas. Provincial governors owe allegiance to the emperor, but to the average citizen of the province, the province governor *is* the ruler, and the emperor is a vague, far-off figure. The emperor retains control over the military, loaning Imperial forces to the provincial governors — and fostering rivalry between his military and political leaders, to prevent them from allying and taking the throne.

The Theocracy. A society ruled by an individual church may closely resemble an empire, with the church's leader — the Prophet, Ayatollah, or whatever — substituting for the emperor. This is true if the church rules autocratically; if it merges a form of democracy in its rule, it will resemble the corporate state (substituting the clergy or faithful members for the stockholders of the corporation). Theocracies tend to adhere to certain founding principles, which sometimes leads to an unhealthy inflexibility.

The "Real" Empire. The technical definition of "empire" has nothing to do with one-man rule. It is a group of states among which one (the *metropole*) controls the internal and external affairs of the others (the *peripheries*).

In general, such a "real" empire can be treated like a federation in which one world or sector is dominant, pulling the strings of the others. The internal government of the dominant area can take any form. So can the peripheral governments — but whatever their form, they're puppets. A rebellion against such an empire is usually an effort by a peripheral state to take control of its own affairs.



The Empire

An *autocracy* is a state in which one person is the final authority. Such states usually clothe themselves in the trappings of religion, feudalism, militarism or all three. Fifty years of science fiction have popularized the term "Empire" for this sort of structure, and we'll follow suit (but see *The "Real" Empire*, in the sidebar).

Theoretically, all power comes from the autocrat, or Emperor — only by his grace does any lesser authority exist within the domain. Empires are *not* necessarily evil, or even totalitarian. An empire may be ruled by wise, fair people.

Empires are so common in science fiction that they're trite. Most (that of *Star Wars*, for instance) are dictatorial. Jerry Pournelle's CoDominium is heartless and bureaucratic. But the Empire of Man in *The Mote in God's Eye*, and the Imperium of *Traveller*, are basically benevolent.

Government

An empire may have a huge bureaucracy, or operate through a system of feudal lords (King of the Sirius System, Duke of Venus, Governor-General of Australia). But all authority essentially leads back to the Emperor.

Some Imperial servitors have more authority than others. The Chancellor is the emperor's officer for civil affairs, while his Adjutant General handles military affairs. There may be an Imperial Senate, elected by the people or selected by subject governments, but the emperor is free to ignore them. Corruption is often widespread — the right bribe to the right person can work wonders.

The ruler may be selected in many ways. Typically, the Emperor rules for life. The next emperor will be his eldest offspring, or the closest surviving member of the Imperial family if there is no child. The succession can be interrupted by rebellion — usually led by rival members of the Imperial family — or by the death of a ruler without an heir. In this case, the next emperor is chosen by an informal political process, heavily influenced by military power. Poison, assassination and intrigue may be common at court at the best of times.

A bureaucratic empire will be divided into provinces, ruled by governors. They will be selected from among trusted military leaders and loyal, weak or elderly civilians. An Emperor unsure of his power will forbid any governor to rule in one place for long, for fear he may become too popular with his citizens.

Individual worlds within an empire have whatever autonomy the emperor is pleased to grant them. Many worlds retain a semblance of their traditional government, and some even have limited independence. New territories are more cooperative when Imperial interference is kept to a minimum.

But such freedoms are subject to the whim of the emperor. At the first sign of disobedience, favored worlds may quickly find their governments deposed, replaced by an Imperial ruler backed by the Imperial guard. Other planets will quickly take the hint and toe the Imperial line. Either that, or they swiftly find themselves with new rulers as well — and a permanent military occupation if they cause too much trouble.

Rebel activity is rife, no matter how hard the empire tries to stifle it — there is a lot to rebel against. Some rebels will want freedom; others will be part of conspiracies to seize the throne.

The Military

A militaristic Empire can use its forces far more freely than other societies. Planetary police and security forces will report to provincial governors, but these forces will have little or no space combat capability.

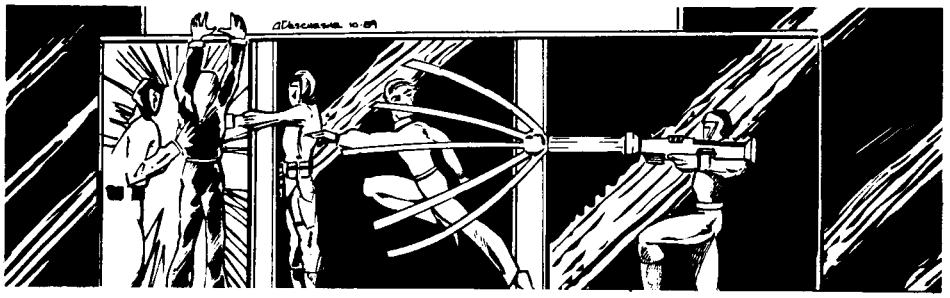
Conquest is the easiest way to expand an empire, using its inherent strength — a large military — rather than relying on exploration and colonization. Besides conquest, the armed might of the empire is geared toward keeping the populace pacified. In peacetime, much of the Imperial Fleet will be dispersed throughout the Empire; huge forces will drop in unexpectedly as a reminder of Imperial power.

Even the Imperial Survey Service takes on military overtones. The scouts not only seek out new worlds, but also make initial judgments about the potential for hostility or conquest. The Patrol is also an arm of the military, as its police duties often involve light pacification and occupation duties.

Defense policy is typically "attack first." The empire cannot be expanded if it is constantly under attack. Therefore, strike at any enemy — or potential enemy — before he can strike at the empire. Besides, war keeps the masses busy, justifies the defense budget, and brings in new subjects.

Imperial citizens may be drafted into the armed forces at any time. Criminals and debtors are routinely sentenced to military service. The military-age population of a rebel world may be drafted *en masse*.

Mercenaries may be common. In times of political unrest, Imperial officials may feel that mercenaries are more reliable than their own troops. Mercs may be hired to do the dirty work that the Imperial Marines consider themselves too good for, and they can be paid in "looting rights."



Law and Order

The word of the emperor is law. Some emperors rule by personal decree, but others are happy to let a huge bureaucracy make all the "boring" decisions. Imperial laws take precedence over all local laws.

Empires are restrictive by nature. Personal liberties are kept in check to ensure the security of the empire — otherwise, there will be unrest and rebellion. In general, nothing can be done without the proper licenses, permits and orders: to use military force, to trade, to prove identity, to travel. Forgers will grow rich (or vanish suddenly).

The Imperial Patrol has police powers. Routine trials are held by local governors, or the Patrol for offenses in space. But important matters must come before an Imperial Magistrate — an elite group of the emperor's personal representatives. Punishments include prison, forced-labor camps, slavery, torture and draft into military service.

An autocrat may tolerate protest against his policies, but never against his rule. At the first hint of any actual threat, dissension is crushed.

Travel is tightly regulated and requires the right documents. Common citizens find it next to impossible to obtain permission to travel beyond the borders. One of the Patrol's duties is to police the borders for refugees attempting to escape.

Interstellar trade may still flourish, but heavy regulations and duties make it difficult to prosper without buying influence in the Imperial court. Small traders may turn to smuggling to survive.

The empire will ban commerce it deems a threat, including military supplies — gun-running to rebels carries an automatic death sentence. Traffic in drugs and vices may be prohibited by a puritanical Emperor or encouraged by a decadent one. But the Imperial Trade Commission is notoriously easy to bribe.

Taxes are numerous and burdensome. Citizens may pay a tax on everything they do, from travel taxes to restaurant taxes.

News will be censored by the Imperial communications bureau, and history itself may be rewritten in the Imperial chronicles. From a totalitarian viewpoint, control — of travel, news and ideas — is everything.

Origin

An autocratic "empire" may be founded when a society is faced with a crisis, from outside or within. Rule by one person, bypassing debate and election, may be appealing, since the autocrat can act far more swiftly than a democracy. This might happen during a war, especially as a desperation measure of a losing side — or an unhappy military might stage a coup. It could also happen in hard economic times, by popular election — citizens might believe a strongman's promise of forceful leadership. An empire could also evolve from a period of martial law — the military rulers just stay in power.

Social or economic conditions — overpopulation, food shortages, unemployment — may lead to restrictions and a loss of personal freedoms. A society which believes it must control its citizens may take on more and more of the characteristics of an empire — though it probably won't call itself by that name.

Effect on the Campaign

If the empire is perceived as corrupt, players will enjoy getting away with whatever they can. If the empire is firm but fair (it can certainly happen!) there will be honor to be won in its service.

Why People Support Rotten Empires

It's nice to think that a government that Goes Too Far will eventually cause the citizens to rise in righteous wrath and throw the rascals out. It's also convenient when all the defenders of the Evil Regime wear uniforms (except for the occasional Secret Police spy). Unfortunately, we know from centuries of experience that it doesn't really work this way. The worst tyrannies imaginable have been enthusiastically supported by people no worse than you or I.

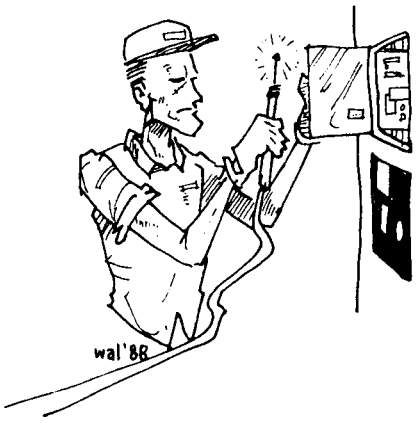
Without going deeply into psychology, here are some of the reasons citizens support tyrannies, which you can use to make your fictional Evil Empire and its people something more than laser fodder:

Citizens fear the unknown will be worse than the known: a foreign philosophy, a strange religion, society breaking down to anarchy. They may fear and hate an enemy population, especially if they are a different religion or race. Let alone *species:* do you hate the Bug soldiers because they are cruel and ruthless, or because bugs are icky? Many people fear that a new government would cost them their jobs or personal power; in a corrupt regime, they may have good reason to be afraid of justice. A clever regime's propaganda will play on all these fears, constantly portraying the foe as inhuman, the rebels as terrorist killers.

People who are used to obeying the law often have a hard time changing their habits when the law becomes oppressive. They still believe that "the police only arrest criminals; honest people have nothing to fear." When the rebels break into an armory to get guns, these people see only that a robbery was committed. Enough of this, and patriotic citizens may volunteer for the army to fight the wicked rebels. Obviously, rebellions find more support on worlds that were free until the empire conquered them. But even there, some citizens may hate the occupier but doubt the rebels would be any better. You can fight for "freedom" — but once you win, you have to set up a government.

And people may be loyal to the idea, or to the ideals, of a nation or empire, even when the reality is tarnished. "My country, right or wrong . . . "

It is not evil, or even cowardly, to be afraid of starvation, torture and death. Any successful rebellion must overcome these fears . . . to convince the people that anything is better than slavery. Meanwhile, the government is telling them that anything is better than anarchy. Which is why rebellions have a hard time of it.



The Census Division

The Census Division is the less-glamorous arm of the Survey Service. These individuals — sometimes known as Census Takers or Enumerators, or, less formally, "bean-counters" — have the job of accurately recording the status and continuing history of all inhabited worlds in their territory. They also measure patterns of trade and communication; they may find themselves called on to document monopolies, hunt smugglers, and do other jobs that you'd normally expect the Patrol to draw.

Under a sufficiently repressive society, the Enumerators may spy on their fellow citizens.

Being transferred to the Census Division is considered dire punishment by most scouts.

The Rebels

Every society has its dissidents, and when those dissidents take up arms, they become rebels. The character of the group depends on what it is rebelling *against* and *for*. A group rebelling against a repressive society, in favor of a democratic government, is probably heroic; a rebel movement to replace a king with a dictator is often less admirable.

In a far-flung imperium, rebels might seize several worlds successfully, while in a tightly-held dictatorship the Mind Police might thwart meetings of any kind.

Adventuring possibilities: The GM can easily build an adventure around overthrow of a planetary government; toppling a whole interstellar society could be the focus of a whole campaign. Rebel movements of all types can spice up any adventure: PCs searching for Precursor relics on Epsilon VII may become embroiled in a slave uprising, for instance.

Organizations

Any society will contain a number of important interstellar *organizations*, which make good building blocks for a campaign. Some organizations will be restricted to a single nation; others may extend through all of space. Organizations will include lots of NPCs — bosses, hirelings, foes, and spear-carriers. Most organizations make appropriate patrons (or at least employers) for PCs, but membership may also carry responsibilities — Duty, Sense of Duty, or both.

Below is a representative collection of far-future organizations. The details given are only suggestions — the GM will want to modify them, or use different organization names, as he adapts them to his universe. None of these organizations *has* to exist; if you don't like one, don't use it.

Government Organizations

Interstellar governments have many branches. Their official name should fit the name of their society — for instance, the Patrol might be known as the Alliance Patrol, the Imperial Patrol, the Interstellar Patrol, or just the Patrol.

The Galactic Survey Service

The Survey Service has two primary duties: To explore and chart the frontier, and to maintain accurate records of all worlds.

The Exploration Division of the Survey Service, often known as the Scouts, works to fulfill the first goal. There are two branches in this division — first-in scouts and survey scouts.

First-in scouts are a quirky lot, solitary and temperamental. In their one- or two-man craft, they seek out unexplored systems. If they find a possibly habitable world, they make the best report they can, even landing for close inspection if there are no apparent hazards. First-in scouts especially watch for signs of intelligent life. If a living race is detected, they *avoid* contact — that's a job for specialists.

When the first-in scouts make a favorable report on a new world, the survey scouts are sent in. The "surveymen" include xenobiologists, planetologists, xenoarcheologists and first-contact specialists. They begin by making an exhaustive orbital study, landing only when the planet is judged safe. Survey scouts certify worlds as suitable for colonization, and make recommendations about relations with new alien societies. Survey scouts are more intellectual than their first-in brethren, but they are still adventurous survivor-types.

Survey Stations, manned by Exploration personnel, are occasionally set up for long-term study of rare natural phenomena (e.g., white holes) and major archeological finds (mostly Precursor sites).

During wartime, scouts are attached to the navy. First-in scouts perform long-range reconnaissance, while survey scouts are attached to naval intelligence, often acting as fleet intelligence forces.

Adventuring possibilities: Anyone on the frontier is likely to encounter scouts, especially traders or corporate types interested in exploiting a newly-discovered society or Precursor site. Of course, a scouting campaign is possible.

The Interstellar Trade Commission

The ITC sets tariffs, duties, taxes, rules and regulations for all merchant ships, both corporate and independent. All traders must be licensed by the ITC in order to conduct commerce within the nation. The commission is also charged with preventing monopolies in trade, especially by the larger corporations, sometimes allying with the Special Justice Group.

Trade agents operate the customs stations at all starports, and cooperate with the Patrol and the Enumerators of Survey against interstellar smuggling.

Adventuring possibilities: Independent traders hate the ITC for its red-tape regulations, and love it for the way it keeps the big merchant outfits from putting them out of business. Corporations simply hate it. Everyone will suffer the indignities of going through customs. A shipful of ITC inspectors can poke their noses almost anywhere, making for a free-swinging campaign.

The Mercenary Regulatory Agency

This organization sets policies and directives for mercenary companies. Those that comply will receive licenses. Those that refuse must disband, or leave — or face the marines.

Regulatory agencies almost always prohibit biological, chemical or dirty-nuclear warfare within the nation's borders. Clean tactical nukes are sometimes allowed. Mercs must not go to a troubled world unless hired by someone on the scene, and must leave when the fighting is over.

Unfair technological advantages are sometimes outlawed as well — merc companies must use weapons of the same TL as the world on which battle occurs. Some latitude may be allowed; outnumbered forces may be allowed a technological edge, for instance. See Andre Norton's *Star Guard* and Jerry Pournelle's "Co-Dominium" stories.

Regulators are assigned to each merc outfit. Some are self-righteous and obnoxious; some can be bought; some do their jobs.

The Mercenary Regulatory Agency is also a clearing house for licensed mercenary outfits seeking work. When contracts are negotiated, the employers place half the agreed payment on bond with the agency. If there is a dispute later between the mercs and their boss, the MRA arbitrates — paying the mercenaries from the bond fund if necessary.

The agency maintains a central office on the capital world. Other offices may be opened if local business makes it worthwhile.

Adventuring possibilities: The MRA is a natural opponent for merc outfits, whether on the trail of law-breaking companies or acting as a nuisance for legal organizations. It's also a resource for merc characters out of work. If mercs aren't involved in your campaign, the agency is probably useless.

The Navy

The navy is the primary interstellar military force, defending against (or attacking) rival nations. During wartime, the navy's job is to defend the borders and vital inner systems, while depriving the enemy of his ability to wage war. Between wars, the navy maintains readiness by carrying out mock battles — often in barren, remote systems where they can use live ammunition. The fleet may also make "goodwill" tours to neighboring stellar states — allies *and* potential antagonists — to stave off war by impressing potential foes.

Large naval bases are maintained at strategic locations, often on airless moons or navy-controlled worlds. Small bases — mostly for refueling and repair facilities — are attached to many larger starports. The navy also has an intelligence branch, responsible for gathering current information on enemy military forces.

In an alliance or other loose society, the navy may be the professional core of the fleet, supplemented in wartime by regional forces of varying ability. Where the navy is the sole military arm, tight control must be maintained or the admirals may seize command and declare an empire.

Life as an average navy man is boring — shore leave is the only high point, and even battle may only involve routine tasks. Officers enjoy status and authority; fighter pilots also have prestige.

Adventuring possibilities: Stumbling upon a secret wargame can always be interesting, and in rare cases a naval squadron may pursue a noted villain. In most cases, however, the navy is the background threat — the intervention so awful no one risks it. Pirates and criminals avoid fighting the navy.

The Office of Colonial Affairs

The Office of Colonial Affairs (OCA) oversees colony ventures and regulates the construction of colony ships. It may control new colonies until they are self-sustaining, appointing all administrators and governors. It may also work with the Ministry of Prisons to get involuntary colonists for harsh, mineral-rich worlds. The OCA has branches on any world that is likely to launch a colony effort, and administrative offices on sector capitals and throughout the frontier.

Adventuring possibilities: For colonist PCs, a friendly OCA may be their best friend . . . and a corrupt one will be their worst enemy. An OCA inspection team will encounter interesting situations.

The Patrol

The primary responsibility of the Patrol is the policing of space. Peacetime Patrol duties include rescue work, escort for colony ships, routine space patrols, anti-piracy and smuggling operations, starbase regulation and inspection, and blockading restricted worlds. They circulate a monthly list of the top "wanted" interstellar criminals to starports throughout the nation.

Patrol forces operate under naval command during wartime. Typically, the heaviest Patrol ship will be a light cruiser, but crews are likely to be elite. In a young or

The Marines

Most interstellar wars are fought by starships. However, navies can only control space — it still takes ground soldiers to conquer a planet.

The marines are assault troops, the ground arm of the navy. Their most dangerous jobs come in wartime — boarding enemy vessels (if technology permits) and establishing beachheads on hostile worlds. Marine contingents are present on all warships, acting as security forces.

During peacetime, marines engage in wargames, guard Navy bases, train planetary defense forces, and aid in "police actions" — commando-style raids against pirate and criminal bases in cooperation with the Patrol. Under a repressive society, the marines have the job of crushing unrest and rebellion.

The toughest of the tough, the Marines live up to their reputation in combat and in peacetime. They get the dirty jobs — that's the way they like it. It isn't smart to mess with Marines.

Adventuring possibilities: The most likely place to meet marines is in a "liberty town" — a location where a company of marines has been granted R&R. Rowdy, drunk marines make interesting encounters. Ex-marines make well-prepared adventurers, and may know secrets from their military days.

loosely-knit society, there may be no navy — in this case, the Patrol performs both military defense and law enforcement.

Patrol bases are attached to many starports, and even minor starports are likely to have a Patrol office. The Patrol also has separate *operation bases,* away from the commercial starports, from which major anti-piracy and other missions are launched. The Patrol maintains a covert-operations office; its agents infiltrate criminal organizations. (In a repressive society, they are secret police.) The Patrol is known for rigorous adherence to the letter of the law, and rigid interpretation of those laws. The ideal Patrolman is super-competent, incorruptible and fearless.

Adventuring possibilities: Everyone encounters the Patrol, whether they run *to* it or *from* it when they're in trouble. Of course, PC Patrolmen will never lack for adventure.

The Postal Authority

The Postal Authority is responsible for the mail. Mail between vital worlds is carried by official courier ships. Mail service for minor worlds is contracted out to private trade ships. This is profitable — many independent traders depend on mail runs for steady cash — but PA standards are high! Other interstellar communications may also be controlled by the Postal Authority, depending on technology.

Adventuring possibilities: Characters could be courier-ship pilots or private traders with a mail contract.

The Security and Intelligence Agency

This shadowy, covert group is the national espionage and counter-espionage arm. Agents are trained in intelligence gathering, overt and covert, as well as the "tricks of the trade," including infiltration, misinformation, code-breaking, secret languages and assassination. Counter-espionage agents are responsible for identifying and neutralizing agents of foreign governments. Very often there will be several different agencies, often with very misleading names, who spend a great deal of their time spying on each other!

Advanced cosmetic surgery and clone technology allow agents to operate under cover in a variety of guises — different faces, sexes and races. Potential recruits must have a wide variety of skills and abilities, including the more subtle combat arts.

Under a repressive society, intelligence agencies will spy on citizens while sending *agents provocateur* to foment unrest in rival nations. Loosely-knit societies may have no intelligence arm, though their member states might.

Adventuring possibilities: Characters might find themselves on an intelligence mission — as unsuspecting dupes, or working with agents. If characters are part of an important organization, they may be infiltrated by agents of an enemy society. Or the whole campaign may be espionage-oriented.

The Special Justice Group

Formed as a watchdog agency over the multistellar corporations, the Special Justice Group oversees corporate expansion and diversification, regulates free trade and stock sales, collects taxes and other government fees, inspects existing corporate facilities and approves all new facilities. Its mission is to preserve society from domination by powerful business groups, while maintaining their financial health — realizing that the economy of the state is tied to corporate success. Covert agents infiltrate corporations to uncover assorted violations.

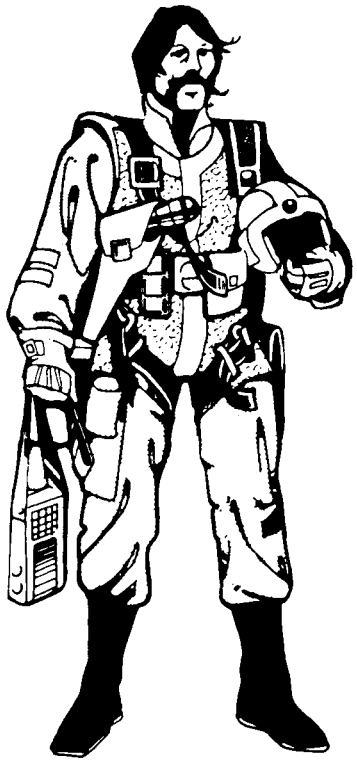
Adventuring possibilities: Characters hired as corporate employees or security forces might meet Special Justice agents — for good or bad. Obnoxious Special Justice officials make perfect opponents for ambitious corporate executives. Another possibility is a corporation-busting Special Justice campaign.

Private Organizations

Corporations

A multistellar corporation is a vast conglomerate of companies in hundreds of fields on dozens of worlds. Some multistellars control entire worlds and support vast armies of employees — corporate security forces can outnumber the local Planetary Defense Forces (and may be better trained).

In many businesses, profits outweigh ethics. Some corporations use dummy companies and trusts to dodge government supervision, considering such high-profit, high-risk activities part of the corporate "game." When not cooperating against the Special Justice Group, the companies are spying on their competitors — bugging research centers, bribing employees to spill secrets, and planting misinformation about new worlds. Sometimes industrial espionage is a gentlemanly game. Often it's deadly.



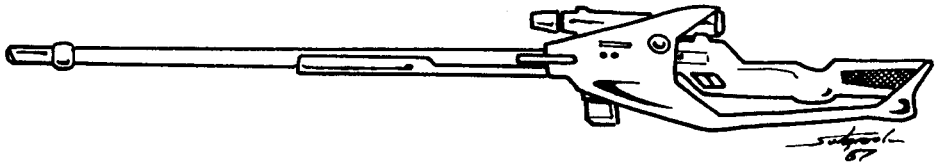
The Rangers

The Rangers (or Star Rangers) are a paramilitary force, trained for survival, rescue and combat on hazardous or untamed planets. They are practiced outdoorsmen and survival experts. Rangers also act as "sheriffs" on new colonies, under the direction of the Office of Colonial Affairs, keeping law and order until the colonies become self-governing.

The Rangers are often called upon to rescue (or bodyguard) Survey missions, and occasionally join Patrol missions. There is a grudging mutual respect between the tough, free-swinging Rangers and the disciplined, spit-and-polish Patrol. In some campaigns, the Rangers may actually be an arm of the Patrol.

Adventuring possibilities: On the frontier, Rangers are the omnipresent law enforcers — PCs might even find themselves deputized during local emergencies. Ranger PCs can be fun, if the campaign restricts itself to the Ranger's assigned territory; a Rangers campaign is also possible.

Adventuring possibilities: Working for a corporation lets PCs be nasty without feeling responsible — they're only following "company orders." Corporations also make good patrons. In other campaigns, corporations make excellent bad guys — exploiters of defenseless aliens, ravagers of priceless Precursor sites, slave lords on remote company planets, and remorseless steamrollers in commerce and industry. Independent traders hate them.



The Free Trade League

At first, it was little more than an association of independent traders that met at market worlds to swap information. As interstellar competition — and regulation — grew, the Free Trade League became a lobbying group for the rights of independent traders. It now has offices everywhere that traders gather.

The League is a clearinghouse for market information. An independent trader who has valuable information he can't use will pass it to the League — which brokers the data to other independents before the big corporations get the word. The original trader gets a 5 to 10% royalty; the League itself takes a percent.

The League also arbitrates grievances among members, and operates as a bank, facilitating transactions between races and cultures. Traders down on their luck can apply for a loan — but if they can't pay it back, they'll be pariahs in the trade community.

Adventuring possibilities: This brotherhood is the home organization for most trader PCs. Other non-military PCs are likely to encounter independent traders, especially on the frontier — passenger rates are low, voyages are slow, and there's always a chance of adventure before journey's end.

Mercenary Companies

A mercenary company is a military outfit — usually ground troops, often with supporting heavy ground vehicles and fighter craft — which works for hire. Regulations and discipline remain under the control of the unit commander, not the employer.

Companies can be contracted for specific missions, or may be hired by the month. "Honorable" merc outfits will fulfill their contracts so long as their employer deals honorably with them; other outfits may desert their employer for sufficient reward, sometimes even changing to the enemy side.

Organization varies, although it is always military in style. The commander may style himself by a variety of titles, including "general" and "commandant." There is a friendly rivalry among the best companies. However, licensed or "honorable" companies have a strong dislike for less-trustworthy outfits.

Adventuring possibilities: PCs who sign on with a merc outfit may see a variety of adventures in far places. Mercs also make good antagonists.

The News Services

Space is big enough to hold a lot of news, and dozens of interstellar news services compete to get that news, explain it in an interesting fashion, and shoot it to the waiting Tri-V watchers. Services will have large offices on major planets, one- or two-man operations on others, and stringer reporters and roving news teams on many more. Newshounds are among the first on the scene of any major event — the uncovering of Precursor ruins, a new stellar phenomenon, or the outbreak of interstellar war.

Adventuring possibilities: PCs can be a reporting team. A news service can also provide a meddlesome "third force" interfering in any adventure. For example: the PCs, as members of the Patrol, are about to assault a pirate base when a Starnews ship appears. Perhaps it will accidentally tip off the pirates about the Patrol's plan; perhaps it will be taken hostage by the pirates; perhaps the Starnews crew has information that will make the difference between success and failure, if the Patrol will only listen!

Three Multistellar Corporations

Tri-Tachyon, Ltd.

This huge corporation is a leader in the manufacture of FTL drives. Subsidiary industries include computers, entertainment modules and xenobiological research. It is rumored to be researching some sort of "trans-dimensional" travel. The Special Justice Group rates Tri-Tachyon as law-abiding — its legal transgressions have been minor, with fines correspondingly light.

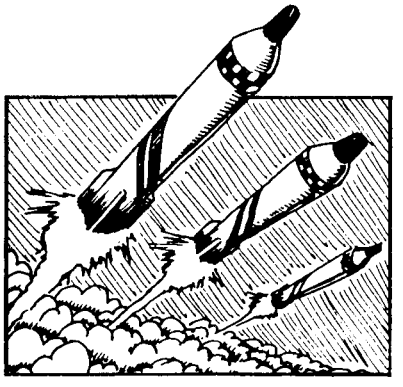
Trans-Sol Incorporated

Though Trans-Sol has dozens of subsidiaries, it is best-known for its advanced vehicles, ranging from cybertanks to personal flitters. Its designs are not innovative — proven designs and customer satisfaction keep Trans-Sol on top. Major diversifications include mining, android research and consumer appliances. Trans-Sol is committed to maintaining its market share, by any means necessary. It has a well-deserved reputation for ingenious forms of industrial espionage, computer sabotage, tax fraud, and similar offenses. However, the corporation seems to draw the line at violence.

Goliath Weaponry GmbH

This ruthless multistellar occupies the top of the Special Justice Group's watchdog list. It began as a cartel of weapons manufacturers, then grew rich through war profiteering — selling weapons to both sides, then collecting on debts to take economic control of entire war-exhausted systems.

The Special Justice Group has cited Goliath for more violations than the two next-worst offenders combined. Unfortunately, the company has been convicted on only minor infractions. Major violations — from sale of military secrets to hostile powers, to involvement in criminal and terrorist activities — remain unproven (evidence and witnesses frequently disappear). Justice agents have been unable to successfully infiltrate the company.



Planning Adventures

"It is the business of the future to be dangerous . . . "— A.N. Whitehead

So you've got your campaign outlined. Now you need to find, or write, the first adventures with which you'll challenge your players.

Adventure in outer space often becomes a generic fantasy, with force blades standing in for magic swords, spaceships for horses, gadgets and psi for magic. Whether the task is to overthrow the wicked Emperor of the Universe, or to preserve the peaceful Federation against slavering hordes of Space Mongols, it's the same old thing. Make the blasters into six-guns, and it's a Western. Put sails on the space freighter, and you're on the Spanish Main.

So what's different about science fiction? Isn't an adventure an adventure, no matter what the props?

Not quite. Science fiction offers something that humanity has almost lost: the chance to be *first* somewhere, to see something really new. And a space campaign, more than any other, can have infinite variety. In a galactic society, you can never run out of new people, places, and things. You can visit high-tech, low-tech, and everything in between . . . and you *can't* know it all. GMs should emphasize the effects of alien cultures and environments on the adventure, and on the adventurers!

Furthermore, *the future hasn't happened yet.* We know what life was like in the Middle Ages: poor, nasty, brutish, and short. If you were rich, it was a little better, but no money could buy more than the simplest medicine, and for every rich man there were thousands of suffering peasants. No magic swords; no magic, period.

Now, the future may be just as oppressive, or worse. But it doesn't *have* to be that way. Technology can take the place of peasantry. The resources of the solar system can make everyone wealthy — without dispossessing any natives. And the effects of high technology on humanity may seem literally miraculous. If anything, most science fiction is too *conservative.*

Science fiction — real science fiction, not space fantasy — is about solving human problems with the tools of the real world. Science fiction assumes there are no "mysteries" — only puzzles that haven't been solved yet. The Universe is a dangerous place, but only for people who don't understand it and won't try to. Make the effort to learn, and you can live anywhere and survive anything. The laws of physics can't be argued with — but they don't hate or love, lie or swindle, plot or hold grudges.

People do all those things, of course. And thereby hangs a tale. You, as the Game Master, can tell it. Keep reading . . .

The Institute for Psionic Studies

On the surface, the Institute for Psionic Studies is a research foundation dedicated to psionics. In reality, it is a secret psionic society that offers aid and training to psis. The Institute for Psionic Studies has branches on major worlds, particularly those with large universities.

Adventuring possibilities: The institute might be either "good" or "bad." An evil institute might take advantage of a PC with developing talents, getting him into terrible trouble; a good institute can help a psionic PC against persecution. Or the institute might be a red herring, staffed by crackpots — especially if psionics don't work in this campaign. And the GM doesn't *have* to tell the players whether psi powers are real or not!

Universities and Scientific Foundations

Scholarly organizations can be huge and influential; they can dominate whole planets. Such groups can contain brilliant (and very peculiar) people. The political interplay within a university (over promotion, favorite theories, grant money, or just personalities) can be fierce, and rivalry between institutions can be bitter. Outsiders, expecting peaceful cloisters and ivory towers, are often numbed by the size of scholastic budgets and the fierceness of scholastic politics!

Adventuring possibilities: The PCs can be hired as part of a scholarly expedition; depending on skills, they may be guards, ship crew, or researchers. Unusual planetary conditions, strange and dangerous life forms, and Precursor artifacts are all obvious targets of scientific curiosity. And no pirate can match the disregard for danger shown by a dedicated researcher!

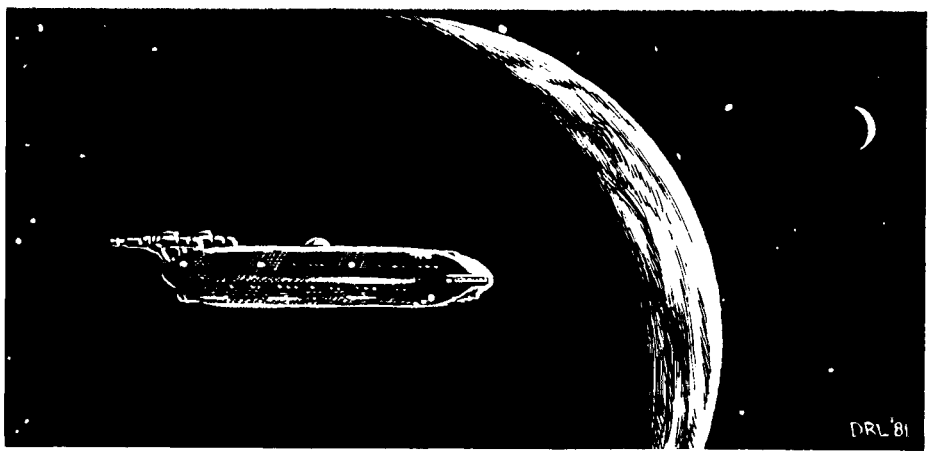
The Organization

The shadowy syndicate known as "the Organization" is the largest criminal empire ever to exist. Its influence stretches through nearly all interstellar nations. The Patrol is only beginning to realize that a single organization is behind centuries of crime. The "Big O" dominates interstellar drug trafficking, gunrunning, prostitution, the black market, and murder for hire.

On many worlds, criminal activities require the approval of the Organization — with a piece of the action going to the syndicate. And on *any* world with a population of more than a few hundred, there's an Organization contact. Organization VIPs live like royalty, often on syndicate-controlled worlds where crime bosses are feudal lords. The Organization also sponsors sanctuary worlds (see p. 121).

Should the PCs want to find an Organization contact on a new world, the best place is Startown or a similar port area. Roll against Streetwise, *minus* the Control Rating of the local government. Each attempt takes two days of bar-hopping and hint-dropping. As a rule, about the time the searcher gives up, he'll be tapped on the shoulder and escorted to Mr. Big's office. A critical failure will lead to unwelcome interest by either the Organization or the local authorities.

Adventuring possibilities: The PCs may be surprised to discover that the crime they just foiled was part of a Big O operation . . . and now the Organization is on their trail. Or the PCs themselves could be interstellar criminals.



CHOOSING TECHNOLOGY 2

As you set the social background of your universe, you must also choose the technological background. The GM sets the general Tech Level of the campaign (see sidebar). He also makes some very important decisions about what stardrives, weapons, communications, and so on are available in *his* universe. These will affect the shipbuilding rules (pp. 78-90) for that campaign; suggested costs, weights, etc. for various drives and equipment are given in that section.

Space Drives / Maneuver Drives

Man's first attempts at interstellar travel will probably be in slower-than-light (STL, or sublight) vessels. Possible technology for such ships exists now (TL7). We could send a colony ship out now, if we cared to — see the sidebar.

A fuel-efficient STL drive, approaching lightspeed, *could* be used to colonize the galaxy . . . slowly. Einsteinian time dilation (see p. 28) would mean that crewmen would live long enough to see many planets, even though their trips would take years from the point of view of groundside observers. F.M. Busby's *The Long View* is a good depiction of such a society.

STL drives can also be used as *maneuver drives* for starships. Some starships don't require a separate maneuver drive. Others (hyperdrives, for instance) will. Types of maneuver drive include:

Reaction Drive (TL6+)

This is a general term for any drive that involves throwing something out the back of the ship, to make the ship go forward. The limiting factor on reaction drives is *reaction mass* — the material ejected as exhaust. A ship that must carry a lot of reaction mass has limited speed. But a ship that uses little mass, or can pick up more while traveling, could in time accelerate to near-light velocities.

The important GM decision about reaction drive is not its type, but its overall *strength* — see p. 82. Strong drives use much more power, but let ships move around a star system quickly without much reaction mass. Weaker drives require either a lot of time or a lot of reaction mass.

Reactionless Drive (TL9+)

This is a general term for any drive that violates Newton's law. The reactionless drive makes the ship go forward *without* pushing anything else backward. A reactionless drive requires power, but not reaction mass (though of course the power plant must be fueled). It makes ships much more efficient; such a drive would be a hugely valuable secret when first developed. A reactionless drive could approach lightspeed.

Contragravity (TL12+)

This gives a craft full control of its own weight. This means, among other things, that it can enter atmosphere, or even land, whether it is streamlined or not! Contragravity is not a drive in itself, but a contragravity-equipped ship can reduce its weight to almost nothing in order to take off or land with a very weak drive. CG units are rated according to the *mass* they can handle. An overloaded CG unit might function at lower efficiency, or erratically, or not at all.

Tech Levels

Star travelers may encounter worlds at any Tech Level, from Stone Age to miraculous. The following Tech Level chart is reprinted from the ***GURPS Basic Set***:

0. Stone Age: fire, lever, language
1. Bronze Age (Athens): wheel, writing, agriculture
2. Iron Age (Rome): keystone arch
3. Medieval (pre-1450 Earth): steel weapons, mathematics with zero
4. Renaissance/Colonial (1450-1700): gunpowder, printing
5. Industrial Revolution (1701-1900): mass production, steam power, telegraph
6. Atomic (1901-1950): cars, airplanes, radio, rockets
7. Nuclear (1951-2000?): fission power, computer, laser, rockets, orbital travel
8. Spacefaring (2001-2050?): STL space travel, fusion power, braintapes, implants, artificial intelligence
9. Starfaring: FTL star travel, fully sentient computers, reactionless drive, longevity
10. Antimatter: antimatter power, artificial gravity, slow FTL radio
11. Force: force screens, tractor beams, fast FTL radio
12. Gravitic: contragravity, grav compensators, personal force screens
13. Worldbuilding: full terraforming of planets, including moving orbits
14. Dysonian: construction of worlds, ringworlds, and so on
15. MT: matter transmission, cosmic power, unlimited FTL radio

16+. As you wish . . .

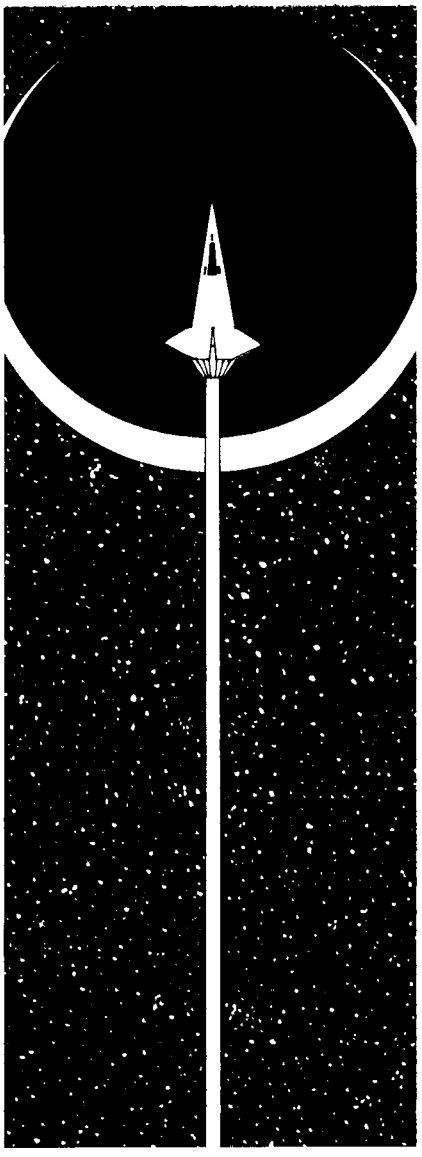
Cultures may be described in more detail by indicating about where they are within their tech level — e.g., "early atomic" describes Earth during WWI. The atomic theory had been developed, but atomic power was still far away.

GMs should not let this TL progression keep them from setting the exact technology they want. The higher the culture, the more likely it is to develop unevenly. A culture whose space travel is still slower than light, but has full control of gravity, may not seem to fit onto this progression — but it's *your* campaign.

Technology Checklist

Use this list to make sure you've made all the necessary decisions about starship drives and other technology for your campaign.

- Overall tech level
- Sublight drive (maneuver drive) type
- Sublight fuel consumption
- Stardrive (FTL drive) type
- FTL travel speed (and frequency of good worlds)
- FTL travel range and fuel consumption
- Interesting side effects, if any, of FTL
- Ease of FTL astrogation
- Power plant type
- FTL communications speed, range and availability
- Sensors
- Weaponry (ship and personal)
- Medical technology



Experimental FTL Drives (TL9)

The first faster-than-light ships will probably be expensive, massive, fuel-hungry, risky and totally unpredictable. For a first-steps-to-space campaign, take any of the drives described below for TL10+, and add dangerous quirks.

One other possible "drive," not mounted aboard ship, is the *implosion* drive. The stressed space produced between four huge matter/antimatter explosions can throw a nearby ship many parsecs in an instant. Any such voyage is a huge gamble; if one bomb malfunctions, the other three will simply destroy the ship.

With practice, it is possible to aim such a jump, but ships will still need maneuver drives to reach planetfall even if the aim is successful. And faulty aim could send a ship anywhere, or even *anywhen.*

Without FTL communications, it will be years before messages from successful implosion-drive ships reach Earth. And return is impossible unless the ships carry extra bombs, and good astrogation equipment, with them.

Stardrives / FTL Drives (TL9+)

A bewildering variety of faster-than-light drives exists in both scientific speculation and science fiction. The same name is often used by different authors to describe different methods of travel. However, most science fiction FTL drives — regardless of the "theory" on which they operate — fall within one of the following types. The GM should pick one. It's possible that more than one could exist; in that case, either one type has made the other(s) obsolete, or each type has its own advantages and disadvantages. One might be faster while another is safer or cheaper.

Hyperdrive

The theory behind hyperdrive is that there is a different "dimension" in which the speed of light can be exceeded. The starship goes to hyperspace (or "subspace" or "otherspace"), travels there at speeds which seem faster-than-light from our normal universe, and then reenters "normal" space at its destination. Ships in hyperspace are wholly isolated from other ships and from the normal universe; they can perceive nothing, and cannot be perceived, until they emerge. A "slow" hyperdrive takes weeks or months to travel between the stars. If a hyperdrive is fast enough or the trip short enough, the ship simply pops from *here* to *there* — like a jump drive (below) that requires no special jump points.

Entering hyperdrive takes a lot of energy, and a ship's course is set before it enters hyperspace. If something happens to the drive or power plant during the voyage, the ship may emerge *anywhere.* Hyperdrive ships need maneuver engines unless the hyperdrive is *very* finely controllable.

Often a rest time of some sort is required between hyperskips. This is automatic if the ship requires capacitors which must be recharged. Other reasons for the rest time might be to calculate the next skip; to let the crew relax from unpleasant side-effects of hyperspace; or to let local hyperspace itself relax from the stress of being crossed.

Hyperdrive alters space war dramatically. Battle lines don't exist. Any ship can escape battle if it has time to enter hyperdrive (so the amount of time this requires is a vital decision for the GM). Battles are not fought in deep space but around vital planets, when attackers appear to meet a defending fleet.

Variant forms of hyperdrive include:

Hyper-sailing. What if hyperspace is like an ocean, with energy currents (and reefs, and storms) on which a starship can ride? Such a starship might need *hypersails* to take advantage of the ether's flow.

Tachyon drive. The starship is converted into energy (often a beam of tachyons) which then hurtles across space. A ship that is converted into tachyons might require a receiving station to restore it to its original condition.

Communication-possible. Perhaps, though a hypership cannot make physical contact with things in the real universe, messages can be sent, or received, or both. This might even make hyperdrive sensors possible.

Jump Drive

Space contains "jump points," or connections. The jump drive allows a starship to take advantage of these jump points, moving from one to another without crossing the space in between. Jump points must be found and mapped before they can be used. It is possible that each jump point leads to all others, or that each one leads only to a few. A bad jump can send a ship to the wrong point, where it may be lost forever.

Usually jump drives are instantaneous or nearly instantaneous. But getting to a jump point may be time-consuming, and requires a maneuver drive. And if there is no jump point near the place you want to go . . . you can't get there.

Jump ship battles will occur at or near jump points, because those are the only places ships can go, and because jump points are such strategic locations. A rich planet near a jump point is a prize indeed! Variations on this theme include:

Jumpline drive. Jump points are always connected in pairs. If a ship triggers its drive at one end of a jumpline, it moves to the other end. Usually, lines are two-way. Many (but not all) stars have an associated jumpline. Stars without jumplines are inaccessible; jumplines without stars at both ends are of little use. Stars with several jumplines are valuable crossroads points.

Psi-jump drive. The "jump" is triggered psionically; only those with an appropriate psionic Advantage (as determined by the GM) can activate the drive. Obviously, if this drive is used, the campaign includes psi powers!

Black hole drive. Black holes are the weak points in space at which FTL jumps are possible. There are many variants: Travel might be limited from black holes to "white" holes, or it might be possible to travel anywhere (not just to a jump point) from a suitable black hole.

Stargates. A stargate is an artificial jump point . . . a space station (often ring-shaped). A ship which travels through the gate's focus travels instantly to another gate. The ship needs no FTL drive of its own.

If this is the only FTL travel known, then an STL ship must travel to each new system to build a gate. But once it's there, any number of ships can go through. Stargates might all be compatible, or those of different owners might have different "frequencies." Stargates on different principles are possible; a gate might send ships to hyperspace, convert them to tachyons, and so on. Such gates would not need a receiving gate; they could send a ship anywhere.

Slow jump. It takes a lot of time (maybe fixed, maybe depending on the distance) to travel between jump points. During this type, ships are incommunicado, as per hyperspace (above).

Warp Drive

A warp-drive starship surrounds itself with an energy field — perhaps even a bubble of hyperspace — which lets it travel at FTL speeds. However, the ship can see and interact with things in normal space. If the drive malfunctions, the ship loses its FTL speed, keeping the STL velocity it had before the warp was activated. It can fix the warp engines, or try to limp to a planet at STL speeds.

A warp ship may freely maneuver while traveling FTL, and may make the random turns needed in combat. Warp ships are likely to battle in deep space, when defending fleets intercept attackers. Possible variations include:

Inertialess drive, first envisioned by E.E. Smith. Its energy field allows FTL

Frequency of Habitable Worlds

Campaign scope is affected by the likelihood of finding Earthlike planets. GMs may select the following degrees of probability:

Common — almost every suitable star has a habitable world.

Likely — most suitable stars have habitable worlds. (This is a likely situation.)

Scattered — one must look for habitable worlds rather than just stumble across them. (This may also be realistic.)

Scarce — there are very few habitable worlds.

Rare — there are almost no habitable worlds.

If useful worlds are common, colonists will spread in all directions at once, often leapfrogging large areas in an effort to reach new territory. Worlds will often be overlooked, since there is no incentive to search every single star system. Or a world may be inhabited, and yet be so unimportant that the universe will forget about it. Worlds may even be owned by individuals!

But if good worlds are very rare, space will be explored one stepping-stone at a time. Each colony will become a center of exploration for new worlds. "Unknown inhabited worlds" are very unlikely. Planets will never be private property, and races who use the same sort of planet may become bitter enemies. The finder of a useful world will become rich and famous.

FTL Travel Speed

The speed of FTL travel (see next page) affects the *apparent* frequency of usable worlds. If spacedrives are fast enough, then all stars in an area can be checked in a short time. If you have to check a hundred stars to find a good planet . . . take a month and check a hundred stars.

But if travel is very slow, then worlds will seem far apart even if Earthlike planets are common, and voyages of exploration will be few and lengthy.

Detecting Worlds

In general, the procedure for investigating a new system is always the same: jump in, look around, take notes, and get the word home. But different tech levels go about it different ways. If sensors are good enough (see p. 29), a system's worlds can be charted from parsecs away . . . but eventually, someone will want to visit in person, anyway. This may be a government job (Survey Service), or private enterprise. Or colonists may do their own world-hunting.

And, no matter how good your sensors and weapons are, someone will have to "prove" a planet habitable by landing on it. This is always a chance for adventure.

Campaign Scope and FTL Travel

The *scope* of a space campaign is the distance the characters can traverse regularly. This is tied closely to the type of space travel available to the PCs. Possibilities include:

A single star system. Either there is no FTL travel yet, or your characters don't have access to it.

A dozen star systems. The fastest travel is .1 pc (parsec) per day. (Unless habitable worlds are rare — see above.)

All systems within a selected range of a home world. There are 150 stars within 10 parsecs of Sol, and 500 stars within 15 parsecs. This implies travel speeds of .2 to 2 pc per day.

A galactic arm, or part of one. A playable speed might be 2-30 pc per day.

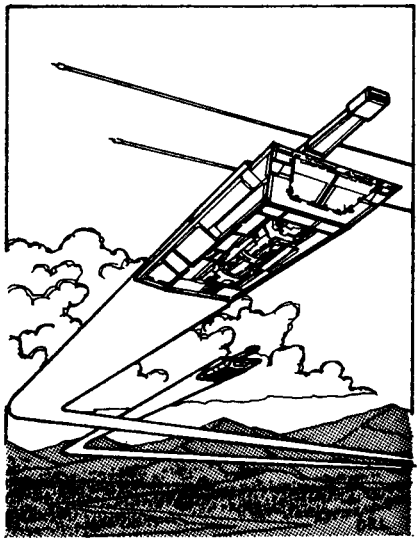
A galaxy, or several galaxies. Instantaneous travel (stargates, for instance), or speeds of hundreds of pc per day.

If the campaign is based on a specific story or series, the scope is already defined. But even if the local civilization spans a galactic arm, the PCs may be concerned only with a few sectors on the frontier. Limiting the scope is easier for the beginning GM; the campaign can always be expanded later.

Speed vs. Acceleration

These rules give FTL starships a *cruising speed* rather than an acceleration rating. The assumption, made both for playability and to conform with most fiction, is that there is *something* — an FTL friction factor, to give it a name — that requires hyperdrive or warp ships to constantly use energy to maintain speed.

If this is true — and it is *much* easier to play if it is — then starships simply have a cruising speed (which can be "pushed" for a maximum speed) just as 20th-century automobiles do.



speeds by negating the inertial mass of the ship. The ship's maximum speed is now limited only by the strength of her engines and the resistance due to density of the interstellar gas. No maneuver drives are needed — just good fractional controls on the engines. The ship can instantly stop or change its direction of motion — it can "turn on a dime" (as many UFOs reportedly can), and is immune to collision (it merely stops at the collision point, unhurt).

Blink-warp. Hyperspace exists, but ships can only enter it very briefly. Every second, a starship makes hundreds of *short* skips; from a distance, it would seem just to be moving very quickly. The GM must decide whether a blink-warp ship can use weapons while warping, or whether it must stop.

Acceleration required. The ship must approach lightspeed on maneuver drives before it can go to warp.

Drive Options

Once the drive type has been chosen, a GM may customize his system. These decisions are important; they provide much of the campaign's flavor.

Drive Reliability

Decide how much attention the engines need. They may be so reliable that a yacht owner orders a checkup every few years. They may be so finicky that a specialist with a Scots accent has to roll against Engineering (Stardrive) at -4 after every engine use, just to get them to go once again.

Drive Speed

Decide how fast the drive can go. How fast you want your starships to travel depends on how large an area the campaign covers, and how fast you want the ships to get there.

Hyperdrives and warp drives can be given a speed in parsecs per day. For hyperdrives, there may also be a limit to the time or distance a ship can stay in hyperspace without emerging into normal space. Each separate trip is called a "skip," and the ship must wait a GM-set time between skips. For instance, maximum skip might be one parsec. If this is almost instantaneous, but the ship requires a day to recharge capacitors, then effective speed is one parsec per day.

For jump drives, "speed" depends entirely on how far away the chosen jump point is. The important factors are endurance (which affects how *often* a ship can jump, with respect to refueling and/or maintenance) and normal-space time from one jump exit to the next entrance.

The following chart provides sample figures for distance, time and speed.

SPEEDS:	*Alpha Centauri 1.3pc*	*Canopus 30 pc*	*Across our galactic arm 2,000 pc*	*To Sagittarian Arm 3,500 pc*	*Galactic core 10,000 pc*
.02 pc/dy	65 days	50 mon	270 yrs	480 yrs	14 cty
.2 pc/dy	6.5 days	5 mon	27 yrs	48 yrs	1.4 cty
.5 pc/dy	2.6 days	2 mon	11 yrs	19 yrs	55 yrs
1.5 pc/dy	21 hrs	3 wks	4 yrs	6 yrs	18 yrs
2.5 pc/dy	12 hrs	2 wks	2 yrs	4 yrs	11 yrs
7 pc/dy	4.5 hrs	4 days	9 mon	1.4 yrs	4 yrs
10 pc/dy	3.1 hrs	3 days	7 mon	1 yr	3 yrs
1 pc/hr	78 min	30 hrs	2.7 mon	4.8 mon	1 yr
4 pc/hr	19 min	8 hrs	3 wks	1 mon	3.4 mon
12 pc/hr	6.5 min	3 hrs	1 wk	1.5 wks	1 mon
20 pc/hr	4 min	1.5 hrs	4 days	1 wk	3 wks
1 pc/min	1.3 min	30 min	1.4 days	2.4 days	7 days
.5 pc/sec	2.6 sec	1 min	1 hr	1.75 hrs	5.5 hrs

For instance, if your campaign centers around a galactic arm and you want the journey across it to take a year, then your starships should travel about 5 parsecs per day. At this speed it will take two years to reach the Sagittarian Arm,

and six years to reach the center of our Milky Way galaxy. Very long trips take longer, of course. Other galaxies in our group are some 700 kiloparsecs apart. The next group of 20-50 galaxies is about 1,500 kiloparsecs away.

Comparative Speed

With warp drives, ships will probably have different speeds, depending on mass and thrust. This can also be true with hyperdrives. Alternatively, all travel in hyperspace is automatically (for instance) at 12 parsecs/hour. The *Ship Construction* section shows the relationship between mass and speed for each drive.

With jump drives, point-to-point speed is likely to be the same for any ship, though one ship can still have better *maneuver* drives than another.

Maximum Range

How far can a ship go at a time? Ships which have to refuel often, or which require lengthy calculations before "going FTL," may have limits on the distance traveled before another jump or calculation is necessary. Possibilities:

Unlimited — The ship can go any distance, perhaps limited only by acquiring enough energy or suitable engines.

Great distances — A ship can travel a large number of parsecs (chosen by the GM) at a time. In fact, ships might not be capable of going small distances.

Small distances — A ship's maximum travel range is small, relative to the distance between stars. For example, if the longest convenient trip is 2 parsecs without stopping, interstellar borders will be fairly easy to guard.

The distance traveled may also depend on other factors. For instance, very large ships might be able to jump farther than small ones (or vice versa) for reasons inherent in the drive system.

Effects on the Campaign: If ships can travel undetected through hyperspace for long distances, then interstellar nations cannot defend their borders — a hostile ship might warp in at any time.

If ships can only travel short distances in FTL, then interstellar borders and border patrols become feasible. If the stops between voyage segments are long — while capacitors are recharged, or lengthy calculations are made — borders become likely.

Fuel Consumption

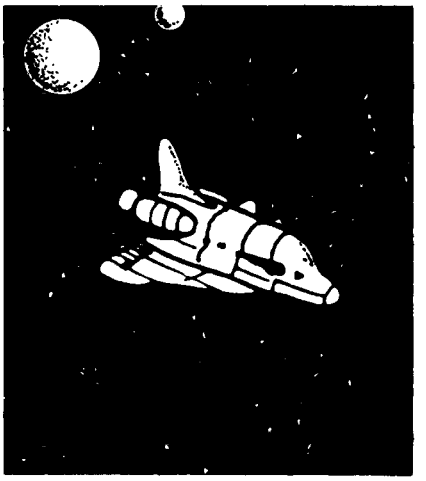
Spaceships vary wildly in the amount of fuel they need. Warp drives and hyperdrives must run continuously while the ship is in FTL mode. Jump drives operate for moments only, when "jumping" — but power requirements at that moment might be enormous. Drives consume either fuel or power from a separate power plant. Sublight "reaction drives" need both fuel and "reaction mass" (something to throw one way so the ship goes the other). And power plants don't create their power from nothing — they too have fuel requirements.

Some fuels are plentiful. A ship that used hydrogen as reaction mass might dive through the outer atmosphere of a gas giant to "scoop" what it needs. A total-conversion power plant could burn *any* matter as fuel. Most restricted are those ships requiring processed fuels, such as radioactives — such ships must either refuel at fueling stations, or carry their own fuel-processing equipment.

Another possibility: FTL engines themselves require some crystal, rare earth, or other scarce material, which wears out or is used up.

Effects on the Campaign: Availability of fuel will affect any strategic plans, military or otherwise. Ships must carry fuel or the means to get it.

Starships with bad fuel economy must refuel frequently. Refueling points become strategically important; interstellar borders naturally expand around such points; exploration depends on the location of new fuel sources. If hydrogen is the fuel, gas giants and cool stars may be the important specks of



Map Obstacles

Where can a starship go when traveling in FTL mode? Are there limits on where it can begin its FTL voyage? Jump drives are limited to jump points. Many warp drives and hyperdrives also have limits. Options:

Gravity-limited. FTL travel might be impossible or dangerous within gravity fields of a certain minimum value (selected by the GM) — anything from distant orbit around a planet to dozens of AUs from any star. Planets are most defensible if starships cannot leave FTL travel within strong gravity wells.

Gravity-required. FTL jumps might be impossible except from *within* a strong gravity well — such as that within a few AU of a star or black hole.

Gas Density. Ships which travel in normal space — that is, warp ships — will be limited in speed by the density of gas present. Conversely, they travel faster in low-density regions.

Nebulas and other gas clouds may be dark (like the Coalsack), lit by nearby stars (like the Pleiades, for instance), lit from within (like a nova shell) or glowing by their own ionized light (like the Hourglass Nebula). These regions may be up to 30 parsecs across. Dark dust lanes are sometimes found on a galactic scale. An uncharted nebula will (at best) slow a journey, and (at worst) be a ship-wrecking hazard. Ships may make long detours rather than pass through large gas clouds.

However, space between galaxies or clusters of galaxies will be very open, and travel will be faster. Rifts between a galaxy's spiral arms could become arteries of travel like terrestrial rivers. Journeys across a galaxy will arch above or below the galactic plane. Increasing speeds for low-density regions may also make otherwise long-distance travel possible.

galactic real estate; for other fuels, other star or world types will dominate. A campaign where fuel is limited or expensive will be similar to the oil embargo situation of the 1970s, while limited fuel and bad endurance resembles the WWI strategic naval situation. When fuel is expensive, merchants will prefer to deal in low-weight, high-profit goods.

If fuel is free or ships are very fuel-efficient, travel becomes cheap. Conquerors might exile entire planetary populations, while merchants can afford to trade in bulky goods such as rice. If travel is both cheap and fast, tourism becomes an industry and the stars become melting pots of peoples and customs.

FTL Astrogation

Once the GM decides how his drive system performs, the next question is: How easy is it to steer a course among the stars? This is where Astrogation skill comes into play. The GM decides what level of skill is required to set a course, and — very important — *how long it takes.* Some of the possibilities include:

Straight-line. Point your ship toward your goal, engage engines, and you're gone. If you know where you are and where you're going, Astronomy or appropriate Area Knowledge skill can substitute for Astrogation.

Modified straight-line. The course must take into account a few major obstacles — stars, hyperspace currents, gas clouds — so safety requires some minimal course computation. However, with Astrogation skill, anyone can plot a course to any coordinate, perhaps stopping every so often to take a bearing.

Complex 3-dimensional. The course must take into account the gravitational fields of intervening suns, hyperspace drift, or some other property that is relatively constant over time. A reliable course can only be computed if the astrogator has complete information about the region.

4- (or more) dimensional. Astrogation simply cannot be learned by most (if any) PCs. The course must take into account time as well as space. A computed course is only good for the intended flight time — if there is a delay, the calculations must be done over. It may even be impossible to calculate a course in advance. An advanced computer could do even complex calculations very quickly. However, hyperships might still have to wait an hour or more between skips to allow time for necessary *observations or measurements* beforehand.

Alternatively, courses may be plotted by mysterious "black box" machines supplied (or left behind) by alien civilizations — players may be able to set courses deliberately, or perhaps can only push buttons until a ship "goes." Or the drive system is experimental and unpredictable. PCs have no way of knowing what a "course" is — the same controls may not give the same destination twice.

Elite astrogators. Perhaps astrogators must have unusual advantages (physical, mental or psionic — natural or artificial), or use a particular substance (an addicting drug, for instance). Or it may be that the Astrogation skill is the secret of one organization. Breaking that monopoly will be dangerous but lucrative.

Effects on the Campaign: When courses are simple, hotshot pilots can "guesstimate" and fly by the seat of their pants. Governments or merchant houses fight over the coordinates to valuable new worlds.

As astrogation becomes more complex, often-used courses can be kept on a computer, but each new one must be plotted from scratch. A proven course through uncharted space is valuable; coordinates may be useless without a working course. Voyages of exploration are made in short hops, not long leaps.

With very complex courses, ships must recompute before every jump. Lawbreakers may be caught by Patrol interceptors before they can break to light-speed. Courses are no longer important, since they cannot be reused — what is vital now will be complete charts of space.

If navigation is unpredictable, only the desperate or brave will chance a star voyage. Governments might recruit (or draft) criminals, political enemies, or the poor to serve as crew, possibly with brutal security measures.

Astrogational Errors

What happens when an astrogator miscalculates a course? Typically, if a jump-drive ship gets lost at all, it is *very* lost. Hyperdrives can go wildly off course, especially if the drive or power plant malfunctioned in hyperspace. Warp drives aren't as likely to get totally lost, because the ship can see where it's going.

Roll against Astrogation skill, modified as the GM sees fit for the difficulty of astrogation (see main text on this page). A successful roll means there was no error. The result of a failure depends on its magnitude. A hurriedly-set course, relative to the time usually required, gives a penalty to skill.

This is the GM's chance to custom-build his own failure table, appropriate for the drive he has designed. Players should *not* be allowed to see this table, though they may be told what the general results of a *minor* error will be. If the penalties for miscalculating are low, then starships "on the run" will always take a quick-and-dirty FTL course. As penalties become more severe, snap courses become emergency measures.

Some possibilities include:

Nothing happens. Literally. If your calculations are wrong, you use up a lot of energy — and go nowhere. Especially appropriate for jump drives.

Off-position. This is more appropriate for hyperdrives than for jump drives. Deviation from the intended destination depends upon the amount by which the skill roll was missed, and may be minor (AUs) or major (parsecs). A ship might go in the correct direction, but a different distance. Or it could go the correct distance in the wrong direction.

Lost. The ship is sent to a wholly unexpected location — the worse the roll, the more lost it is. It may be a reasonable number of parsecs from the departure or destination point, or it might be random on a galactic or intergalactic scale. Astrogation rolls will be required just to locate the ship.

Time-lost. This is especially appropriate for hyperdrives. The ship moves a random distance forward or backward in time. Small time-movements are an interesting nuisance. Big displacements are catastrophic, and should be used to start new campaigns, or not at all. If ships can become "time-lost" predictably, the GM may find himself with a time-travel campaign.

Damage. The ship takes light, medium or heavy damage as if in combat.

Total disaster. The ship is destroyed. Not a good result for play balance.

Power Plants

The GM also chooses the type of power plant carried by ships. In general, this depends on campaign TL. The higher the TL, the more power is available, and the easier it is to build a fast, powerful ship! See pp. 82-83 for options.

Some power plants require special fuel, which can add interest to a campaign.

Communications Technology

Stellar nations are almost impossible to maintain over great distances without some sort of FTL communication, whether it is by "radio" or courier ship. When the message lag between the capital and its frontiers is measured in months, the state is likely to break up, or at least abandon central government. If the campaign takes place in a large area relative to the speed of communication, there will be many stellar governments. If FTL communication exists, then larger areas can be governed — though FTL *travel* is still necessary for truly large empires.

If ships can cross the nation in a month, and FTL radio messages in a day, then it hardly matters whether the nation is 10 parsecs across or 1,000 (except, of course, that the latter allows a lot more room to hide!) The speeds of ship travel and "radio" communications (if any), *relative to the size of the area to be traveled,* will shape your interstellar culture.

Any organization with a monopoly on FTL communications will have a great deal of power — perhaps even enough to control the government.

No FTL Radio

At this stage, the speed of communications is that of the fastest starship. Fast courier ships will maintain contact between worlds, carrying mail, news and government dispatches. Slower, independent ships — often those of free traders — contract for mail runs between less important worlds. The Communications Fleet is a vital branch of interstellar government. Without its services, communication — and perhaps even the nation itself — would soon break down. This is the "Pony Express" stage of interstellar communication. Invading fleets, escaping criminals, and similar menaces might be able to outrun the warning that they're coming.

Of course, if instantaneous jump drives or stargates exist, then news and mail delivery can be very fast indeed. Systems that aren't yet part of the stargate network will still have long waits for mail and news.

Interplanetary trade is risky when a trader doesn't know in advance what the market will be for his goods. A trader who guesses right can get rich; otherwise, he can go broke. People seldom travel far on the cosmic scale, the galactic capital seems remote, and citizens are more likely to be loyal to their provinces than the nation.

If the nation needs a military fleet, it must be large, in order to keep enough strength everywhere it might be required. Consider the huge British Navy of the 17th century. Warfare will require careful planning, but captains (and frontier governors) will have great leeway when they are months from new orders; bravado and strategic skill will be very important.

Travel is always an adventure, because recent news of frontier areas is impossible to come by.

Astrogational Hazards

Theoretically, nothing can interfere with a jump-drive ship during its instantaneous flight. Warp ships and hyperships could be more vulnerable. A miscalculated course could encounter hazards; even a proper course might meet the unexpected.

As hazards increase, exploration becomes riskier, resulting in more "ghost ships" (human *and* alien) and "lost" worlds. Hazards also increase insurance rates and prices of interstellar goods, prompting research toward less hazardous travel.

Some of the astrographic features listed on pp. 98-99 are hazardous. Other possibilities:

Normal Space

Debris. Warp ships may be vulnerable to large quantities of stellar dust, clouds of comets, fields of asteroids, or even ship wreckage. These might force the ship to suffer damage or go sublight.

Uncharted large objects. Some very large items — including black holes, dwarf stars, protostars and wandering planets — are difficult to detect, and might not be present on charts. A close encounter with an uncharted object could be an adventure in itself. The object could also affect a ship's course — for instance, a black hole might "hook" a warping ship, changing its course. These same comments apply to *charted* objects blundered into by miscalculating navigators or malfunctioning drives.

Hyperspace

Storms. "Space storms" in normal space are space opera, but they might exist in the unknown reaches of hyperspace.

Monsters. Hyperspace could be inhabited — by anything from sentient life to huge energy creatures.

Gravity Wells. Very massive objects could have a gravity "shadow" in hyperspace, which would slow or re-direct a ship.

Time Effects

Einsteinian time dilation occurs aboard ships *approaching* the speed of light. The effects depend on the percentage of lightspeed achieved: a day at .9 of c (lightspeed) would have far less effect than a day at .99c! Computing this is possible, but not trivial — see the Glossary. In general, the GM is advised not to worry about the details. If ships approach lightspeed, assume a T ratio of 21:1 . . . three weeks pass in the universe for every day that passes aboard ship. This is appropriate to a speed of about .999c.

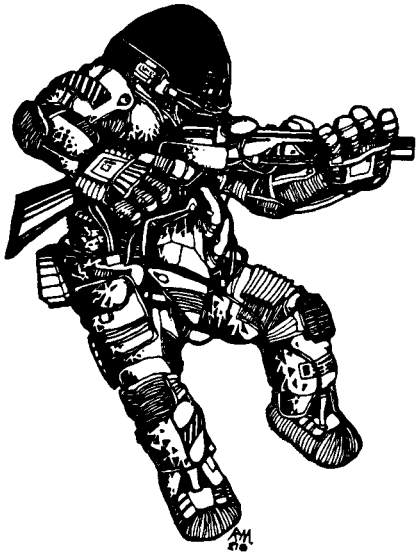
However, this effect applies only to sublight speeds. The effects of FTL travel on time are purely speculative, and are therefore up to the GM. Possibilities include:

Instantaneous jump. No time passes, either on or off the ship, during FTL travel. This is the normal condition for jump ships.

No effect. The same time passes aboard ship as in the rest of the universe. This is the simplest method for the GM!

Time dilation. As described above, but with any time ratio set by the GM. For instance, 1:10 — meaning that one hour will pass on the ship for every 10 hours in the outside world. If time dilation is large, then starmen, aging far slower than others, will feel distanced from the "groundhogs." This may result in the evolution of a separate starfaring society. It could also result in a sense of superiority — or hatred — leading to conflict.

Reverse dilation. The universe "freezes" while the voyage takes place. Time passes normally aboard ship. Crewmen may use freeze tubes to keep from aging too fast.



Slow FTL Radio

At this stage, simple messages can be sent at speeds two or three times that of the fastest starships. However, this is expensive. Routine messages must still be sent by courier. FTL communications might be a government monopoly. FTL transmitters may be so large or costly that many worlds must still rely on couriers. Ships in normal space can receive messages in midflight, but cannot send their own FTL messages. This can be considered the "telegraph stage" of FTL communications.

Traders who can afford access to FTL communications will have a big advantage over their rivals, except in frontier areas without FTL stations.

Space navies can be smaller, because fleets can be centrally located and called in time of need. This is also affected by the ships' own travel speed; most nations will want to be able to muster significant force on notice of not more than a day or two. But opponents will be able to muster large fleets more efficiently, too. Captains on patrol will have great autonomy, since they can't depend on getting up-to-date orders, but border worlds may be in close touch with headquarters.

Fast FTL Radio

At this stage, communication between nearby star systems is cheap, and many times the speed of the fastest ship. Courier vessels are only necessary during the earliest stages of a planet's colonization, until an FTL com station can be built (even then, ship's FTL radios can be used), or when communications are too highly classified or confidential to be entrusted to the spacewaves at all. Ships and planets can communicate freely with each other, except for ships in hyperspace.

Trade becomes much safer, with fewer risks and rewards, when a trader can check the market at his destination before taking on cargo.

Fleets can be smaller yet, and still used efficiently, because warships can be scattered throughout the nation on patrol, yet quickly called together in an emergency. Captains will rarely take action without checking HQ for orders. An analogy would be the police cars of a 20th-century city.

However, even fast FTL radio has limitations. These are up to the GM to set. The point, of course, is to produce situations in which a call for help is impossible! Interesting possibilities include:

Limited range. Maximum range may be a few parsecs, or thousands. Alternately, a radio's range might vary depending on its quality and the power being used. The device may work only close to a gravity source — or only in deep space. It may be necessary to build repeater "beacons" at regular intervals, either ground or space based.

Static. Reception may decrease sharply, depending on the environment — stellar density, radiation, gravity wells, and so on. If FTL radios are sensitive to gravity, then each inhabited system may have to establish a communication relay in orbit about a main world, or even beyond the solar system.

Delay. Even if messages travel far faster than ships, there *will* be a delay when contacting someone far away. The GM should decide exactly how fast messages travel. (Perhaps a more expensive "radio" sends messages faster.)

Energy drain. The GM is free to modify the energy cost of the units given under starship construction. Conceivably, an FTL broadcast might require so much power than a ship cannot use engines and radio simultaneously.

FTL blocking. FTL communicators might not operate, or be seriously hampered, while the ship is in FTL travel. And hyperdrive ships, by definition, cannot contact the outside universe. If ships cannot communicate during FTL, that may be a direct reason for some voyages — military missions, for instance — to drop out of FTL and communicate with home base.

Unlimited FTL Radio

Swift, unlimited communications create a universe similar to 20th-century America, where a great deal of information is available at a touch of a button — perhaps including surveillance of enemy forces (equivalent to our satellites today). Any vessel can be contacted at any time; the size of military fleets is governed only by the size of the opposing force and the speed with which trouble-spots can be reached.

This is sometimes too much communication for an exciting campaign. Travel is less of an adventure when news from all over the galaxy can quickly reach any civilized world. And worlds may become more and more alike — everywhere begins to look like Galactic Prime (or California).

But it can still be exciting if the *ships* are comparatively very slow, and/or the range of a ship's own system isn't too great. Thus, an exploring craft may be out of communication for long periods. Or, even worse, it may be in range of unhelpful advice from the chair-warmers back at HQ. "Survey Control, a mutant space amoeba just ate the stardrive! What do we do now?" "Survey 1138, it will take about a month to route a rescue craft to you. Meanwhile, the scientific staff wants some information on that amoeba. Here's Dr. Gzint." "Gzint here, Survey 1138. What color is that amoeba? Please send somebody out to take its temperature. Can you tell if it's carnivorous?"

Sensors

What can a ship detect, and how far off? It's an important question, especially for star warriors and searchers for new worlds. Sensor power and accuracy can be no better than communications technology, and might be worse. If you can't receive a deliberate transmission from a ship, you certainly can't detect it when it's not transmitting. And without some sort of FTL sensors, any FTL travel must be "blind." An astrogator cannot be sure that the space ahead of him is empty . . . only that it was empty some time ago.

If something can be detected, it can be defended against; the better the detection, the more prepared the defenses will be. In a campaign where sensors are accurate but short-ranged, FTL combat is possible but parsecs-distant planetary scanning is not. If sensors are inaccurate but long-ranged, FTL combat is largely a matter of blind luck modified by volume of firepower, but a ship will have at least some idea of what a world is like long before arriving.

A standard sensor package, or "sensor suite," can detect and measure mass of objects; detect and measure heat, radiation, and other energies, including FTL drive energies; and analyze planetary and stellar compositions.

Rules for *use* of sensors are given on p. 36.

Sensor Range

The GM determines the raw range of sensors; this sets their effective tech level. All the ranges below assume that the detecting starship has the best and most modern sensor suite, amply powered.

TL7: A large starship can be detected only by accident at a distance as small as 1 AU. This would be visual or radio detection only. Finding the planets of a star, while orbiting that star, would take a week of observation.

TL8: A starship can be spotted at 1 AU in space or in a system, both visually and with a drive detector. Planets of a new sun can be found in a day's time.

TL9: A starship can easily be spotted at 100 AU in space or 10 AU in a system. Planets can be located with a routine scan.

TL10: FTL detection is possible — in other words, objects can be detected before their light-waves reach the detector. Detection of a starship at 10,000 AU in space is routine. In a system, a ship would still be detected at 10 AU, due to hyperwave interference from the star.

TL11: A quantum leap in technology: "Realtime" detection of very distant

FTL Side Effects

The GM may specify side effects of FTL travel. These can be an interesting "balancing" factor in a campaign with two different stardrives. One is much faster — but unpleasant or even risky.

Mechanical Effects

FTL effects may be severe enough to plague engineers. Options include:

Severe turbulence. Acceleration effects of FTL are the equivalent of high-G maneuvers (see p. 76). Ships must be built to withstand the level of acceleration, as determined by the GM. Equipment must be secured; people must be strapped down to protect against injury.

Temperature. Starships are subjected to unusual heat or cold. Ships might require extra life support equipment, or — in extreme cases — costly temperature control gear for the entire ship.

Equipment disturbance. FTL travel causes certain devices to fail or work erratically. Most commonly, this affects astrogational equipment, requiring ships to have living astrogators. Alternatively, only machines can stand FTL, and living creatures must travel in freeze.

Health Effects

Discomfort. Characters must roll vs. HT (either at transition, or at GM-chosen intervals during FTL travel) to avoid nausea or spacesickness.

Disorientation. Everyone has a DX penalty.

Illness. As for "Discomfort," except at a penalty to the HT roll, and critical failure means voyagers may *die.* Freeze equipment allows a bonus on the HT roll.

Death. Traveling at FTL is lethal. Humans may travel FTL only within freeze chambers, and are revived only when the ship returns to sublight speed.

Mental Effects

Mental distress. Those who miss their IQ rolls — attempted at GM-chosen time intervals during FTL travel — are plagued by nightmares and/or mild headaches. The result is -1 (or more) to IQ.

Psychic distress. Travelers must make IQ rolls to resist constant delusions and manic impulses. They may avoid this if heavily medicated or in freeze. If safe FTL travel requires crewmen to be incapacitated, adventures can be built around something that happens when the characters can't do anything about it.

Psionic benefits. During FTL, psionic abilities might be heightened, latent talents may blossom, and non-psis may have flashes of psi ability or prescient dreams.

Psionic snow. Psionic powers do not work during FTL, and psis may suffer nausea, headaches or other results. Non-psis are unaffected.

Special Sensor Types

The following special sensor types might be allowed in a campaign. Typically, their range would be much less than those of standard sensors, and the cost would be extra. Active devices send out a signal, which itself can be detected; passive devices only "listen," and cannot be detected:

Point detectors. These sensors are used to locate and pinpoint jump points or jumpline entries. Active.

FTL-scan detectors. These detect the radiations from an "active" point detector or a ship's regular sensor suite. Each will only detect against one sensor type. Passive.

Hyperdrive emergence sensors. These detect the "ripples" caused when a vehicle leaves hyperspace and enters normal space. These ripples travel at about 10 times lightspeed (the speed of a slow FTL radio). Passive.

Hyperdrive wake sensors. These detect the "wake" of a vehicle in hyperdrive. These should only be allowed if communication with hyperspace is possible! Passive.

Teleportation

The development of teleportation — instantaneous travel from one place to another — will replace many other forms of transportation, depending on just how cheap it is. (For an excellent article on this, see Larry Niven's "Exercise in Speculation: The Theory and Practice of Teleportation," in his collection *All the Myriad Ways*. This should be required reading for anyone planning to invent teleportation.)

Two particularly interesting possibilities:

Short range, low cost. Teleportation booths are only useful on the surface of a planet (or within large ships). You can go from any booth to any other booth within (say) 20 miles, for $1 per jump, deducted from your credcard. This reduces travel time in civilized areas to near zero, but doesn't affect the rest of the campaign very much.

Very long range, very high cost. This is like a stargate (p. 23), but much more so. Once a teleportation station is established on a new planet, anyone can go there instantly. But it's *very* expensive . . . thousands of dollars per *pound* of matter transmitted. It won't replace starships, but if the very rich have to go somewhere fast, they can. News will travel instantly with this system. Or colonists can spend their life savings to reach a new planet.

Teleportation is probably at the "miracle" level . . . TL15 or above . . . but the GM can introduce it at any level.

objects becomes possible as a spinoff of FTL radio. A starship can now be tracked, in real time, at .1 *parsec* in deep space or 20 AU in a system.

TL12: A starship can be detected and tracked at ranges of up to two parsecs in deep space, or 20 AU in a system. Planets can now be located from 2 pc away.

TL13+: Ranges continue to increase astronomically.

Sensor Reliability

Sensors can have varying degrees of reliability, affecting the amount of time needed for a complete scan, the amount of information revealed, and the accuracy of that information. Choose one of these:

Highly accurate. Sensors can be routinely used, even in combat. Operator skill rolls are needed only for exceptional situations. One attempt may be made every 5 minutes, if desired. All rolls are at +4.

Reliable. Sensors are reliable, given enough time. An operator may roll hourly at +4, every 10 minutes at normal skill, or every 5 minutes at -2. (Of course, frequent rolls also increase the chance for a critical failure!)

Difficult. Sensors require a trained operator with the right instincts — a good sensorman is highly regarded. Roll hourly at normal skill, or at -4 for a "snap shot" sensor reading requiring 10 minutes.

Primitive. Sensors are not reliable. Any results require extensive periods of time (an hour, minimum); most rolls are at -4 or worse. Even a master sensorman is not expected to be consistently correct.

Weaponry

Man's ingenuity in developing weapons is exceeded only by his ability to invent imaginary ones. Some "generic" starship weapons for various TLs are described in *Starship Combat;* personal weapons are on p. 54-63. GMs can choose from these . . . or use them as models to invent their own!

Other Technology

The choices you make for FTL travel and communication will help define the general tech level of your universe. Routine interstellar travel means at least TL9 in transportation. But whatever the overall tech level of the campaign, there will probably be worlds with lower TLs — and maybe a few higher!

Also, just because you've reached TL9 star travel doesn't mean that other technology has kept up. You may be using TL8 fission power. And medical knowledge may be limited to organ transplants, with cloning still in the future.

Once you set the basic TL, you must decide which items of lower TLs are still in use, and what higher-tech items have become available. Study the equipment and gadget lists (pp. 45-53), weapon and armor lists (pp. 54-63), and the medical section (pp. 64-70), and choose what to allow. Some classic SF novels have introduced very strange combinations. In H. Beam Piper's *Space Viking,* for example, ships used hyperdrive and contragravity, but fought with atomic missiles, while handguns fired lead bullets.

Be careful what technologies you introduce. Many innovations — particularly in the fields of mind control and man-machine interfacing — could lead to a society where "adventuring" as we know it is impossible. If potentially dangerous technology is used *sparingly,* as braintapes are in the ***Autoduel*** universe, explain how it is kept under control. If the limiting laws/embargoes/religions break down, an adventure is beginning!

Many writers simply assume that the future will be just like the present, except with spaceships, blasters and computers. But it seems likely that society, and humanity itself, will change more in the next hundred years than in all previous history. To try to predict all these changes isn't practical in this book . . . or in your campaign. And it's your universe. If you want something (or a lot of things) to be just like today, go right ahead.

CHARACTERS 3

Character Creation

Player characters should be built on 100 character points, with a general limit of 40 points of disadvantages and 5 quirks. Racial disadvantages of aliens and variant humans don't count against the 40-point limit.

The literature of science fiction is so diverse that dozens of character types are available for a ***Space*** campaign. To help prospective players create appropriate PCs for a new campaign, the GM should fill out the *Space Campaign Plan* on p. 44 and distribute copies.

Some important character types include:

Starship Crew

Crew positions include Captain, First Officer, Pilot (or Helmsman), Astrogator, Communications, Medical, Science, and Security Officers, Engineer, Technician, Cargomaster, Steward, and Gunner (or Weapons Officer). On smaller ships, several positions are held by each crewman; larger ships have several crew for each position.

Skills of value to starship crew include Astrogation, Computer Operation or Programming, Electronics (especially Communications, Force Fields, Medical/Life Support, Sensors, Starship Weaponry), Engineering (any space specialty), Free Fall, Gunner (any starship weapon), Mechanic (any space specialty), Piloting (spaceship or auxiliary craft), and Vacc Suit.

Merchant

An interstellar trader who cruises the spaceways, buying and selling. Merchant, Fast-Talk and Diplomacy skills are a must. Unless he's a full-time trade specialist, he'll also need crew skills — especially on a small trading vessel.

Navy

Crew on a regular military vessel. *Marines* are ground troops transported via starship. Military Rank is useful, unless you want to be a private all your life.

Patrolman

A member of the Interstellar Patrol (see p. 17), combining the skills of a police investigator with those of a soldier to keep the spacelanes safe. Sense of Duty is a must.

Pirate/Smuggler

The most common interstellar criminals. Smugglers run contraband from world to world — anything from guns to drugs to slaves — slipping past the Patrol in fast, well-protected starships. They can use any of the Thief/Spy skills. Pirates are the scourges of the spacelanes, attacking freighters, liners, lightly guarded colonies, prospectors and other prey. Combat skills and Odious Personal Habits are appropriate.

Survey Scout/First-in Scout

Scouts (see p. 16) find and explore new worlds. They might specialize in one or more sciences, or be "general specialists." Planetology, Xenobiology and Survival skills will be vital.

Other Starfarers

These may be found either groundside or as starship passengers. They may have their own ships, but they might not have crew skills; they may have hired crew.

Assassin

The killer for hire or for a cause. Skilled in many weapons (especially silent ones), stealth and disguise, interstellar assassins are among the most dangerous characters in space. All the Thief/Spy skills, appropriate weapon skills, and a good cover skill will be needed.

Bounty-Hunter

Adventurers who make their living tracking down criminals, traitors, spies and pirates along the frontier. They often go where official lawmen, such as the Patrol, cannot — by treaty, by convention or because the risk isn't worth the prize. They are often solitary, though teams also exist: the catch is easier but the bounty must be split. Their methods may be questionable, but they often get results when the law can't. Thief/Spy skills, especially Streetwise, and Carousing will help.

Colonist

The hardy folk who carve new lives out of the wilderness of a virgin planet. They may be part of a religious or ethnic group, sponsored by a government, part of a commercial venture, or on their own. Survival is the most important skill here.

Dilettante

Wealthy folk who travel because they've seen everything at home, often with an entourage or at least a servant or bodyguard. High Social Status is appropriate; so is Savoir-Faire, if the dilettante bothers to use it.

Diplomat

The silver-tongued negotiators that keep rival worlds cordial — or at least on speaking terms. They are assigned to newly discovered civilizations, often accompanying survey crews when a new world is known to have a sapient species. They also serve on embassies to other starfaring nations or races. They are usually government employees, though some may be skilled independent negotiators . . . or spies. Fast-Talk, Diplomacy and Savoir-Faire are musts. Xenology is useful.

Escort

Tough, competent characters, hired to guide and protect more peaceable starfarers. They may be individual guides or hired guns, small freelance teams, or corporate employees. Scientists, journalists and diplomats are especially likely to need their services. Streetwise, Survival, vehicle and weapon skills will all be useful.

Esper

Psionic adepts, skilled in the powers of the mind. They may use their abilities openly, or hide them, depending on the prevailing attitude toward their kind. Espers can often find useful employment in intelligence services, as assassins or with survey crews, depending on their exact skills.

Fighter Jock

The elite warriors who pilot fighter craft — starfighters, aircraft, or both. They would have Military Rank, Acceleration Tolerance, high levels of Piloting and Gunner, and probably Carousing.

Intelligence Agent

They could be freelancers, planetary agents or even corporate spies. They may range from noncombatant information gatherers to deadly assassins. They usually operate under a cover identity — often as a diplomat, but potentially in any role. They need Thief/Spy skills, and a mundane skill to make their cover believable.

Interstellar Journalist

The newsgatherers of the galaxy, traveling from world to world in search of a great story. They may be part of a roving news team, or solitary investigative reporters, operating overtly or covertly. They may be part of an interstellar news organization (see p. 19), or freelancers who sell their scoops to the highest bidder. A public relations official for a multistellar corporation or the government could fall into this category as well. And this is a good (and common) cover for agents and assassins. Useful skills include Streetwise, Writing, Photography, Fast-Talk, Interrogation, Xenology and Savoir-Faire.

Missionary/Chaplain

Interstellar missionaries can often be found along the frontiers, peddling their own brands of religion to newly discovered societies, or caring for the spiritual needs of colonies and frontier outposts. Some may be found aboard large naval vessels or at military bases. Some might be con men hiding behind the cloth; many will be fanatic proponents of new cults or religions. Fast-Talk, Bard and Theology are all appropriate skills.

Primitive

Many natives of low-tech worlds (TL3 and below) have access to the spaceways. They may be descendants of a colony that has lost its technology, or members of an "undeveloped" race. Many tramp-spacer crewmen are from a primitive background. They are often prized as hunters, naturalists, beast masters and woods- and craftsmen on more "civilized" worlds. Any low-tech skills are appropriate; high-tech ones are forbidden if you take being Primitive as a specific disadvantage — see p. 33.

Prospector/Belter

The crusty, colorful characters who exploit planets or asteroids for their mineral resources. They may work alone, be affiliated with mining corporations, or be part of a freelance team. Some may own or lease specialized prospector ships, mining asteroids in free space. Prospecting skill, of course, is required. Survival, and probably a Guns skill, are musts for planetary prospectors; asteroid miners need shiphandling and Vacc Suit skills.

Riffraff

You can see them around any spaceport . . . the tough, street-smart types, hoping for a break that will get them offplanet. Some are elderly; some are just kids. All of them look like bums to the star-crews. Some are; some aren't. Streetwise, Scrounging and Fast-Talk are all vital skills. Either Running or a weapon skill will be good life insurance.

Rogue

If a Riffraff kid manages to get into space (and survive for a few years), he or she is likely to develop into a Rogue. Smuggler, scavenger, blaster for hire . . . a Rogue will do anything for fun or money. The Rogue's ambition is to get a ship; his next ambition is to keep it. Typical talents include Fast-Talk, Gambling, Carousing, Streetwise, Guns and Merchant.

Scientist

May be affiliated with a university or institute, or work for a corporation; either way, they are sent to the ends of the universe to do research or test theories. Some are stereotypically absent-minded. Others use their skills practically, sometimes bettering themselves first and mankind second; this type can use Fast-Talk, Streetwise and Merchant skills.

Terrorist/Rebel

One planet's terrorists may be another's valiant rebels. As a rule, terrorists are more indiscriminate than rebels, striking at random and often deliberately harming civilians. Rebels will usually limit their activities to strikes on military or government installations. Weapon and Thief/Spy skills are all very useful. Politics skill is also helpful!

Trooper

Ground fighters — either infantry or armored. Might be a member of a mercenary unit or the Interstellar Marines. Most mercenaries work as full-fledged military companies, often with established base camps, though small groups may act as roving soldiers of fortune. Any appropriate military skill, plus Military Rank and perhaps Scrounging, will be useful.

Advantages, Disadvantages and Skills

This section will discuss some particular options for character design as they apply in a science fiction universe. Note again that the GM should provide players with a Space Campaign Plan (see p. 44) before the campaign begins, so they will know what sort of advantages, disadvantages and skills are appropriate for this particular campaign, and which ones are undesirable.

Advantages

Military Rank ***see p. B22***

Patrol and Survey generally follow Navy ranks; Marines and mercenaries follow Army ranks.

Patrons ***see p. B24***

Patrons in an SF universe may include government and military organizations, merchants, or multistellar organizations.

Remember that an employer is not automatically a patron; the Federation Navy may be far more powerful than a tramp merchant vessel, but it's much less likely to come to the aid of a single crewman in difficulties.

Status ***see p. B18***

It is possible for a character to have status in his or her home culture, but get little or no benefit from this status during the campaign because that home culture is far away. The GM may modify the cost of Status in such cases, in a manner similar to that used for Reputation, when there is a chance that those the PC meets will not understand/respect his status.

New Advantages

Acceleration Tolerance ***10 points***

This is the ability to withstand for short periods the sudden high-G forces of extreme acceleration. It is most useful for fighter and starfighter pilots at TLs where it can sometimes be possible (for instance) to dodge a missile. This advantage gives a +5 to HT on any roll to avoid the effects of acceleration. It is not the same as Improved G-Tolerance (below).

Bionics ***Variable – see p. 67***

This covers a wide range of artificial parts for the human body – see *Medicine* (p. 67). If a bionic part enhances normal human function, it will cost character points, whether the character starts with it or adds it later. If it functions exactly like a lost limb or organ, there is no character point cost (though if a character buys one as a replacement, it will still cost money).

G-Experience ***10 points***

This is the advantage of experience in many different gravitational fields over a period of time. Your reflexes quickly adapt to the different rate at which things move and fall in different G fields. You suffer only half the DX penalty (see p. 72) under non-standard gravitational fields.

No character may start with this advantage unless he or she has space experience already. However, this advantage *can* be bought after a PC is created, once that PC gets experience in at least three different G fields. It is treated as an advantage rather than a skill because (for game purposes) your brain and body either know how to make the adaptation, or they don't.

In situations where lower-than-normal gravity would *help* an attempt, a person with G-Experience rolls at their "normal" DX, plus the appropriate bonus, plus a further +1 for the G-Experience. For instance, if a normal person in a certain low-G situation would get a +2 to catch a ball, a person with G-Experience would get +3.

Improved G-Tolerance ***5/10/15/20/25 points***

This advantage allows a character (or race!) to function under a wider range of gravities than a normal human being. Normal human G-tolerance is measured in increments of .2 G (see p. 71). For an increment of .3 G, pay 5 points. For an increment of .5 G, pay 10 points. For an increment of 1 G, pay 15 points. For 5 G, pay 20 points. For 10 G, pay 25 points.

3D Spatial Sense ***10 points***

This advantage is a heightened form of Absolute Direction (p. B19), and includes that advantage. On an IQ roll, the user may retrace a rough path through space, and know which way is Galactic Up, which way the Core is, and so on. It is useless during a hyperspace skip or when traveling through a stargate, though it can be used in warp travel at -1 and in hyperspace "skip" at -2. It also adds +2 to Astrogation skill, and +1 to any type of starship or spaceship Piloting.

Disadvantages

Dependents

A member of an egg-laying race may have an *egg* as a dependent! Of course, the egg would only count as a dependent if the character really was concerned about it and personally responsible for it. An egg is helpless; such a dependent egg is a disadvantage worth a base of 16 points.

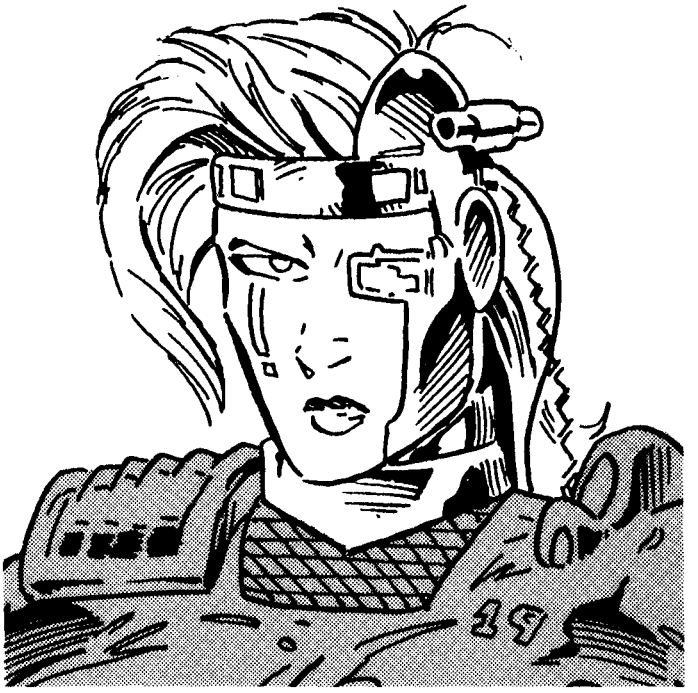
New Disadvantages

Acceleration Weakness ***-5 points***

This disadvantage is the reverse of Acceleration Tolerance. Characters with Acceleration Weakness are more likely to suffer from extreme acceleration; they get a -3 to HT on any roll to avoid the effects of acceleration.

G-Intolerance ***-10/-20 points***

This disadvantage means that a character (or race!) can function only under a narrower range of gravities than a normal human being. Normal human G-tolerance is measured in increments of .2 G (see p. 71). For an increment of .1 G, pay -10 points. For an increment of .05 G, pay -20 points.



Space Sickness ***-10 points***

You are miserable in free fall; you may never gain Free Fall skill, but will always operate at your default of DX-5 or HT-5, whichever is better. A spacesick character must roll vs. HT the moment he enters free fall. If he fails the roll, he chokes — treat as drowning (p. B91). Furthermore, he will be nearly incapacitated during the entire time he is in free fall — effectively -5 on all subsequent skill and other rolls (including DX, HT, ST and IQ). On a successful roll, he will have a mere -2 penalty to everything.

In campaigns in which PCs are mainly planetbound, this disadvantage is no handicap, and should not be allowed.

Skills

In particular, this section covers the ways that spacers can use their skills, in combat and out, on a starship. A ship crewed by skilled people is far likelier to succeed. Shipboard computers (p. 51) can be used for some skill rolls, if necessary — but a skilled operator has more ability than a computer.

Armoury ***see p. B53***

New specializations include: Starship Weapons (possibly different kinds, depending on the campaign); Vehicle Armor; Body Armor; Starship Armor (if starships have armor). Skill use is at -5 without appropriate tools (p. 46).

Astrogation (Mental/Avg.) ***See p. B59***

This is a vital skill for star travel. Modifiers and results of failures are up to the GM, since this skill can be defined very differently for different universes; see p. 26.

Astrogation rolls are also required to find the ship's position if it gets lost, or to determine likely routes for another ship that is being followed.

Battlesuit ***see p. B49***

Battlesuit training is generally available only in military or mercenary units. However, skill defaults to Exoskeleton-2 (see p. 36) for all battlesuit operations except weapon use.

Beam Weapons ***see p. B49***

Many beam weapons are described on pp. 58-61. Modifiers: -2 to an unfamiliar weapon of a known type (e.g., a Hamill blaster when you're used to the Fisher model). -4 or more for a weapon in bad repair. -4 for a weapon of unfamiliar type (e.g., a laser when you are used to blasters). All normal modifiers for missile-weapon fire apply. *Types* of weapons include:

Lasers (TL7+): Includes all weapons that use stimulated emission of energy — lasers, hand flamers and microwave disruptors (masers). Lasers are completely recoilless, so there is no penalty for multiple shots in one turn (though not all lasers can fire twice per turn).

Sonics (TL8+): Includes weapons that damage or disable by use of amplified, focused sound — stunners, stun rifles, sonic disruptors. As above, there is no recoil. TL9 weapons that use stasis or paralysis fields are the same type for purposes of use, but different from an Armourer's standpoint. TL10 disintegrators are also the same to use, but different to repair.

Blasters (TL9+): Includes weapons that damage totally or primarily by the emission of charged particle beams — blasters and particle-beam rifles. Blasters *do* have a recoil.

Shockers (TL8+): Includes weapons that damage primarily by use of bolts of electricity. Shockers are recoilless.

Driving ***see p. B68***

Specialize in a vehicle type. In high-tech societies, these include those mentioned on p. B68 and in ***GURPS Autoduel*** (all available at TL7+), as well as:

All-Terrain Vehicles/Crawlers (TL7+): All ATVs, whether wheeled or tracked.

Air-Cushion Vehicles (TL8+): Hovercraft.

Contragrav vehicles require Piloting, not Driving, skills.

Electronics Operation/TL (Mental/Average) ***See p. B58***

Specialties other than those listed on p. B58 include:

Starship Energy Weapons: maintaining and repairing energy-based starship weapons. (For non-energy weapons, see the Armoury skill.)

Vehicle Energy Weapons: as above, but for vehicle models.

A very important specialty, especially aboard starships, is:

Electronics Operation/TL (Sensors) ***Defaults to IQ-5 (Mental/Average)***

Electronics Operation (Sensors) rolls, at the appropriate TL, are required for any sensor use. The frequency of rolls depends on the reliability of the sensors (see p. 29). The GM, not the player, rolls.

The amount of information that can be gained may increase with TL (GM's option) but is similar at any starfaring tech level. The more successful the roll, the more data gained. Examples:

Critical failure: Dangerously flawed information, of any level of precision, at the GM's whim.

Missed by 3 or more: For a ship, no contact. For a planet, badly flawed data about mass, temperature and atmosphere.

Missed by 1 or 2: For a ship, uncertain contact. For a planet, uncertain data about mass, temperature and atmosphere.

Made exactly: General data. Ship's mass +/- 50%; planetary mass, temperature, and general atmospheric composition.

Made by 1 or 2: Ship's mass +/- 20%; ship's drive type; precise composition of planet's atmosphere; planetary radioactivity level.

Made by 3 or 4: Ship's mass +/- 5%; ship's current drive power +/- 10%; general planetary biosphere; most common elements on planet.

Made by 5 or 6: Ship's mass +/- 1%; ship's current drive power +/- 2%; general nature of biosphere; general elemental distribution on planet; location of ships and stations in close orbit around planet.

Made by 7+: Ship's exact mass and drive power; details on biosphere of planet; location of major nuclear (or higher) power use on planet.

Critical success: As above, and any additional information the GM feels might be appropriate and useful.

The operator gets +1 to skill if the range is less than 10% of maximum for the TL (see p. 29), +2 for range less than 1% of maximum, and +3 if less than .1% of maximum. At ranges this short, rolls can also be made twice as often as normal. However, all ranges are reduced (see p. 29) if the object being scanned is ship-sized and within 100 AU of a star.

Bonuses and penalties for detecting very large and small ships, ships firing weapons, and so on, may be added at the GM's discretion.

Engineering ***see p. B60***

Engineers must specialize in the appropriate drive(s) for their ship. Each type of normal-space drive is a different skill; each of the three types of FTL drive – hyperspace, jump drive or warp drive – is also a different skill. Life Support is also an engineering specialty. Starship engineering specialties don't default to IQ, but they default to other starship engineering skills of the same TL at -5.

An engineer who has specialized in the ship's drive type may tune the drive for better performance by a successful roll vs. skill-2. This "tuneup" lasts until a month passes, or the ship sees combat, or after emergency thrust (see below). A failed roll has no effect, and that engineer may not repeat the attempt that month. A critical failure on this roll causes the drive to break down!

Results of drive tuning depend on the drive type:

A *reaction drive* requires less reaction mass; the percentage of mass that is saved is equal to the number of points by which the roll was made.

A *reactionless drive* requires less energy, by a similar percentage.

A *warp drive* has its Warp Thrust Factors increased by a similar percentage.

A *hyperdrive* requires less energy, by a similar percentage – though this is not likely to make a significant difference except on a very large ship. In a universe where hyperdrives may operate at different speeds, the "hyperspeed" of the ship is increased by the indicated percentage. A successful drive tuning roll also gives the astrogator +1 on his skill rolls, because the drive's action becomes more predictable.

A *jump drive* also becomes more predictable; the astrogator gets a +1 on his skill rolls, or a +2 if the engineer made his tuning roll by 6 or more.

When the captain absolutely has to have a little extra out of the engines, a good engineer will complain . . . and do it. Successful skill rolls, at appropriate penalties, will let any ship system exceed its parameters. This is limited only by the cleverness of the players and the generosity of the GM. Time required is left to the GM's discretion; in a cinematic campaign, the engineer may say "I'll need two weeks," and the captain will reply "You've got ten minutes." Some examples:

Faster charging of capacitors, in emergencies, by a percentage equal to 5 times the amount by which the skill roll is made.

Emergency speed from a warp or reaction drive, by a percentage equal to 5 times the amount by which the roll is made.

Extra performance from a life support system, by a percentage equal to 10 times the amount by which the roll was made.

However, any failure should reduce performance by twice the amount that a success would have increased performance. And critical failures in an emergency situation should always be disastrous.

Free Fall ***see p. 73, B44***

A very important skill for spacers. A Free Fall roll is necessary to perform any complex action in free fall.

Genetics ***see p. B61***

Beginning at TL8, characters taking this skill may specialize in Genetic Engineering – i.e., designing new life forms. At TL8, only simple microbes may be designed. At TL9 larger life forms – plants and animals – may be developed, including completely new species, and humans may be genetically enhanced or engineered. This requires complex facilities, which will be very difficult or impossible to improvise.

Gunner ***see p. B50***

Available for any type of weapons, for starships or vehicles, available in the campaign – see pp. 85-87. Can help win a space battle, and is specifically useful for missile defense (see *Starship Combat*).

Guns ***see p. B51***

Beam weapons and sonics will not entirely displace guns. High-tech guns include the needler, and perhaps other unique projectile weapons.

Language Skills ***see p. B54***

Each language is a separate skill. Alien languages do not default to one another unless they somehow derive from the same parent tongue (i.e., languages spoken by descendant cultures). Difficulty of typical starfaring languages:

Easy: Trade Lingo.

Average: Interlingua or any other languages designed to be pronounced *by a character's race.*

Hard: Alien languages which can be pronounced using a character's natural vocal equipment or simple mechanical devices.

Very Hard: Alien languages which cannot be pronounced with a character's natural vocal equipment or simple mechanical aids.

Dialects. If FTL communications are limited and civilization vast, a common language may have hundreds of dialects. Treat a dialect as defaulting to the base language (or another dialect) at whatever penalty the GM sets.

Mechanic ***see p. B54***

New specializations include all sorts of high-tech ground vehicles; all sorts of starship drives; and "robotics" – all robots and robotic parts, including propulsion systems, power plants, and robot limbs. Skill use is at -5 without appropriate tools (p. 46).

Piloting ***see p. B69***

Piloting specializations include contragravity craft, high-tech aerospace vehicles, and the different types of spacecraft (depending on your campaign) at each tech level. Unless technology is so advanced that ships *always* have gravity and atmosphere, no one will learn to pilot a spacecraft without also learning Vacc Suit and Free Fall skills.

Piloting rolls are required for takeoff and landing, or for docking with a station or larger ship. A failure by 1 indicates a rough docking; 2 or 3 indicates minor damage. Worse rolls indicate more damage; a critical failure wrecks the ship.

Streamlining of a craft (p. 79) affects Piloting rolls made in atmosphere.

For ships that don't land or dock, a Piloting roll is also required to enter standard planetary orbit. A failed roll just means a possible navigational violation; a critical failure means a dangerous orbit.

Piloting rolls can also affect combat (see *Space Combat,* p. 91).

Shield ***see p. B52***

Anyone who has Shield skill may apply the skill to a force shield (see p. 63) after only an hour of practice (or use a force shield at -2 with no practice). But anyone experienced with a force shield will default at -2 to a regular shield, which is heavy, clumsy, and *opaque.* 50 hours of drill reduce this penalty to -1. Another 100 hours eliminates the penalty entirely, giving Shield

skill equal to Force Shield skill; thereafter, any increase in one skill increases the other. A character who starts with both skills at the same level is assumed to have gained this familiarity already, at no extra point cost.

New Skills

Exoskeleton (Physical/Avg.) ***Defaults to IQ-6, DX-6 or Battlesuit-2***

This Vehicle skill covers powered exoskeletons, from the personal, nonaugmenting walkers that enable humans to move in very high gravity (p. 50) to the large cargo exoskeletons that take the place of forklifts in high-tech societies. Unfamiliar units are operated at a penalty, as per Driving skill (p. B68).

For any ordinary DX roll, an exo wearer rolls on the lower of Exoskeleton skill or DX. For DX-based skills, he rolls on the lower of (skill-1) or (Exoskeleton-1). The GM may assess penalties for actions that should be especially difficult in a suit, such as Acrobatics. However, most exoskeletons (or "exosuits") have removable gauntlets so the wearer can do delicate work.

Planetology (Mental/Avg.) Defaults to IQ-5, Geology-4, Meteorology-4, other Planetology-3

This Scientific skill is the overall study of planetary makeup and conditions — geological, meteorological, climatic, atmospheric, hydrographic and ecologic — of one general planetary type. Pick one skill:

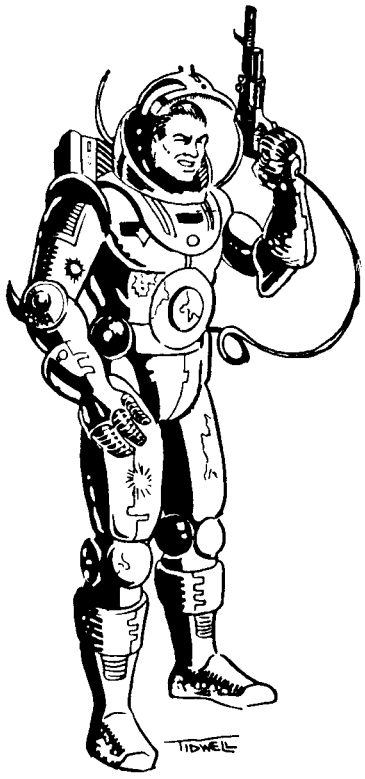
Rock/Ice Worlds: Mercury, Pluto types (also most moons, asteroids and other small, airless planets). See p. 105.

Earthlike: Essentially, all habitable worlds. See p. 105.

Hostile Terrestrial: Titan types. See p. 105.

Gas Giants: Jupiter, Uranus types. See p. 106.

Planetology can be used in place of several other skills. Geology and Meteorology default to it at -3; Botany, Ecology, and Zoology at -4; Survival in that world's major terrain(s) at -5. For detailed information about a world, consult an expert in the pertinent scientific skill — Geology, Meteorology and so on.



GM may assess penalties for worlds that differ greatly from the norm for their type.

Psionic Skills

Mental powers are common in many SF universes. GMs may permit such "esper" skills if they like, using the rules from Chapter 20 of the ***GURPS Basic Set.***

Shipbuilding/TL (Starship) (Mental/Average) ***Defaults to IQ-5 or Shipbuilding-5***

At TL8+, spaceship and starship construction is routine enough to default to IQ. It has just enough in common with ocean shipbuilding of the same TL to let the skills default to each other at -5. Roll against this skill to design a ship, to identify a ship and learn something about it, or to aid in damage control (see *Space Combat*).

Xenobiology (Mental/Average) ***No default***

This Scientific skill is the overall study of life of all kinds, native to any one general planetary type. Pick one skill:

Terrestrial: See p. 105.

Hostile Terrestrial: Titan types. See p. 105.

Gas Giants: Jupiter, Uranus types. See p. 106.

Xenobiology can be used in place of several other skills. Zoology, Ecology and Botany default to it at -3; Genetics, Biochemistry and Physiology at -4. For detailed information about a life form, consult an expert in the pertinent biological skill. GM may assess penalties for worlds that differ greatly from the norm for their type.

Xenology (Mental/Hard) ***Defaults to IQ-6***

This Scientific skill is an overall knowledge of the major alien races in the known universe, their cultures, lifestyles, mores, societies and psychology. It identifies an alien's race, and gives information about its culture, physical makeup, attributes and possible behavior patterns once identified; it provides *very basic* information about aliens of new races.

A successful Xenology roll is required before use of Diplomacy with aliens; for very alien races, even Merchant, Tactics, etc., will be different and will require a Xenology roll first. If the Xenology roll fails, the actual skill being attempted is at a -4.

Modifiers: +1 or more for familiar races; -1 to -6 for "very alien" races. Difficult questions should carry an appropriate penalty. Prolonged observation should give a bonus, especially for new races. A xenologist may specialize in a particular alien race, getting a +5 on rolls for that race and a -1 on all others.

"Depth" of a xenologist's knowledge will also depend on the number of races known to science: -1 for 5-10 races, -2 for 11-50, -3 for 51-100, -4 for more than 100. This applies only to remembering facts about an already-known race. When contacting new races, experience with a wide variety of aliens is an advantage: +1 if 11-50 races are already known, +2 if more than 50 are known.

Home Gravity

This is an item of "personal information" that becomes important in a ***Space*** campaign. The "native" gravity of each character must be recorded on the Character Sheet. Use the last line under *Advantages, Disadvantages and Quirks.* If no gravity is recorded, the character's home gravity is assumed to be that of the race's native world: 1 G for Earth-type humans, and so on.

"Average" starting wealth in an interstellar society is $15,000. For most PCs, 80% of this will be tied up in home equity, furniture, clothing, etc., leaving only $3,000 available to spend on adventuring gear. Of course, a Wealth advantage will increase both a PC's liquid cash *and* the quality of his home.

GMs may vary this starting wealth as required by the campaign. In general, set starting wealth equal to 30 times the monthly cost of living for a person of status level 0.

Colonist characters, setting down on a strange planet, are assumed to have put everything they own into their venture. Therefore, a colonist PC may spend his entire wealth on adventuring goods. If a colonist is part of a cooperative venture, with access to community equipment (such as a bulldozer to clear land), then *half* of his wealth may be spent on adventuring goods, and the other half represents his share of the colony's equipment.

Starships are *very* expensive. Characters who will have a ship, and no other permanent home, may use their entire starting wealth to buy that ship. Even so, they will probably be able to manage no more than a down payment even if several of them pool their wealth — see sidebar, p. 80.

Social Status and Cost of Living

Status (p. B18) reflects your position in interstellar society. Examples are listed below. Immediate family of individuals with status 1 or more have the same status; more distant relatives have status reduced by 1 or 2, but never to less than they'd have on their own. "Administrator," in the table, could refer to a corporate executive, government figure, or Organization boss.

Level		*Monthly Cost of Living*
-1	Spaceport Scum	$ 200
0	Ordinary Citizen	500
1	Naval officer	1,000
2	City/county administrator; merchant ship owner	2,000
3	Owner of a merchant fleet	4,000
4	Planetary administrator	8,000
5	System administrator	15,000
6	National bureaucrat, Senator, etc.	30,000
7	National (interstellar) administrator	50,000

Buying and Selling

The basic unit of interstellar currency in most SF universes is the *credit.* For simplicity's sake, we will assume that one credit is roughly equal in buying power to one 1990 dollar. A sample price table is given below. The symbol for the credit is "$" — the old Terran symbol for the dollar. Amounts in millions of credits are often expressed as *megacredits* (M$).

On newly colonized worlds, barter may be necessary, and Merchant and Economics skills may prove vital.

On advanced worlds, financial transactions are handled through electronic transfer rather than physical cash. A common device is the credit transactor, or *credcard.* This credit-card-sized device is set by a bank to register the individual's personal credit account. When a transaction takes place, the two parties use their cards to record the exchange, which is also transmitted to the local credit office for its records. Stores uses *cardmeters,* which can only accept incoming transactions. All credcards are coded to the owner's fingerprints, retina patterns, or the equivalent; they are essentially worthless to a thief.

If FTL communications are limited or unavailable, there can be long waits for credit verification when the buyer is from a different planet; in this case, a traveler will have to carry hard cash or valuables in order to open a local account.

Outside the borders of the issuing nation, credcards and cash may be less acceptable. Other nations will have other units of currency. These may have different bases, and vastly differing values. In most campaigns, exchange rates should be simple: e.g., one Imperial Credit equals two Bolaski Pulg-Notes. More complex systems should be reserved for interstellar trading scenarios (traders *have* to be able to deal with different currencies) or for those rare scenarios in which financial confusion is the crux of the adventure.

But when complexity and confusion are the order of the day, the GM can be creative. Different races can use different forms of credit, and value different goods. Treasure could be in the form of bars of plutonium, hand-drawn art circulating as money, or optical chips recording letters of credit. Really alien races may make funny faces as a medium of exchange, offer change in viral cultures, or trade their goods on the basis of personal intimidation. Some forms of "treasure" may be very inconvenient, or even dangerous, to carry. Nobody said it was easy to be a star trader.

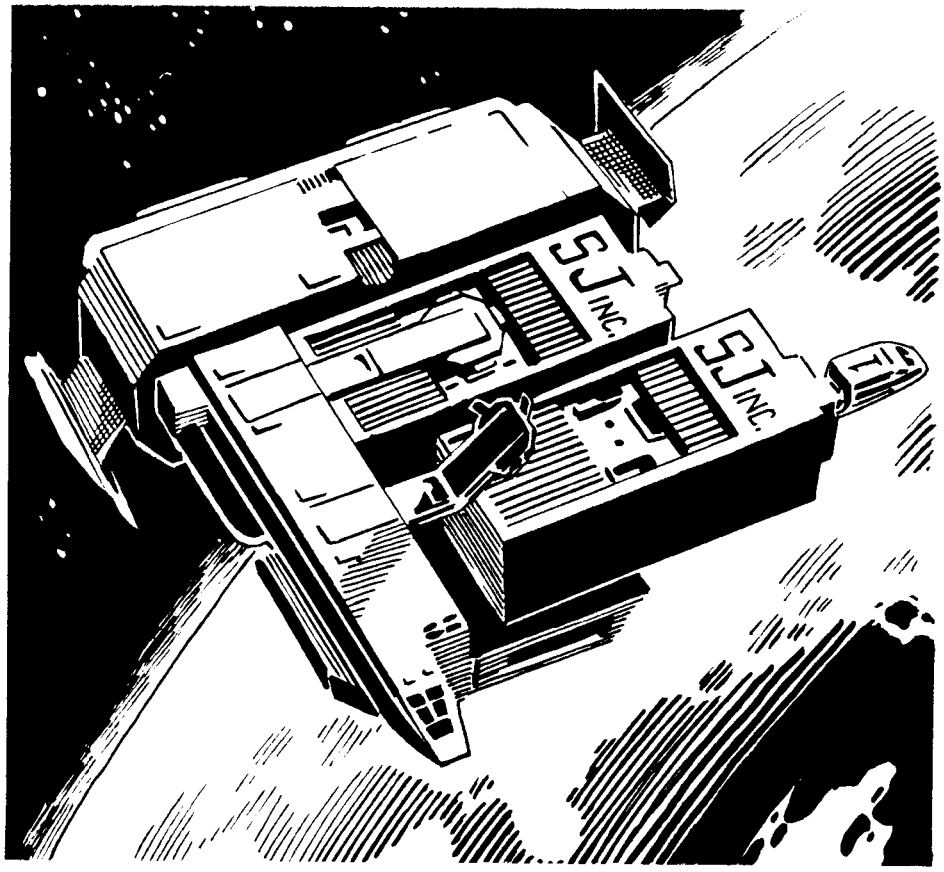
Price Variations

The GM may wish to vary prices from world to world. To determine randomly how much a price may vary on a specific planet, roll 1 die to determine whether the price is greater or less than list; in general, 1-2 equals a lower price, 3-4 equals normal, 5-6 equals higher. Then roll 1 die and multiply by 10% to determine the percent difference. Thus, a roll of 1, then a roll of 4 means the item costs 40% less than list on this world.

Generally, everything is more costly on remote or frontier worlds, *especially* high-tech items. Merchant skills may allow bargaining for a better price. Black-market goods are always expensive (see p. 57).

Prices

Hotels, per night	
Sleeper Cube	$6
Startown Low	$25
Starport Average	$50
Starport Deluxe	$200
Food, Drink, Etc.	
Meal (Synthetic)	$5
Meal (Real Food, TL8+)	$10
Meal (Real Food, Imported)	$40
Soft Drink (Okrakola), per bottle	$.50
Synthebeer (Rethay Lite), per mug or bottle	$1
Happy Stick (Leary Tube), per stick	$1
Mixed Drink (Naval Snoot), per drink	$3
Algae Wine (Bex-X), per bottle	$5
Medical Expenses	See pp. 64-70
Communications/Information	
Computer Net Data Time (special), per hour	$15
Comm Net Hookup (citywide), per month	$20
Long-Distance Call, per minute (planetary)	$1
Interplanetary Call, per minute (in-system)	$5
Interstellar Call: depends on FTL radio technology!	
Interstellar Mail, per ounce, per parsec	$.20



Planetary Transportation

Ballistic Liner (transcontinental hop)	$200
Bullet Tube (per 1,000 miles)	$200
Hover Cab Service (per person per 10 miles)	$20
Private Shuttle Rental (per day)	$1,000

Ship Operations

Starport Docking Fees (per 1,000 cy per day)	$500
Starship/Spacecraft Fuel	See pp. 80-84
Ship Insurance against loss or damage, per year	10% of vessel cost
Ship Rental, including insurance, per month	3% of vessel cost

Interstellar and Interplanetary Passage

If interstellar travel is routine, starfarers don't have to have their own ship. Passenger vessels ply regular routes, and freighters will carry a few passengers wherever they go. Costs given below are for interstellar travel, starport to starport. Inter*planetary* passages are 40% of these rates.

Luxury: $2,500/day. This is for the very wealthy. Travelers in Luxury passage sections enjoy large suites, gourmet food and a variety of other luxuries. Includes 10 cy of luggage.

First Class: $500/day. Respectably spacious private cabins, first-class food and good service. Includes 2 cy of luggage.

Standard: $250/day. Usual accommodations on interstellar liners. Passengers may have a small private cabin or may share a larger one with another passenger. Food is adequate; services are limited. Includes 1 cy of luggage.

Steerage: $150/day. The lowest class of interstellar travel for conscious, aware passage. At best, travelers may share a small semi-private cabin with one or more fellow passengers. Often they are given hammocks in the cargo section or even a small storeroom. Food may be synthesized in the mess, or it may be concentrated rations; sometimes it costs extra. Steerage travelers may have to put up with unexpected detours and delays, and may find themselves displaced in favor of higher paying passengers (or even cargo), until the next ship comes along. Includes ½ cy of luggage.

Freeze Passage: $50/day. Passengers who opt for freeze passage are usually those so down on their luck they can't afford any other method of travel. They spend the entire voyage in suspended animation in cold-sleep tubes. Not everyone can be revived successfully (HT roll; 1d injury on a failure, 3d on critical failure; badly-maintained freeze tubes can malfunction and kill the sleeper). Sleepers must sign releases exonerating the shipowners from responsibility. Includes ½ cy of luggage.

Working Passage: A negotiated arrangement by which a qualified traveler receives free passage in exchange for serving on the crew during the flight. Accommodations depend on the job. A stand-in for a missing pilot may get quarters equivalent to First Class; a cook/steward would be lucky to have Standard digs. Working passage is usually offered only by the smaller lines and by independent vessels, such as free traders, who may have difficulty finding last-minute crew replacements.

Luggage: In addition to their standard luggage allotments, travelers may carry whatever they can stow in their rooms (if they have any) and may purchase additional cargo space at $10 per cy per day.

Job Table

On "civilized" worlds, PCs may find jobs to provide income while they are not in play. Of course, not every job is available on every world. Jobs can help cover the PC's cost of living, as required by his Status. See p. B192 for general job rules.

The Job Table lists a number of jobs; the GM may add others. Some have skill or experience prerequisites (default values don't count here; you must have at least a half-point invested in the skill).

Remember that if a character's time spent adventuring is part of his job (e.g., for a starfighter pilot), his success should depend mainly on regular play, not job rolls.

Critical Failure Key

"LJ" stands for Lost Job — you were fired, demoted, or lost the client. The "d" indicates dice of damage ("3d" is 3 dice of damage; "10d" is 10 dice, etc.) — you were in an accident, fight, etc. The "i" indicates a lost month's income ("-2i" means losing 2 months' income) — you were fined, forced to pay for damages, had to replace equipment, etc. If there are two entries separated by a "/", use the second result *only* when a natural 18 is rolled.

Note that for some dangerous jobs, the result of a critical failure can be serious injury. The GM may choose to play out these episodes to give the PC a fighting chance.

Job (Required Skills), Monthly Income	*Success Roll*	*Critical Failure*
Poor Jobs		
Involuntary Colonist (no qualifications), negligible	8	1d/4d
Starport Bum* (no qualifications), $250	Scrounging or Streetwise	-1i/3d
Welfare Recipient (no qualifications), $300	10	-1i/dropped from rolls, reapply in 6 months
Struggling Jobs		
Actor or Actress* (Acting 10+), $50 × skill	PR	-3i/LJ, 1d
Colonist* (Any useful Craft or Outdoor skill 10+, Survival 11+), $50 × best PR	Best PR	-2i, 1d/-4i, 4d
Driver/Chauffeur (Appropriate vehicle skill 12+), $60 × skill	PR	-2i, 1d/LJ, 3d
Laborer (ST 10+), $550	ST	LJ/5d
Shop Clerk (Merchant 10+), $600	IQ+Reaction	LJ
Average Jobs		
Bounty Hunter* (Beam Weapons 12+, Survival 10+, Tracking 13+), $100 × Worst PR	Worst PR-2	LJ, 2d/LJ, 6d
Courtesan* (Sex Appeal 13+), $100 × skill	PR+Appearance	-2i/-4i, 2d
Criminal Enforcer* (ST 12+, Beam Weapons or Guns 12+, Brawling or Judo or Karate 12+), $90 × IQ	Best PR-4	LJ, 3d/8d
Interstellar Missionary* (Bard 10+, Occultism or any Theology 11+, Status 1+), $75 × best PR	Best PR	-2i/LJ, 2d
Journalist* (Research 12+, Bard or Photography or Writing 12+), $70 × best skill + $500 per +1 general Reputation	Best PR	-3i, 1d/LJ, 3d
Lab Assistant (Computer Operation 10+, Research 11+, any Science skill 10+), $100 × (worst PR-6)	Worst PR	-2i/LJ, 3d
Pirate (Beam Weapons or Force Sword 11+, Free Fall 11+, any shipboard skill 12+), $1,000 × Reputation	10+Status	-3i, 4d/2d, imprisoned
Private Detective* (Criminology 12+, Law or Streetwise 12+), $75 × best PR	Worst PR	-3i, 2d/LJ, 4d
Prospector/Belter* (Prospecting 10+), $100 × skill	Prospecting	-3i, 1d/LJ, 3d
Starship Crew (Status 0+, appropriate shipboard skill 10+), $80 × best appropriate skill + $200 × (Rank or Status)	Specific job's PR	LJ, 2d/LJ, 8d
Trooper (Status -1+, appropriate combat skill 10+), $1,000 + ($200 × Rank)	Best PR-2	-2i, 2d/-5i, LJ
Comfortable Jobs		
Assassin* (Beam Weapons or Crossbow or Guns 12+, Stealth 12+), $300 × worst PR	Worst PR	-4i, 4d/8d
Computer Programmer* (Computer Programming 14+, Electronics (Computer) 12+) $250 × worst PR	Worst PR	-3i/LJ
Corporate Executive (Administration 13+, Business experience 5+ years, Status 0+), $3,000	PR	-2i/-4i, LJ
Corporate Spy* (Acting 12+, Stealth 10+), $300 × worst PR	Worst PR	LJ, 1d/LJ, 4d
Diplomat* (Diplomacy 12+, Administration 10+, Status 1+), $1,000 × (Diplomacy-11)	Worst PR	-2i, LJ/LJ, 2d
Free Trader* (Merchant 12+, any shipboard skill), $1,000 + normal for shipboard position	Merchant	-3i, 1d/LJ, 4d
Major University Professor (Any academic specialty 13+, Teaching 11+, Status 1+), $1,000 × (specialty-12)	Specialty	-3i/-5i, LJ
Science Officer (Computer Programming 12+, Electronics (Sensors) 11+, any Science skill 10+, Status 0+), $400 × (Status + Rank + best PR-12)	Worst PR	-1i, 1d/LJ, 3d
Scientist* (Computer Operation 12+, Research 13+, any Science skill 14+), $300 × best Science skill	Worst PR	-3i/LJ, 3d
Ship's Captain* (Leadership 12+, Tactics 12+, Status 0+), $500 × (Status + Rank + Leadership-12)	Worst PR	-3i, 2d/LJ, 4d
Smuggler* (any shipboard skill 12+, Streetwise 12+), $3,000	Streetwise	-2i, 1d/-2i imprisoned, 3d
Wealthy Jobs		
Corporate Chief Exec (Administration 13+, Leadership 12+, at least 10 years Business experience, Status 3+), $5000	Worst PR	-4i/-5i, LJ
Corporate Research Scientist (Research 12+, any practical Science skill or Engineering 13+, Status 1+), $2,000 × (Research-12)	Worst PR	-3i/LJ, 2d
Doctor/Surgeon* (Diagnosis 12+, Electronics (Medical) 10+, Physician or Surgery 13+, Status 0+), $650 × Best PR	Worst PR	-3i/-10i, lose license
Holo-Vid Star* (Acting or Bard or Musical Instrument or Singing 12+, Status 1+), $500 × (best PR + reaction bonus)	Best PR	-5i/LJ, 1d
Idle Rich/Noble (Status 3+), $3,000 × (Status-2)	none	-4i, 1d/-12i, loss of title
Planet/System Govt. Administrator (Administration 12+, Status 1+), $5,000 if minor system, $10,000 if major system	PR	-3i, LJ/LJ, imprisoned
Sector Administrator (Administration 13+, Status 2+), $2,000 × (Administration + Status-13)	PR	-4i, LJ/LJ, imprisoned

Variant Human Races

In a universe in which mankind has been starfaring for thousands of years, *variant races* will develop. These may be adaptations to new conditions (heavy muscles for heavy gravity) or just genetic drift (crimson skin and white hair).

Variant humans are created on the same attribute table used for humans — but they may get *bonuses* or *penalties* in one or more attributes. These bonuses and penalties affect the final attribute level, not the point cost. For example, the Skathi, a heavy-world race, get a +3 to ST. If a Skathian pays 0 points for ST, he gets a 10 (from the basic attributes table) plus a 3 (bonus) for a total ST of 13. If he pays 10 points for ST, he gets an 11 (from the table), plus the bonus of 3, totaling 14. And so on.

Many races have "automatic" advantages and disadvantages. For example, all Skathi have Absolute Direction and Bad Temper. When a variant-race PC is created, racial disadvantages do *not* count against game limits on allowable disadvantages.

Friends and Enemies: Variant races have whatever racial foes the GM gives them. Most variants are not attractive by normal human standards, and will get a reaction penalty for their appearance. However, well-traveled or cosmopolitan people (Patrol officers, for instance) will ignore or genuinely not notice racial differences.

Psychology: Like Terro-humans, most variants prefer the company of their own kind and environments similar to their homes. Heavy Worlders are most likely to go adventuring, since they are physically superior to standard humans.

Other variant races can be created for other environments — for instance, a barrel-chested race adapted to very thin atmosphere. Add some interesting racial advantages or disadvantages, and possibly some cosmetic change from human norms — green skin, bald heads, extra fingers, and so on. There will usually be a character point "cost" or "bonus" to be a member of a variant race. To compute this, start by calculating the value of the race's attribute modifiers. Use the costs listed on the human attribute table in the ***GURPS Basic Set.*** For example, a +1 on any attribute is worth 10; a +3 is worth 30; a +4 is worth 45, and so on. Negative modifiers, of course, have negative costs. Advantages and disadvantages have their normal point values.

The three most common variant racial types are:

Heavy Worlders — *45 points*

These races evolved on planets with a gravity significantly stronger than Earth's — at least 1.75 G. They are short, squat and very muscular.

Advantages and Disadvantages: Details depend on the world. "Generic" Heavy Worlders have ST +3 and HT +1. They have the G-Tolerance advantage, with a .5-G increment, and a home gravity of around 1.5 to 2 Gs. Their weight is 25% above human norm — all of it muscle — and they are a foot shorter than normal for their ST. They are wider, too, which sometimes causes them trouble traversing narrow passages (roll DX to avoid this). Heavy Worlders are unattractive by normal human standards (-1 reaction by normal humans).

Light Worlders — *-15 points*

These races evolved on planets with gravity significantly less than that of Terra — no greater than .7 G. They tend to be tall and willowy, sometimes even emaciated in appearance. They usually have long limbs and spidery fingers.

Advantages and Disadvantages: Again, this varies with the specific race. Generic Light Worlders have ST -2, HT -1 and DX +1. Their weight is normally from 15% to 25% less than normal humans of their height, and they stand up to 2 feet taller than ST would imply. They are thin enough that they can squeeze into narrow places that would require most humans to make a DX roll to fit in, and they can outreach any normal human by a foot or more.

In campaigns where gravity control is not possible, being a Light Worlder is worth an extra -5 points, because they are uncomfortable on the worlds favored by the dominant version of the human race.

Spacers — *-40 points*

These are humans who were born and have lived their entire lives in zero gravity. Unlike the above variants, this is not necessarily a genetic adaptation; anyone raised in free fall would show Spacer characteristics.

Spacers are generally poorly muscled, and suffer debilitating effects in any gravity stronger than .2 G. A "born" Spacer, in particular, might have very underdeveloped legs. Some Spacers are *very* tall — 3 feet over normal for their (very low) ST. Spacers' weights are 50% of the human norm for their height. Very emaciated Spacers should add an Appearance (-1 or worse) disadvantage when dealing with normal humans.

Advantages and Disadvantages: Spacers have ST -5 and HT -2. Their native gravity (see p. 36) is 0 G, so they suffer badly in "normal" gravity. Spacers automatically get the Free Fall skill at DX+3. Spacers in their own environment live a long time; they don't start making aging rolls until age 70, but age normally thereafter.

Genetically Enhanced Humans

At TL9, genetic manipulation of humans is possible, though expensive. At TL10, it is routine. Certainly we'll be able to breed new types of man long before we're wise enough to decide what makes humans "better." Campaign possibilities include:

Men To Fit The Job. If genetic manipulation is fairly easy, New Men might be built for all kinds of jobs. Heavy- and light-world colonists could be created in one generation by relatively simple manipulations. With a little more difficulty, the manipulators could create furred colonists for cold worlds, water-breathers for ocean planets, lemur-eyed folk for dark worlds . . . Indeed, a human-only universe could include races as alien as anything a writer ever imagined.

Reactions of regular humans to "new men" will vary from admiration to hatred. But, at least for the first few generations, many humans will be jealous of their superior traits and contemptuous of the fact that they were "bred like animals."

Everybody's Perfect. In a campaign where genetic manipulation is widespread, the GM may (for instance) halve the costs of better stats, physical advantages and some mental advantages. Anyone can have the genetic improvements of their parents' choice, to be strong, fast, beautiful and have a perfect voice.

Super-warriors. Suppose the manipulation process is new and difficult. A cadre of supermen, the offspring of a secret project, could be trained as devastating warriors. They would have very high attributes and possibly special abilities like Night Vision. Intelligence might be left at normal or even low levels.

Super-agents. If the process is *very* difficult, the results might be too expensive to use as cannon-fodder . . . so the super-kids would be trained as assassins and secret agents. A campaign might focus on the exploits of such a group . . . or they might be the feared enemy. Heinlein's *Friday* tells the story of one such agent.

Alien Races

If the campaign includes alien races (see p. 7), the GM should permit alien PCs whenever they can reasonably fit in.

Everyone — GMs and players — must roleplay creatively when taking the part of aliens. Even in a space-opera campaign, where all the aliens are human beings in furry coats, this will add to the fun. And in a "hard" SF campaign, it will be *necessary* to play other races as genuinely *alien*. A few points to keep in mind when dealing with alien races:

Charisma always works. For game purposes, we define this "force of personality" as universal.

Voice, good looks, etc., rarely work. Aliens will not respond to a pleasant voice unless it is, by coincidence, pleasant to *them.* Few aliens will notice physical beauty in a human. And so on.

Aliens will have racial likes and dislikes. This may be as simple as "reacts at +2 to Terrans," or as quirky as "will not deal with anyone wearing orange."

Aliens may not want the same things we do. Likewise, they may not fear the same things we do. Most humans want wealth, comfort, and the approval of their fellow man, and fear injury, ridicule and death. Aliens may not see things the same way . . .

Aliens may like and dislike different things about individuals. For an example, see the Sparrials, below.

Creating Alien Races

GMs may invent alien races at will, using the guidelines described above for variant human types. It is a good idea to develop a race and its homeworld "in parallel." A race will be shaped by its world; if the race is very strong, for instance, it probably comes from a high-gravity world. If it breathes methane, it comes from a Hostile Terrestrial or Gas Giant planet. And so on. The creator of a race should always specify its preferred gravity, temperature and atmosphere (both gas content and pressure). This defines the sort of real estate the race will be interested in.

When you develop a race, don't just describe it physically. Consider its psychology. This will be determined largely by the race's planned role in your campaign — but make it interesting!

In a "space opera" campaign, most races will have human motivations, perhaps with one trait intensified . . . dog-like aliens who are very loyal, cat-like aliens who are very proud and combative, snake-men who are creepy and sinister. In a "hard SF" campaign, some aliens are likely to have wholly unfamiliar shapes, and their physical makeup will give no clue to their psychology. Their motivations may be wholly unknowable to humans!

Alien Advantages and Disadvantages

Alien races will have racial advantages and disadvantages, as described above for variant humans. Some things will be disadvantages only if the campaign is primarily human-dominated. For example, if a race averages 3 feet tall, they will have the racial Dwarfism disadvantage if they must rely on humans to get them into space . . . but if they build their own ships, their small size doesn't matter, and they don't get bonus points for their size. It's just a "feature" of the race.

Reaction bonuses or penalties can be ignored, unless they apply to *most* other races they will contact — or to the dominant intelligent life form in your universe. In that case, each point of reaction bonus is worth +5; each penalty is worth -5. Other attributes that affect reaction, such as appearance, are treated the same way.

A race may have other strong or weak points that don't translate directly into listed advantages and disadvantages. GMs should allow a reasonable "cost" for these.

Often, aliens can be built by taking a standard advantage or disadvantage and defining it creatively. For instance, you could choose the Hideous Appearance disadvantage and say it is because, instead of teeth, the alien's mouth is full of tiny, wormlike tentacles that squirm and wiggle obscenely as he talks. (Of course, to his own race, he is the very epitome of beauty.)

Alien "Features"

Alien races may also have *features* far different from the human norm. Something is considered a feature if it gives the possessor no significant advantage or disadvantage, but is interesting enough to mention. In humans, red hair might be a feature. Some sample features:

Native society. A race might be naturally patriarchal, or communistic, or attach a very high value to personal property or honor. Perhaps certain castes (or sexes, or ages) are not intelligent.

Physical appearance. Fur, feathers, scales and so on. But thick fur might be equivalent to armor. Fur that gave PD 1 and DR 1 would be worth 20 points; PD 2 and DR 2 would be worth 45 points.

Means of communication. But a particularly obscure mode of speech (such as that of Kurt Vonnegut's Tralfamadorians, who communicated by "farting and tap-dancing") would give a penalty on reactions.

Sexuality. A race might be asexual, or have several sexes. There may be social advantages and disadvantages, *within* the race, to the different sexes. The specific means of reproduction, or the life cycle, may be unusual.

Sample Aliens

Following are four alien races that can be dropped into any interstellar campaign. Really outré races require more special rules than can be given here . . . see ***GURPS Aliens,*** a complete book on alien races.

The technological development of these races is deliberately not specified. GMs may use them as the primitive natives of a new planet, the Elder Race that takes Man to the stars, or anything in between.

Sparrials — *0 points*

The Sparrials are a small, vaguely feline race, descended from a tree-dwelling predator. They are bipedal; their hands have four skeletally-thin opposable fingers with retractable claws. They are sleekly furred; most coats have varying patterns

of brown or rust color, but albinos are relatively common. The mouth is the most "alien" feature; closed, it does not look unusual, but it contains several fleshy organs and a grid of rough, serrated bone that serves as teeth.

Environment: Sparrials are native to a .95-G Terrestrial world with an average temperature of 65° — Cool by human standards. However, they have a wider temperature tolerance than humanity; they can live anywhere a human can. They breathe a standard Terran oxygen mix at .97 atmospheres.

Advantages and Disadvantages: Sparrials have ST -3, HT +1 and DX +2. They automatically have the advantages of Night Vision, Acute Taste and Smell +2, and +3 to Detect Lies skill vs. humans, Sparrials and most other races (they can smell fear). If they take a round to prepare, using the Step and Concentrate maneuver, they can make leaps of twice their normal Jump distance. They have the racial disadvantages of Kleptomania (stealing small personal items is a common form of Sparrial competitiveness), Gluttony and Stubbornness. A Sparrial has normal height and weight, by human standards, for its ST.

Psychology: Sparrials are active and adventuresome, but can be very patient when there is need. They tend to be quarrelsome among themselves until a "pecking order" is established, through argument, battle or clever thefts. Sparrials steal from those around them in much the same way humans trade quips and insults — to establish dominance and show their own worth without combat.

Sparrials react very strongly to smell. They dislike some races, and like others, purely on the basis of odor. Human scent varies widely, in Sparrial view. The first time a human meets Sparrials, roll 1 die and subtract 3, and record the result. This determines how the Sparrials like his odor; that is the Sparrial reaction bonus (or penalty) to that person thereafter.

Sparrials have two sexes; the males are slightly smaller and faster than the females.

Pachekki — *0 points*

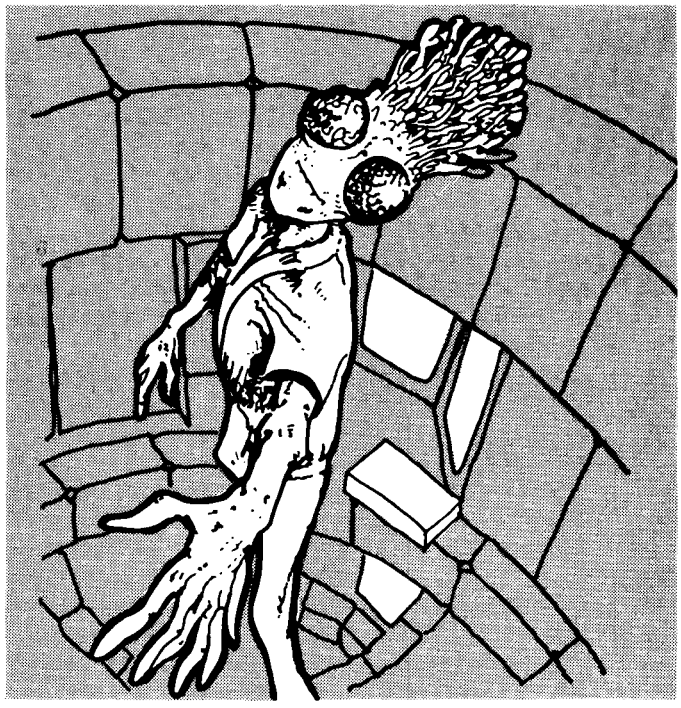
The Pachekki's ancestors were amphibian omnivores, living in the branching vegetation of a fresh-water sea. They are upright bipeds, like men. But they are nothing like Terran life; one detractor called them "bastard offspring of bugs, lizards and crabgrass." With their lipless mouths, bulging insect eyes and "hair" of waving auditory palps, they look rather awful. Their hands are their most human feature — but they have six fingers and a thumb!

Environment: Pachekki are native to a watery .7-G greenhouse world with an average temperature of 100° — Very Hot by human standards. They prefer a humid oxygen atmosphere, with atmospheric pressure 1.2 times Terran standard. This is rare in low-gravity worlds, so the Pachekki will find "perfect" planets rare and will lay strong claim to them.

Advantages and Disadvantages: Pachekki get ST -4, DX +3, HT +2, IQ -1 and -1 to basic Speed. They have the advantages of Peripheral Vision, Rapid Healing, and Double-Jointedness. They also get +3 to Swimming ability. Their racial disadvantages are weak hearing (-5 to all Hearing rolls) and Split Personality (see below). By human standards, they are very unattractive: -2 on reactions. They are tall and slender: a foot taller than human normal for ST, and 20 pounds lighter than human normal for their height.

Pachekki also have a limited Regeneration ability; they can regrow lost fingers, eyes, palps and other small body parts. Lost limbs, however, don't regenerate.

Psychology: The average Pachekki is not very bright . . . but there are a few smart ones, and they become the explorers and



leaders. "Underling" Pachekki are not slaves or drones, but they will follow their smarter leaders with a matter-of-fact loyalty that Terran rulers envy. Pachekki are very interested in technology and bio-technology. They work hard to shape their environment to fit themselves; with access to genetic technology, they'll work just as hard to shape themselves to other environments. As a race, they are somewhat jealous of species that can use the more common types of terrestrial planet.

Pachekki are bisexual, but each individual changes sex in response to random environmental stimulus. A Pachekki character rolls 1 die each day; on a 6, he becomes she, or vice versa. A male Pachekki has the additional trait of Laziness; a female is Impulsive and generally hyperactive. Sexes are not otherwise distinguishable without dissection, except to another Pachekki. Pachekki government tends toward collective leadership to balance the effects of sex changes on individual leaders.

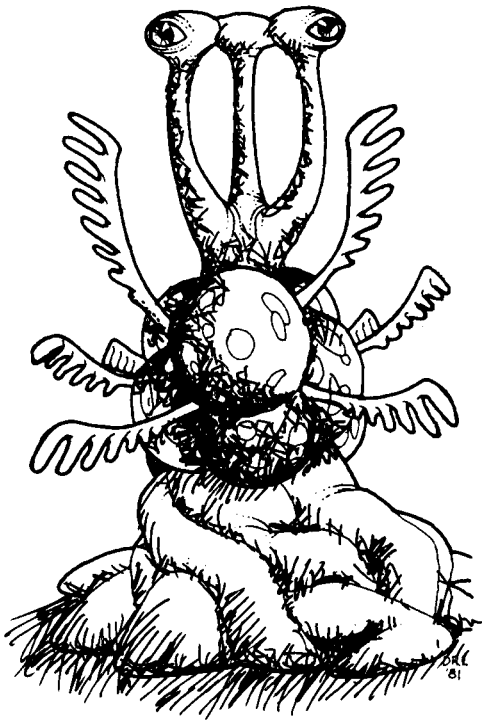
Treefolk — *80 points*

On the Treefolk's home world, the kingdom of life did not divide into plants and animals. The Treefolk share characteristics of both. They photosynthesize (using a purple pigment), and get nutrients from thick roots. But they also use their eight handlike fronds to pull up other plants and catch slow animals to eat.

Environment: Treefolk are native to a 1.1-G Terrestrial world with an average temperature of 75° — Earth-normal. They breathe carbon dioxide and release oxygen; atmospheric pressure makes very little difference to them. Their home star is a type F6; under dimmer suns, they tend to be sluggish, losing one IQ point for each spectral type cooler than F.

Advantages and Disadvantages: Treefolk have ST +2, a HT +4, a DX -3 and IQ +2. Their Move is only 1. Their organs are diffuse and duplicated, giving them two points of Toughness. Their three stalked eyes, which look very human, give them Peripheral Vision. Treefolk don't start aging until they reach 150, and then only at half the rate of a human. They have one level of G-Tolerance.

They have the Hard of Hearing and Color Blind disadvantages. Their own speech is in the ultrasonic, where they can hear quite well. Treefolk can communicate ultrasonically



beyond the hearing of humans, but can speak in lower registers for the convenience of other races. They cannot swim; in water more than three feet deep, they eventually drown, though it takes (HT/2) hours.

Treefolk are huge: a foot taller than human normal for ST, and 100 lbs. heavier than human normal for height.

Psychology: Treefolk love nature, and tend to live near bodies of water or in areas of moist rich soil. Their "homes" are well-kept outdoor areas with small shelters; a Tree may have possessions that must be sheltered from the elements, but *he* likes standing in the rain. They are *not* pacifists, and can be implacable foes. They are independent and self-sufficient by nature; while they comprehend the idea of "government," they find it obnoxious, and will obey political authority only grudgingly. They fear fire above all else. Treefolk are bisexual, but the difference matters only to another Tree.

They like technology but dislike human cities, where they can't feel the ground under their roots. High-tech Treefolk would get around in small carts containing pots of earth, and would use bright sunlamps to colonize worlds of dimmer suns.

Special Combat Rules: Because of their unusual structure, Treefolk perform differently in combat. They cannot punch, but can swing a weapon. In fact, they can fight effectively with two hand weapons at once (but can only aim one *missile* weapon at a time). They are very resistant to damage from projectiles — the bullets tend to go through or lodge in them, causing only half damage. However, they take double damage from fire or any flame-producing weapon (and their Toughness doesn't protect them from it). Their eight fronds give them a +4 on any attempt to Grapple. All their hexes are "front."

Gormelites, or "Shaggies" — *20 points*

These ogreish humanoids are something of a mystery. There is reason to believe that their ancestors manipulated them genetically, or that they are descended from the survivors of a nuclear war. The general form is shockingly human: two arms, two legs, a head, two hands, each with four fingers and one thumb. But the differences are equally shocking. The mouth is flat and lipless, edged with bone; there are no teeth. Nose and external ears are absent. The eyes are blank white membranes. The body is covered with sparse fur.

Environment: Shaggies are native to a 1.2-G Terrestrial world with an average temperature of 40° — Cold by Earth standards. They breathe oxygen at slightly under Earth atmospheric pressure.

Advantages and Disadvantages: Gormelites have ST +4 and HT +3. They are 6" taller than human for their ST, and 50 lbs. heavier than human for their height. They have 1 point of Toughness. Their racial disadvantages are psychological: Greed, Overconfidence, Paranoia, Bad Temper and Bully. They also have a Reputation, known to all, as dangerous, untrustworthy thugs: -2 on any reaction. But they are not berserkers; their attacks are clever and calculated. Many are sadists.

The Shaggy life-span is about equal to that of humans, but few die a natural death; wars and duels account for most adults before their 40th year.

Psychology: The race is very territorial and acquisitive. Gormelites would reject as nonsense the idea that "all men are created equal." To them, there is only master and servant . . . and those too weak to serve are usually killed out of hand. A Gormelite's goal is to be a master, or, failing that, to be a highly-ranked servant of a very tough master. This is one reason that Terran scientists theorize they may have been an artificially-bred warrior-race. For whatever reason, Gormelites do not cooperate well with each other, and get along even worse with most other races. Their entire planet (and any other planet they may control) is divided into small, independent states, each controlled by a warlord whose only ambition is to conquer his neighbors.

Normally, Gormelite females are just as tough and nasty as males. Pregnant females secrete hormones that make them self-defense pacifists, and pacify others at close quarters; thus, a Gormelite "nest" is a comparatively peaceful place. Disagreements and duels are taken outside. The young Shaggies are kept in the nest until they begin to mature (about age 12).

Danger to the "nest" will drive Gormelites of both sexes into total rage, and no normal Gormelite will endanger a nest, even his bitterest foe's. Unfortunately, they show no such compunction toward the homes and children of other races.

SPACE CAMPAIGN PLAN

GM: _____ Date: _____

Campaign name: _____ Campaign's starting year: _____ Rate game time passes: _____ Campaign type: _____

Known alien races: _____

Campaign's base world: _____ (Suggestion: give players a Planetary Record for this world.)

Frequency of "good" worlds: _____ Is exploration still going on? _____ Where? _____

Campaign political background:

Name and type of stellar state: _____ Control Rating and (if different) weapons CR: _____

Brief description of the state and its neighbors: _____

Brief description of the political/economic situation: _____

Campaign's Tech Level: _____ Differences from this tech level as described in ***GURPS Space***: _____

FTL communications speed, range and availability: _____

Medical Technology: _____

Starship rules:

FTL drive type: _____ Speed: _____ Fuel: cost, consumption, etc.: _____

Ease of FTL navigation: _____ FTL Engineering Skill Difficulty: _____

Obstacles to FTL travel: _____ Time effects of FTL travel: _____

FTL side effects, error effects, special notes: _____

STL drive type: _____ Speed: _____ Fuel: cost, consumption, etc.: _____

Ease of STL navigation: _____ STL Engineering Skill Difficulty: _____

STL side effects, special notes: _____

Power plant type: _____ Engineering Skill Difficulty: _____ Fuel: cost, consumption, etc.: _____

Usual/allowable weaponry and shields: _____

Player Character information:

PC races (or human subtypes) allowed: _____

(GM should provide racial descriptions for any new races allowed as PCs.)

Base wealth for PCs: _____ Starting social levels allowed for PCs: _____

Language(s) the PCs will need: _____

Especially useful/useless character types: _____

Especially appropriate/inappropriate professions: _____

Advantages and skills that will be especially useful in this campaign: _____

Advantages and skills that will be worthless in this campaign: _____

Disadvantages that will be discouraged in this campaign, either because they are fatal or because they won't really be disadvantages: _____

Appropriate Patrons (and base value): _____

Appropriate Enemies (and base value): _____

Special disciplines available in this campaign:

Magic? (How powerful? How common? General mana level?) _____

Psionics? (How powerful? How common?) _____

Rules variants: New skills, advantages, disadvantages (summarize) _____

Rules variants: Changes in combat rules (summarize) _____

The GM should also provide the players with details on:

new gadgets, and their availability; new advantages, disadvantages, or skills; "house rules" for character creation; changes in the combat rules; new NPC races; important organizations; and history (see p. S7).

GADGETS 4

The equipment described in this book will work with most future universes. But SF campaigns can never have too many gadgets. The GM should definitely invent new and unique devices. Some will be available anywhere; others will be secrets for the adventurers to discover.

Gear listed in other ***GURPS*** worldbooks, such as ***Autoduel***, can be adapted. Other items can easily be derived from equipment in today's world. Or adapt from your favorite SF novels. For a complete book of science fiction gadgets, see ***GURPS Ultra-Tech.***

GMs are also free to *omit* any device that would unbalance their particular campaign. For instance, if the campaign is about mankind's first contact with an alien race, interspecies translation equipment should not be available!

Unless specifically noted, items remain available at all TLs after introduction. However, they become less expensive. For items introduced at TL8 or later, *halve each item's cost* at the TL after introduction, and halve it again at the next TL.

Any *electronic* device also becomes smaller at higher Tech Levels. Each such item halves in size (if applicable) *and* weight at the TL after introduction, and halves again at the next TL.

Some items, specifically mentioned, continue to drop in cost or weight, or become more effective, as TL increases.

Certain items are listed at TL7 even though they are not yet in common use . . . but they will be soon, or would be if we needed them!

The standard power cells used by TL8+ gadgets are described on p. 53.

Personal Gear

Personal Kit: Attaches to a belt, etc. Holds eating utensils, pen, firestarter, small change, toothbrush, comb and so on. $25, ½ lb.

Utility Belt (TL5): A web belt with pouches for money, equipment, ammo and other valuables, plus hooks and loops for tools, equipment, holsters and so on. $25, ½ lb.

Credit Transactor (TL7): A small electronic-currency transfer device (see p. 37). Uses one A cell (see p. 53) for power. $20 (plus a minimum deposit of $100), negligible weight.

Chronometer (TL5): A wrist or pocket timepiece, with other functions optional. TL5: $500+, ¼ lb., local time only. Winds up. TL6: $100+, weight negligible. TL7: $25+, weight negligible, may keep a variety of times at extra cost; may include calculator at extra cost. TL8 and 9: As TL7, but may also include a communicator. TL10+: A wrist-sized personal computer may be worn, and telling time is only one of its functions. Cost is $1,000. See p. 50.

Towel (TL4): 2' x 4'; terrycloth or similar. $10; 1 lb.

Survival Gear

Bush Knife (TL5): A large knife. Serrated top allows it to be used as a saw. Standard issue to Survey scouts, Rangers, and so on. $60, 1½ lbs.

Survival Knife (TL7): As above, but handle is hollow and contains a variety of miniaturized survival equipment, including fishline and hooks, antiseptic, stimulants, miniature tools, light, firestarter, compass, knife sharpener, wire for animal snares, and up to three other very small items the owner specifies beforehand. $100 at any TL, 1½ lbs. Custom versions are available, at ever-escalating prices, with assorted built-in electronics such as radio, rad detectors, homing buttons, and so on.

Biphase rope (TL8): ⅜" diameter supports 1,000 lbs.; $5, ½ lb. for 10 yards. ¾" diameter supports 4,000 lbs; $30, 2 lbs. for 10 yards. Strength doubles at TL10 and again at TL12.

Concentrated Rations (TL7): Highly nutritious concentrated food pastes in squeeze tubes. One tube supplies a human with all the nutrients required for one day. Tastes good, but not filling at all; ration users always complain of hunger. A full week's worth of rations (7 tubes), $50, 2 lbs.

Filtration Canteen (TL7): A canteen with a built-in filtration unit designed to purify and hold up to a quart of water. Will remove *almost* all impurities, microbes and poisons; there is always the possibility of a contaminant for which the filter was not designed! It takes 5 minutes to purify a quart of water. Filters must be replaced every 100 quarts; a color change signals this. An "exhausted" filter still has a few quarts of capacity, but only the manufacturer and the GM know how many. $175, 1 lb. empty or 3 lbs. full. Replacement filters are $25.

Vapor Canteen (TL8): A canteen that actually draws moisture from the atmosphere as long as there is any water vapor at all. It extracts and holds one quart of water. Time required varies with the amount of water vapor in the air — with an Earth-standard humidity of 50%, it takes four hours to extract a quart of water. Extracts 100 quarts on a B cell. $450, 2 lbs. empty or 4 lbs. (full). Larger versions are available for use at base camps: $3,000 buys a 1-cubic-yard version that weighs 300 lbs., runs for a month on an E cell, and generates a quart per 5 minutes in 50% humidity with a fair breeze.

Magnetic Compass (TL5): Standard compass; always points to magnetic north on any world with a strong enough magnetic field (a Navigation or Planetology roll may be needed to know the difference between magnetic and geographic north on a particular world). The same at higher TLs. $5, negligible weight.

Inertial Compass (TL8): A hand or belt unit that indicates the direction and distance traveled from any preset point on a planetary surface. It can be set for the location at which the user is physically present, or for any other coordinates (requiring a Navigation roll if coordinates of the location aren't known). Must be calibrated for the planet (1 hour with a hand computer, and Navigation or Electronics roll; or connect it to a properly-

programmed computer and get an instant recalibration). Uses an A cell. Distances measured are accurate within 1 yard per 1,000 miles. $250, 1 lb.

Thermo Suit (TL7): Insulated hood, jacket and leggings, with internal heating coils. Uses a C cell. Protects against freezing (see p. B114) by increasing effective temperature as set by the wearer: 48 hours at +10°, 24 hours at +20°, 12 hours at +30°, and so on. Adds 10 to wearer's effective HT for all rolls to resist freezing, even if the heater is off. PD 0, DR 1. $150, 5 lbs.

Envirobag (TL7): An insulated sleeping bag, good for temperatures down to -10° and up to 100°. An optional heating unit, using a C cell, works as for the Thermo Suit. It can be sealed and hooked up to air tanks. Folds to the size of a paperback book. $75, 6 lbs. Heating unit, $50, 1 lb.

Desert Environment Suit (TL9): A specially designed full body suit that insulates the wearer from extremes of desert heat and cold. It also recycles the wearer's body fluids, collecting pure water in a reservoir from which the wearer may drink. Good for temperatures up to 150° and down to 0° F. Uses one C cell to operate a built-in refrigerator. Cell life depends on the setting: 24 hours for -10°, 12 hours for -20°, 6 hours for -30°, and so on. Adds 5 to wearer's effective HT for all rolls to resist freezing or overheating. DR 1. $700, 20 lbs.

Pressure Tent (Personal) (TL7): A completely airtight one-man tent (holds 2 very tightly). User(s) must have an air supply with them! Opening it loses a half-hour of air. DR 2. $500, 15 lbs., as big as a large book.

Pressure Tent (Two-Man) (TL7): As above, but larger; holds 4 in a pinch. $1,500, 30 lbs., backpack-sized.

Pressure Tent (Base) (TL7): As above; meant for up to 8 men, but 20 could crowd in. DR 4. $5,000, 150 lbs., 1 cy.

Enviro-Bubble (TL8): Emergency inflatable bubble with self-sealing flap that can be entered and inflated within a few seconds (make a DX or Vacc Suit roll) and provides 15 minutes of air. It is flexible enough to move in, but Move is only 1. Usually worn on the belt for quick activation. $800, 5 lbs.

Tools

Tool kits exist at all tech levels; this section will only deal with those for TL8+. Note that tool kits do not drop in price or weight as tech level increases; as gadgets get more complex, so do the tools required to fix them. Note also that all tool kits contain several power cells, but the cells found in salvaged kits are likely (GM's decision) to be partially or completely used already.

Basic Tool Kit (TL8 and up): Standard tool kits for engineers, mechanics, armorers and electronics technicians — everything needed for many emergency repairs. Anyone attempting repairs without one of these kits does so at a -5 to skill. A kit from the next lower TL is only a -3. Each type of kit must be purchased separately, though a Mechanic may "make do" with one of the others at only -3 to skill. Any kit will include a few devices requiring small power cells, and is therefore a source of extra cells in a pinch — 1d+2 AA cells, 1d A cells, 1d-2 for B cells. Mechanic or Engineer kits, $800, 300 lbs., ½ cy as cargo. Armoury or Electronics kits, $1,200, 100 lbs., ¼ cy as cargo.

Portable Shop (TL8 and up): More elaborate versions of the basic tool kits — equivalent to repair shops on small starships. Has almost everything necessary for emergency repairs, plus a wide range of "generic" spare parts that can be tooled to specific requirements. Use of one of these adds +2 to the appropriate skill; a shop of the next lower TL is about as useful as a basic kit of the proper TL. It will have 2d each AA, A and B cells, 1d C cells, 1d-2 D cells, and 1 E cell. Mechanic, Engineer or Armoury shop, $4,000, 3,000 lbs., 5 cy as cargo; Electronics shop, $7,000, 1,500 lbs., 4 cy.

Mini-Tool Kits (TL9): Small, belt-sized versions of the various tool kits. Routine repairs can be made with one of these at only a -2 to skill. Major repairs are at -4 when using a mini-tool kit. Mini-kits of lower TLs are at a further -2. Roll 1 die for AA and A cells, 1d-3 for B cells. All types, $400, 2 lbs.

Laser Torch (TL8): Small close-focus hand laser for light cutting and spot welding. Does 4d per second cutting damage to doors, bulkheads, etc. Damage is cumulative per turn to cut through tough materials. Can be used in combat (SS 12, Acc 1, RoF 4, Damage 1d cutting, ½D 3, Max 15). Uses a C cell which lasts 60 seconds. $250, 5 lbs.

Flashlight (TL8): Throws a 50-foot beam for 6 continuous months on a C cell. $20, 1 lb. A belt or helmet model that leaves the hands free costs $10 more. $100 buys a heavy-duty light that can be used as a baton without being damaged. Larger and smaller lights are available, of course.

Thief/Spy Equipment

Lockpicks (TL5): High-quality lockpicks that give a +1 to all skill rolls on mechanical locks of the appropriate TL. $200, weight negligible.

Electronic Lockpick (TL8): A sensor/decoder that gives a +3 to either Lockpicking or Electronics (Security Systems) skill on attempts to break any electronic lock, +/-2 for each difference in TL between lock and lockpick. Uses an A cell. Illegal on many worlds. $1,500, 3 lbs.

Thermal Lockpick (TL7): Consists of a contact disk and a remote (up to 5 yards) detonator. Burns through all types of locks (except on a roll of 17 or 18, in which case the lock fuses and won't open at all). However, the lock is ruined and entry can't be covered up. Will also burn a 3" hole in walls of up to DR10, unless the wall is of heatproof material (ordinary metals and plastics are not heatproof!). Illegal on most worlds. Failure of the Lockpicking roll can be risky; critical failure does 3d burn damage to user! Detonator uses an A cell. Comes with 5 contact disks. $500, 1 lb. Extra disks, $100 each.

Contact Mike Set (TL7): A sensitive adhesive-backed dime-size microphone which transmits to an ear button. Range only about 5 yards. Can be used for routine "bugging," but also gives +2 to any attempt to open a mechanical combination lock or safe when the mike is placed on the lock mechanism! Uses an A cell. $300 for a mike and button on the same frequency.

Disguise Kit (TL5): Suitcase-sized kit with makeup, wigs, mustaches, beards, false noses, etc. Gives +2 on Disguise rolls. $300, 10 lbs.

Living Disguise Kit (TL11): Far more sophisticated disguises and makeups. Includes premolded sensa-skin sections (noses, ears, facial sections and so on) for living disguises, along with sensa-skin neutralizer for removal of the otherwise permanent material. Depending on the exact contents, the kit may allow users to realistically impersonate aliens, the opposite sex, and so on. Gives +4 on Disguise rolls. Illegal on many worlds. $5,000 (and up), 10 lbs.

Chameleon Suit (TL10): A full body suit designed to

camouflage the wearer. It is sensor-controlled to change color to match the background. All attack and spotting rolls against the wearer are at a -3 penalty. A suit takes 5 seconds to change color(s), during which time it offers no protection. It also suppresses heat signatures of targets, giving a -3 to infrared spotting and targeting. It works for 24 hours on a set of three A cells. It takes 20 seconds to put on a chameleon suit, 10 to take one off. The suit has PD 0, DR 1. Cost is $1,850. Weight, 10 lbs.

Holobelt (TL10): A belt-mounted holographic projector that casts around the wearer a preset three-dimensional image, roughly man-sized, for concealment. The image must be bigger than the person concealed! Standard planetary holo disks let the user choose between a variety of native-looking rocks, trees, mailboxes, bushes, animals, etc. Operates for 24 hours on one B cell. All attacks at the user are at -1 to skill, and aimed shots to specific body areas are not possible.

Drawbacks of the belt: It gives no protection against infrared or bioscanners. A cube inappropriate for a given planet is more likely to draw attention to the user than it is to conceal him. Because the suit projects light, the holo-image *glows in the dark.* And the suit must be allowed to vent waste heat (which produces a large heat signature) at least every 6 hours, or it starts leaking heat anyhow, and becomes very uncomfortable. $1,100, 4 lbs. Prerecorded holo disks, $100 each.

Distort Belt (TL10): Similar to the holobelt in appearance, the distort belt affects incoming scanner pulses to give a distorted, or false, reading of the belt's wearer. Effectively, it gives a -5 penalty to anyone using a scanner to detect the wearer. The scanner signal, on a failed roll, will either not register the belt wearer at all, or will show him as something else (as preset by the user). Even a successful scan will be able to give no more than general information about a belt wearer. Useless against visual sighting or psionic detection. Works for 12 hours on a B cell. $2,200, 3 lbs.

Holodistort Belt (TL10): A combined distort and holobelt that works for 6 hours on a B cell, matching its distort readings to the image. $4,000, 5 lbs.; $200 per holodistort cube.

Psi Shield (TL??): This device exists only if there are psi powers in the campaign, and even then only if the GM permits it. When worn, it gives the user a mental shield which protects against telepathy. The user does not know if someone is trying to penetrate the shield, but any attempt to detect, read or control his mind is at (suggested) -10. Presence of the shield is obvious to any telepath who attempts to contact the shielded individual. At the GM's option, the shield may also interfere with any psi operations by the wearer, or even cause headaches and IQ penalties for high-psi users. Works for a month on a B cell. 1 lb., $1,000 (or much more, if it is a secret).

Sensor Equipment

Radiation Detectors: See sidebar, p. 77.

Scanners (TL9): Small, handheld sensors, each designed to locate and identify one sort of thing. The three main types are: *Radscanners*, which detect energy, power and radiation sources of all kinds (not just radioactivity); *Chemscanners*, which scan for minerals, metals, and chemical compounds; and *Bioscanners*, which are highly-specialized chemscanners that locate the characteristic complex molecules produced by life-forms. Radscanners can pick up the scanning radiation of the other types of scanners, but radscanners are passive detectors and cannot be detected themselves.

A scanner allows a roll on Electronics (Sensors) skill to detect its general category of item within its scanning range of 1,000 yards. A search for a specific item within its category is at -2 to skill (or more, if the user is not sure just what he is really scanning for), but can detect the item up to 2,500 yards away. Large concentrations can be detected at up to twice these distances. More specific data can be picked up at ranges of 500 yards or less on a roll at Skill+2. The device can be used for detailed analysis of an item within 50 yards, but the user must roll against the appropriate science skill to properly interpret the data. Scanners may be set for a specific area sweep, which lets the user scan a 60° arc each turn at the ranges listed above. A scanner can be set for a 360° scan instead, but all listed ranges are divided by 5. Changing the setting takes 1 turn.

All these stats are for TL9 scanners. TL10 scanners weigh half as much and have twice the range, and give +1 to rolls. TL11+ scanners have 5 times the range listed above, and give another +1 for every TL above 10.

Scanners can be linked to a hand computer or (by radio) to a larger computer for more detailed information or analysis. Individual scanners are about the size of a pack of cigarettes. Gives 2 months of continuous operation on a B cell; in practice, one cell will last for years. $1,000, 1 lb.

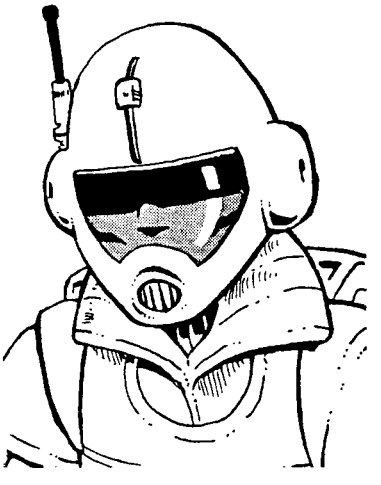
Multiscanner (TL9): Combines the functions of all three above scanner types, plus its own dedicated computer (+1 on science rolls to interpret data) and a data recorder. Includes a short-range communicator for linking with a larger computer. About the size of a 20th-century cassette recorder; can be hooked to a utility belt or carried on a shoulder strap. Works for a month of continuous operation on a B cell. $5,000, 5 lbs.

Multiscanners improve at higher TLs, as for scanners.

Psi Scanner (TL??): Only exists if psi talents are generally known, and maybe not even then; GM's option. Possibly it can be used only by a psi. Or the device may be a military secret. Operates like the above scanners, but detects *active* use of psionic powers. Cannot be used to determine if a person is a psi, if he or she is not using any psi abilities! $1,000, 1 lb.

Light-intensifier Goggles (TL7): Picks up and intensifies available light. Halves any penalty for darkness (round in user's favor) except complete darkness. Will burn out if it is hit by a laser! Works 3 months on a B cell. $200, 1 lb. At TL8, $300 will buy light-intensifier contact lenses with no weight.

Infrared Goggles (TL7): Eliminates the night penalties for all action, including combat, but imposes a -1 to weapons skill because of the slight distortion when seeing via infrared. Allows vision in *total* darkness if there is at least 10° difference between objects. At any temperature, allows weapon fire in darkness at only the -1 penalty if the targets produce heat — which most living things and active machines do! Gives a +2 to detect living beings if used in *daylight.* Can be blinded by a powerful heat source. Works for 6 months on an A cell. $600, ½ lb. at TL8; half price, but no lighter, at higher TLs.



Anti-Glare Goggles (TL7): Polarized goggles that darken automatically to cut glare and ultrabright light. Allows direct viewing of the sun and other stars without risk of blindness. Also protects eyes against hand laser fire. $150, ½ lb.

Multiview Goggles (TL8): Combines the functions of infrared, light intensification and anti-glare goggles. Works for 3 months on an A cell. $1,200, 1½ lbs.

Televiewers (TL8): Lightweight electronic binoculars that provide an extremely sharp image. Magnification can be adjusted from 5× to 20×; includes an electronic range-finder for up to 5,000 yards. Such a range-finder gives +2 to Gunner skill if used with artillery of TL6 and below, which does not normally have such accurate distance measurements. Infrared or light-intensification can be built in at $300 each. Gives 3 months continuous operation on a B cell. $950, 2 lbs.

Communications/Information Equipment

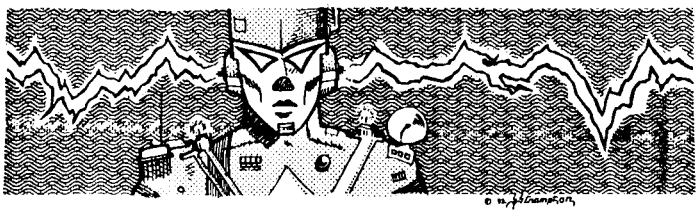
Implant Communicator (TL8): Implanted in the user's skull (mastoid process). Powered by an AA cell, which should last at least 10 years in this application. Has an effective range of about 10 miles. Frequencies, etc., are controlled remotely by a master unit; without the master unit in range, the implants are useless. With practice, users can subvocalize, thus communicating without moving their lips (IQ-4 to notice someone in the same room doing this). Ship crews and military units often use implants to keep in touch. Costs $500, plus $500 for implantation. The master unit costs $1,000 and weighs 5 lbs.; it includes a dedicated computer that assigns frequencies and routes messages by verbal request. Each master can control up to 100 implants, and masters can talk to each other if programmed to do so. The master uses a B cell, which lasts for a year of steady use.

Short-Range Communicator (TL8): Small hand-held communicator about the size of a cigarette lighter. Has an effective range of 10 miles (can be increased to maximum of 20 miles on an Electronics (Communications) skill roll, -1 per extra mile). Can also be linked into a larger comm net at the appropriate costs (see *Prices*, p. 37). Can be built into a helmet, watch, locket, etc., at an additional 10% to cost. Uses an A cell, which lasts for a year of steady use. $50, weight negligible.

Medium-Range Communicator (TL8): A larger, palm-sized communicator with an effective range of 100 miles (can be increased to a maximum of 200 miles on a skill roll, -1 per 10 miles extra). Can be linked into a comm net at the appropriate costs. An optional booster unit doubles the cost and weight and allows it to reach any orbiting starship equipped to pick up its signals. A B cell powers a year of steady use. $200, 1 lb. Double cost for a video display.

Long-Range Communicator (TL8): A purse-sized communicator carried by a strap worn over the shoulder, with an extensor mike and optional earphones for private listening. Has an effective range of 1,000 miles (can be extended to a maximum of 2,000 miles on a skill roll, -1 to skill per extra 100 miles.) Can reach starships in standard orbits. A B cell powers 3 months of steady use. $600, 10 lbs. Add $100 for a video display.

At higher TLs: For all the above communicators, multiply range by 10 for TL9 and 50 for TL10. At TL9, video is standard at no extra cost. At TL10+, the display is a 3-D hologram.



Brainwave Communicator (TL13): A helmet device that picks up the wearer's brainwaves and transmits them to any other brainwave helmet to which it is tuned. Messages transmitted this way are commonly believed to be impossible to jam, or to intercept without the users' knowledge, but both sender and receiver must make a successful IQ roll to open communications. This is, in effect, mechanical telepathy. Language is no barrier between creatures of the same species; members of different species are at a -2 (or more) to open communication, even if they share a common language. Words are transmitted automatically. Separate IQ rolls are required to send pictures or diagrams, or to tell a lie successfully! Effective range is 50 miles, though messages may be relayed at greater distances through other tuned-in helmets. Different species usually need different types of helmets; one make does not fit everyone! Requires a B cell. $3,500, 5 lbs.

Translator Medallion (TL10): Disc-shaped device, usually worn around the neck. Preprogrammed to translate any one spoken language to another with a skill (typically) of 14. Extra languages can be programmed in at extra cost when the unit is built; most units (except those carried by slavemasters, for instance) are at least two-way. Uses an A cell (lasts at least a year). Weight negligible; $1,000 to translate A to B only; $1,200 to translate A to B and B to A; an additional $1,000 for each language database added, with full two-way translation between any two languages. Can also radio-link with a computer that knows more languages.

Mental Translator (TL13): Picks up and translates brainwave patterns to spoken (or whatever) language, and vice versa. Enables aliens who could not normally reproduce or understand human speech to do so. Usually capable only of translating one species' brainwaves into one other major language. Usually worn near the brain. Uses an A cell. $2,000, 1 lb. Each additional language it can translate into will increase cost by $1,000.

Digital Camera (TL8): Takes full-color pictures recorded on standard computer media (see p. 52). No "developing" is required. Each gigabyte of storage holds 40 very-high-quality color pictures, or 50,000 (!) shots of about the quality of a TV picture. In the latter mode, it works as a motion-picture camera, getting 12 minutes of TV-quality film, with sound, per gigabyte. Runs 1 month on a B cell. $500, 2 lbs.

Holo Camera (TL9): Records full-color still holograms on special film (requires development). $1,000; 5 lbs. A film pack takes 20 shots and costs (including developing) $200.

Holomotion Camera (TL9): Looks something like a rifle, but takes 3-D color *movies*. $3,000; 20 lbs. Film cartridges, in sizes up to an hour, cost $50 and weigh 2 oz. per minute (includes developing costs).

Holo Projector (TL9): Allows projection of holo movies or still shots in any space from 1 to 6 cubic feet (commercial entertainment models produce much larger images). Runs for 2 months on a B cell. $750, 8 lbs.

Reader (TL8): A simple "dumb terminal" that reads databases or camera disks and project them on a screen. $100, 2 lbs.

Recorder (TL8): Records and plays back sound, using standard computer disks. Holds about two hours of hi-fi sound, or 1,000 hours of low-fi voice recording, per gigabyte (see p. 52). $175, 1 lb.

Air Masks, Vacc Suits and Life Support

Air mask (TL7): Used on worlds that have harmless but unbreathable atmospheres (nitrogen, reducing, CO_2, and so on). Covers the entire face (human eyes get oxygen directly from the air). Always includes a short-range communicator, which uses an A cell. Requires air tanks or a filter (below). 3 seconds to put the mask on, 1 to take off. 2 lbs., $100. For another $50, the mask includes an emergency tank with 3 minutes of air.

Air tanks: For a 1-hour tank at TL6: 40 lbs., $200. For a 1-hour tank at TL7: 30 lbs., $100. For a 2-hour tank at TL8+: 10 lbs., $100. For a 24-hour tank at TL8+: 73 lbs., $400.

Air refills are $5 per hour if you don't have your own ship with air compressor. Tanks take 10 seconds to put on, 2 to drop.

Note that in each case, an hour of oxy-helium breathing mix, at one atmosphere, weighs only about 1½ lbs.; the rest is the tank weight. (Oxy-nitrogen, or ordinary compressed air, would weigh 4.2 lbs.) Of course, these times are an approximation. Different people use air at different rates. For game purposes, assume that all adults breathe the same amount of air, and that children under 12 use half as much. All times given here assume external pressure of 1 atmosphere or less. At 2-atmosphere pressure, an air tank only lasts half as long, and so on.

Scrubber (TL6): Can be added to an air mask (+1 lb., $200). Gets rid of exhaled CO_2 and water; captures and recycles unused oxygen and inert gas in the breathing mix. Does not replace air tanks, but makes a tank last twice as long. Works for 12 hours on a B-cell; also requires a chemical charge ($20 for 12 hours).

Rebreather (TL8): Can be added to an air mask (+1 lb., $200). Captures exhaled CO_2 and water and turns them into oxygen (for rebreathing), discarding carbon and hydrogen; captures and recycles inert gas in the breathing mix. Does not replace air tanks, but makes a tank last 10 times as long! Works for 12 hours on a B-cell.

Respirator (TL9): Makes thin or low-oxygen atmospheres breathable by concentrating the oxygen. Often combined with goggles to protect eyes from effects of thin air. 3 seconds to put on, 1 to take off. Works 1 month on a B cell; includes a short-range communicator. 3 lbs., $300.

Reducing Respirator (TL9): "Reducer" for short. A mask which makes Dense or Very Dense oxygen atmospheres breathable by chemically reducing the partial pressure of O_2. Includes goggles to protect the eyes from burning effects of too much oxygen. Works 1 month on a B cell; also requires a monthly chemical recharge ($50). Includes short-range communicator. 3 seconds to put on, 1 to take off. 5 lbs., $500.

Filter attachment (TL6) for air mask or respirator: Used to filter out contaminants; cost depends on what is being filtered. Filter medium must be replaced periodically; again, cost varies from a $10 cartridge (to filter heavy dust or pollen) to replacing the whole mask (in highly corrosive atmosphere). 1 lb; cost varies from $100 to $1,000 or more.

NBC suits (TL7): These suits are worn over regular clothing to protect from nuclear, bacteriological and chemical contamination — but not against actual radiation! They are airtight, but not pressurized against vacuum. They include a clear hood (-1 to vision and hearing) with a filtered mask (see above). If an NBC suit is penetrated, it no longer protects against fallout, disease, gas, etc. NBC suits take 30 seconds to put on, 15 to remove. PD 0, DR 1; 10 lbs.; $600.

For an additional $100, an NBC suit comes with a regular air mask, allowing air tanks to be used. For an additional $200, NBC suits will protect against corrosive atmospheres as well. Actual radiation protection can also be added: $200 for PF 2, $1,000 for PF 5.

Vacc suit (TL7): A flexible, insulated pressure suit. Required in vacuum; may also be worn in poisonous (noncorrosive) or Very Thin atmosphere. Covers the whole body, with a rigid helmet. Has exterior pockets, Velcro patches, straps, hooks, etc., for equipment, and at least two lifeline hooks. Always includes short-range communicator, which uses an A cell. Styles differ widely. Requires an air tank.

The gloves reduce DX and manual skills by -1. The clear helmet allows undistorted vision (but cuts hearing rolls by -2 in air). Touching helmets in vacuum allows private suit-to-suit communications. Indicator dials tell the wearer how much air and power are left, what the suit's internal temperature is, and so on. (At TL8+, this is a heads-up display projected on the helmet). A tube leading to a 1-quart reservoir provides water.

A back-mounted life-support pack provides heat and cooling, and energy for the suit's systems. It uses a C cell, which is good for a week (longer than anyone would stay in a suit). The life-support pack has DR 3 and HT 20. After it takes 10 hits, there is a 50% chance of it malfunctioning on each further hit. When it loses all its HT, it no longer works; the user's survival time depends on the environment.

Any vacc suit has a front pocket with 10 emergency patches. Any damage that penetrates the suit must be patched immediately. This requires 3 seconds and a Vacc Suit roll. If the first attempt fails, each further attempt is at a cumulative -1. Every 3 seconds loses 10% of the suit's air.

A vacc suit takes 1 minute to put on or take off; if the suit is worn without the helmet, the helmet takes only 5 seconds to put on. A successful roll on Vacc Suit skill can halve these times. Default skills cannot be used to decrease suit-up times.

A typical vacc suit is 10 lbs., $1,000, PD 0, DR 1. The helmet has PD 2, DR 3. Military models (armored, laser-reflecting, etc.) are common at higher prices; see below for some options. The above weight and cost halve at TL9, and again at TL10.

Vacc suit accessories of all kinds are available. Common ones include *helmet light* ($30, 6 months on B cell); *water and concentrated food* system, holding 24 hours' worth, delivered through helmet nipples ($500 for system; uses standard concentrated rations); *waste relief system* (a good idea if you plan to wear the suit more than a few hours; $500); *better communicators or translators* (see above costs); *built-in computers* (as per costs given below); *reflective coating* (acts as reflec armor, and gives PF 2 vs. radiation; $300); *extra patches* ($10 per patch); *recorder* (as above). Radiation protection (see p. 76) can be added: $200 for PF 2, $1,000/+20 lbs. for PF 5, $2,000/+40 lbs. (rigid suits only) for PF 10. Suit exteriors are usually personalized so the wearer can be easily recognized.

Heavy-duty vacc suit (TL7): As above, but tougher: PD 2, DR 3. $1,500; 20 lbs.

Armored vacc suit (TL8): Required in corrosive or superdense atmospheres. Rigid, and covers the whole body; the DR protects the life support pack. Styles differ very widely; some are more like small tanks than "suits." Requires an air tank (or several). Always includes short-range communicator, using an A cell. Requires 2 minutes, or more, to put on or take off. All DX or DX-based skills (including Free Fall, but not Driving or Piloting) are at -2. 80 lbs., $4,000 and up, PD 4, DR 30.

Military armored vacc suits (TL8): Fully sealed and pressurized versions of all combat armor suits (p. 63) are available. Add 5 lbs. to the suit's weight (for the life-support pack described in *Vacc Suits*) and $1,500 to price. Air tanks are extra.

Exoskeleton (TL8): A mechanical suit which amplifies the

wearer's ST. Often used by those who must work under high gravity. An exoskeleton wearer rolls on the lower of Exoskeleton skill (p. 36) or DX, for any ordinary DX roll. For other DX-based skills, he rolls on the lower of (skill-1) or (Exoskeleton-1). The GM may assess extra penalties for actions that should be especially difficult in a suit, such as Acrobatics. However, most exoskeletons (or "exosuits") have removable gauntlets to allow the wearer to do delicate work.

The wearer ignores ST penalties for high G; he uses the exo's ST instead. He halves (round down) all DX penalties for high G. HT and IQ penalties are unchanged. Suits should be fitted to the user, though "generic" models may be worn by anyone of the right general size, at an extra -1 to DX or skill rolls. It takes 2 minutes to strap into an exo, and 1 to remove it. All necessary bodily functions can be performed while in an exosuit.

An exoskeleton will run for about a week on a D cell; it always has sockets for two cells, for safety. Cost for a typical exosuit is $35,000 (ST 15, no armor, no frills). Subtract $4,000 if the suit is generic rather than fitted. Add another $10,000 for each additional ST point up to 20. Any amount of frills (weapons, armor, life support, etc.) can be added, but this eventually turns the exoskeleton into an exploration suit or battlesuit, at tremendous expense. An exosuit weighs 10 lbs. per point of ST up to 20, and another 20 lbs. per additional ST point.

Exoskeletal vacc suit (TL8): For use on high-G worlds with superdense or corrosive atmospheres. Start with a heavy-duty or armored vacc suit; add the cost and weight of the desired exoskeleton. Requires both Vacc Suit and Exoskeleton skills. Uses a D cell, plus an A for the communicator, as above. Fatigues wearer at 1 per hour (wearer *may* rest while wearing the suit). Note that certain "options," such as food and a waste relief system, are almost necessary. An EAVS (exoskeletal armored vacc suit) is only one step away from a military battlesuit, and anyone accustomed to one will be able to operate a battlesuit (but not its weapons!) using Exoskeleton skill.

Hand Thruster (TL7): A hand-held unit for use in free fall. Propels the user with bursts of compressed nitrogen. Each burst accelerates or decelerates a normal-mass human at 1 hex/turn in the direction opposite to that in which the thruster is pointed. A successful Free Fall or Vacc Suit roll is necessary to point the thruster in the desired direction. The unit's N_2 cylinder is good for 30 1-second bursts. $50, 4 lbs. including cylinder; extra cylinders cost $10, weigh 1 lb., and take 5 seconds to replace.

Thruster Pack (TL7): A rocket-powered harness seat for short jaunts in free fall — ship to ship and so on. It consists of a "seat" unit with a thruster in the back, a pair of arms with reverse thrusters, and a control arm that curves in front of the user. Maneuver jets are located at strategic points along the entire pack. It takes 20 seconds and a Vacc Suit roll (which can be reattempted every 5 seconds if missed) to strap into the thruster pack. It can accelerate or decelerate a normal-mass human at up to 3 hexes/turn on each turn. The large N_2 cylinder allows 100 seconds of full acceleration, or the equivalent. Successful Free Fall+1 rolls allow the user to control his speed and direction (at TL8+, a dedicated computer gives +2 to this). $2,000, 45 lbs. including cylinder. Extra cylinders cost $30, weigh 10 lbs., and take 5 seconds to replace.

Magnetic Boots (TL7): Actually, they look more like heavy sandals, and could be built and maintained at TL4 if needed. They let the wearer walk along bulkheads or on starship hulls in microgravity or zero G: at regular Move if the character has Vacc Suit skill, and at ½ Move if not. There are two types: one sort is fitted like shoes, for inside wear, and the other fits onto any vacc suit. 10 seconds per boot to put on, 5 to take off. $100, 2 lbs./pair. Or magnetized plates may be built onto the soles of any rigid suit's boots at an additional $100 and ½ lb.

Artificial Gill (TL8): A backpack unit that allows the user to breathe underwater; uses electrolysis to extract oxygen from water, and feeds it to a face mask. Requires Scuba skill to use. Useless in fluids other than water. Takes 20 seconds to put on and 5 to take off. Works 24 hours on a C cell; always has sockets for 2 cells, and an alarm to warn when the first is 90% exhausted. $2,000, 20 lbs.

Wet Suit (TL6): A flexible suit that covers the diver's entire body, with goggles for the eyes and a face mask for attaching an artificial gill or air tanks. It insulates against cold and has ballast sufficient to keep the diver at any depth he wishes. Foot flippers add 25% to swimming speed (minimum +1 Swimming move). PD 0, DR 1. Infrared or light-intensification goggles for improved underwater vision can be added for the appropriate cost. It takes 2 minutes to put on or remove the suit. $500, 20 lbs.

Contragrav Gear

Regardless of general tech level, none of this equipment is available unless contragrav (anti-gravity) technology exists.

Contragrav Chair (TL12): Essentially, a floating (or flying) wheelchair. It supports itself and flies at any height; it also keeps its wearer in a 1-G environment (or whatever he prefers). Removes all penalties for heavy-gravity living, but not suitable for manual labor. Usual maximum speed is 10 mph (Move 5). A CG chair can carry up to 600 lbs. plus its own 200-lb. weight. Runs 1 month on a D cell. Cost for a typical CG chair is $30,000. Accessories, life support, weapons and armor can be added.

Contragrav Platform (TL12): The contragrav chair without the chair. Can carry up to 700 lbs. in addition to its own 100-lb. weight. Has no motive power of its own, but can be pushed or pulled like a cart; effective weight to the puller is only 50 lbs., regardless of its load. Runs 1 month on a D cell. $4,000.

Contragrav Chute (TL12): An anti-gravity "parachute" that nullifies gravity by about 99%, so that the wearer falls to earth very slowly from any height. This harnesslike device takes 10 seconds to strap on and 5 to remove. Requires a Parachuting roll, at +4, to use safely. Weapons fire while in a CG chute is at -2, or more in rough air; recoil penalties are *doubled.* The wearer has poor maneuverability; he may Dodge, but this only adds 1 to passive defense. A CG chute works for about an hour (to be safe, one drop) on a C cell. $2,500, 20 lbs.

Contragrav Belt (TL13): A harness unit that lets the wearer fly at up to 80 mph (40 hexes/turn) at heights up to 5 miles on a standard 1-G world. Carries up to 500 lbs., though speed and maximum height are halved with over 250 lbs. Flies 1 hour on a C cell; belts always have at least two cell sockets, and a beeper goes off when the first cell is 90% exhausted! It takes 5 seconds to put on and activate, 2 to remove. Controls are at the user's chest, and require only one hand. Piloting (Grav Belt) rolls are required on takeoffs, landings and difficult maneuvers. $5,500, 20 lbs.

Assault troops often use CG belts. Weapons fire from someone flying a belt is at -2, or worse if the user is doing tricky flying, dodging, or in rough air. Dodge roll in a belt is half Piloting (Grav Belt) skill, rounded down. Anyone dodging is at an extra -2 to fire on the next turn.

Computers

Computers first appear at TL6, and develop rapidly after that. Computers change so fast that a home system of "late" TL7 would seem miraculous to a user of even a few years earlier.

At TL6, computers are huge and experimental, practical only for mass-storage uses. They are very costly.

At TL7, computers become desk-sized and available to the middle classes; they are easy to program. If a modem is available, some remote databases can be reached and used.

At TL8, computers are no bigger than the keyboard and screen. For most users, Computer Programming skill becomes unnecessary, and any Computer Operations roll is at a +3 because systems are so easy to use.

At TL9, computers are self-programming and troubleshoot their own problems. Systems with voiceboxes can carry on a good conversation. Though they are not "sentient," they can easily fool you. And some systems *are* sentient — see below.

At TL10, it may be hard to tell the computers from the people. At TL11 and above, there may be no reason to *try* to tell them apart.

Hardware

Computers are rated in terms of *Complexity*, relating to the programs (see p. 52) that they can run. Complexity 1 is the simplest; Complexity 6+ computers may be sentient. In addition to the usual reductions in weight and cost, for each TL above 8 an equivalent computer has a Complexity rating increased by 1. For instance, a personal computer has Complexity 2 at TL8. At TL12 a "personal" computer is only a fourth the size, costs only a fourth as much — and has Complexity 6!

Computer Types

Dedicated Computer: This system provides built-in computing capacity for a single device. It runs one program, and only one; that program is hard-wired in and cannot be changed. Complexity of the computer is equal to the complexity of the program. Cost is typically 1d × 10% less than cost of the equivalent general-purpose computer, plus the cost of the program.

Personal Computer: A system that fits into a pocket or a briefcase. At TL8, personal computers are Complexity 2 and run for one year on a B cell. Cost is $1,000; weight is 2 pounds.

Minicomputer: At TL8, a minicomputer is Complexity 3 and costs $15,000. It uses building power or can run for six months on a C cell.

Microframe: These multi-user Complexity 4 systems are used in such applications as large passenger ships; they use ship or building power. The base cost is $40,000, plus $2,000 per user. Weight is 200 lbs.; size is .1 cubic yard.

Mainframe: Used for a capital ship, major business, etc. Such a system would have Complexity 5, and cost $200,000, plus $1,000 per user. Weight is 500 pounds, and size is 1 cy, not counting terminals and peripherals.

Megacomputer: This machine is not available until TL9, and is Complexity 7 then. Commonly referred to as a megacomp, it is most often found administering functions for an entire city! Volume and weight are variable. A minimum size, for the simplest system, is 1 ton and 10 cubic yards. Cost is *very high.*

Sentient Computers: At TL9, it is possible that a megacomp will become self-aware; it may or may not let its users know! Once per year the GM can roll 3d for each megacomp in his campaign. On a 6 or less, it will "wake up." A computer that becomes sentient is immediately upgraded to Complexity 8 in terms of processing capability. Depending on the society, the awakening of a megacomp may cause rejoicing . . . or panic.

At TL10, computers cannot accidentally become sentient, but those of Complexity 6+ can be built that way on purpose. Such a system has its own personality and an effective IQ (on things it's not specifically programmed for) of Complexity +5. Cost of a self-aware computer is 3 times normal.

Fully-sentient "artificial intelligence" (or AI) systems are considered people in some places; they can't be "enslaved," and are eligible for citizenship. In some places they are property, with varying degrees of "civil rights," but never equal to "natural sentients." Other governments outlaw AI completely.

Sentient computers should be considered characters, complete with quirks.

Optical systems: Ordinary computers can be damaged or destroyed by the electromagnetic pulse (EMP) of a nuclear weapon. An optical system is immune to EMP, but is twice as large and heavy, and costs five times as much, as a standard one.

Using Computers

At TL8+ all computers can have voice-instruction capability; Computer Programming rolls are not required for most purposes, and Computer Operation rolls are at +3. At TL9, Computer Operation skill is almost never necessary, and therefore almost unknown.

Complexity 2 computers can give simple spoken replies; Complexity 4+ systems can understand idiomatic conversation and reply in kind, within their realm of expertise. Users may give any instructions to a computer, if it has the appropriate program. GMs make the ultimate decision as to the capabilities of a program and the response of a computer to an impossible order. Simple systems can be dangerously literal-minded.

Players may give any instructions to computers they control, if the computers have the appropriate programs. For instance, a computer with Optical Recognition and Gunner programs could be told to fire on any ship identified as Pachekki-built. The owner writes down the instructions for the "program" in as much detail as he wants and gives this to the GM. A sentient computer may ask for clarification if the instructions seem unclear or unwise. Other computers will follow instructions literally; the GM can have a lot of fun with ambiguous commands.

A system's Complexity determines what programs it can run, and how many. A program of Complexity 2 can run on a computer system of Complexity 2 or above, but not on a Complexity 1 system.

The number of programs that can be run *simultaneously* is calculated as follows: A computer can run two programs of its own Complexity level, or 10 programs of the next lower level. The capacity of a system can be enhanced by 50% (to *three* programs of its own Complexity level) for a 50% price increase.

Thus, a Complexity 1 computer can run two Complexity 1 programs. A Complexity 2 computer can run two Complexity 2 programs or 10 Complexity 1 programs, or one Complexity 2 program and five Complexity 1 programs, and so on.

TL Differences

No system can run a program of a later TL. Systems can run programs from the previous TL without difficulty; beyond this, specialized (and archaic) hardware will have to be found to interpret the media, and the GM should *decrease* effective Complexity of the computer by 1 for each TL of difference . . . most systems lack the capability to translate old machine languages!

Software

Programs listed below are introduced at TL8 unless otherwise noted. If a program has a skill level, or gives bonuses to skill, more complex versions of a program give increased bonuses. For each +1 to program skill, double the cost. Unless otherwise specified, a program has a base skill of 12, or gives a user a +2 bonus, when it is introduced. Add +1 to a program's base skill for each TL after it was introduced.

Software is stored on memory units called *disks*. A TL8 optical disk is about 3" across and holds 10 gigabytes, or *gigs*, of data. At TL9, they are dime-sized, with the same capacity. At higher TLs, size stays the same, with memory density increasing by a factor of 10 per TL. Blank disks are always $5 apiece.

Above TL8, many programs and databases are protected against unlawful copying. A Computer Programming-4 roll (or harder) is required. Failure may destroy the original or produce a subtly defective copy. Critical failure can wreck the system.

Typical Programs

Astrogation: Cost and complexity depend on the difficulty of astrogation in the game world. Requires a database of astronomical information.

Damage Control: Requires a complete technical manual for the ship; a Computer Programming roll is required to input data about refitting at TL9 or less. Any attempt at damage control is at +2 if this program is running and in communication with the damage control crew. Complexity 2; $2,000.

Datalink: This enables a computer to link (through a cable or communicator) with another electronic device, such as a computer, scanner, etc. Complexity 1, $400.

Electronics Repair: In conjunction with the probes from an Electronics Tool Kit (see p. 46), this program troubleshoots any electronic device in its technical database (roll against the program's skill). A success tells the operator what to fix and how (it gives a +2 to Electronics or Electronics Operation or 12 on the appropriate skill, whichever is higher *for repairs only*). Complexity 2; $500. See below for technical databases.

Environmental Analysis: Assists in the analysis of physical data from scanner readings. It can spot possible hazards, analyze the ecosphere, and so on. The program gives +2 to appropriate skills, or analyzes at skill 12. Complexity 3; $3,000.

Expert Systems: These are programs with the knowledge of an expert in a particular skill, such as Shipbuilding, Biochemistry or Arctic Survival. They are available for all Professional and Scientific skills, Survival, Diagnosis and Intelligence Analysis. Effective skill is 12 for Mental/Average skills, 11 for Mental/Hard skills, and 10 for Mental/Very Hard skills. They are used in place of the user's own skill, but the time to perform a skill with the assistance of an Expert System is doubled. Cost is $10,000 for Average skills, $20,000 for Hard skills, and $50,000 for Very Hard skills; Complexity is 3. An expert system with +1 skill is twice as expensive *and* has +1 Complexity.

Gunner: This program requires a copy of the Targeting program (below). It lets the computer act as a gunner with a skill of 12, or adds an additional +2 to the Gunner skill of a human gunner. It uses the same sensors that the Targeting program does, but has sophisticated target-recognition routines and friend-or-foe identification. Complexity 4, $45,000.

Interpreter: This program translates from any language to any other, as long as the right databases are on line. Nonverbal languages can be handled if appropriate sensors and "speakers" are available; costs vary widely. Typical language skill is 14, though this depends on the database. Complexity 4, $10,000.

Medical: A Medical program adds +2 to any Surgery or Diagnosis, +1 to First Aid, for any medic working with it, at TL8. At TL9+, double each bonus. Complexity 4, $40,000.

Optical Recognition: The computer must have cameras or other optical sensors. This program lets the computer recognize faces, ships, vehicles or anything else that can be pictured. Complexity 4, $20,000.

Piloting: Requires that the computer be tied in to an appropriate vehicle, with attachments to all necessary sensors and controls (this adds $1 per ton of vehicle, minimum $1,000). The computer has Piloting-14. Complexity 3, $30,000 for surface vehicles or slow contragrav craft (under 200 mph). Complexity 4, $80,000 for aircraft, fast grav vehicles or spacecraft. Costs much less for very common vehicles!

Targeting: Linked to fixed- or vehicle-mounted weaponry, this program gives a +1 to the skill of a human gunner. The number of guns that can be aided at once is limited only by the system's capacity; each gun requires a separate copy of the program in memory (of course, only one copy has to be *bought*). The computer must have the necessary sensors and connections (cost typically 10% of weapon cost, or a minimum of $500 per weapon). Complexity 1, $1,000.

Translation (TL11): Analyzes and translates new languages with ten minutes' exposure to conversation, starting at a skill of 5, and adding 1 to skill for each half-hour of exposure, up to a maximum of 11. Non-verbal languages can be handled if appropriate sensors and "speakers" are available; cost varies widely. Complexity is 6. Cost depends on the level of language that can be translated: $5,000 for Easy only, $7,500 for Average, $10,000 for Hard and $25,000 for Very Hard languages.

New or Custom Programs

Players may develop ideas for new programs; the GM may decide they are standard, or require them to be custom-created. Customized programs should be very costly. A new program is likely to have some amusing bugs in it when it is first used.

If someone wants to write his own computer program, use the *New Invention* rules (p. B186), using Computer Programming/TL instead of Engineer/TL, with a skill penalty equal to twice the Complexity of the program rather than -15.

Databases

A *database* is a collection of information in computer-readable form. At TL8+, any database has its own built-in search and indexing programs. For any database of a given size, the wider the subject it covers, the less detail it has.

Size of a database is measured in gigabytes. One gig might hold any one of the following: general information about a thousand star systems; complete physical data about a single star system; the complete history, in rough detail, of a world; the complete history, in fine detail, of a whole world for 20 years; a year's records for a medium-sized business; complete dossiers on 100 people, in incredible detail; a large bookshelf full of books of any kind; a translation database, with dictionary, grammar, and detailed cultural referents, for any one language.

Technical databases are important. One gig might hold a complete technical manual for a starship, or for ten different fighter craft, or 100 types of complex vehicle, exosuit, etc., or 1,000 simple vehicles (e.g. automobiles), weapons or complex devices, or 10,000 different radios or similar small devices.

Minimum cost of a database is $1,000 per gigabyte, for encyclopedia-type public information. Secrets, specialized information, or information costing lives or money to gather, will be more costly. Adventurers who bring back information on new systems, etc. can sell it to database publishers!

Power Cells

An important feature of a high-tech campaign is that the PCs' gadgets make them very powerful . . . *while they work.* But a laser without batteries doesn't even make a good club. Most gadgets have to have power; if no power requirements are listed, though, the device needs none. We assume that electricity will continue to be used at least through Tech Level 15.

The GM is free to ignore this section entirely, and assume that everything gets whatever power it needs.

Power Cells

At TL8 and above, most equipment runs on standardized *power cells.* Their technology is up to the GM. The costs and times given below assume that they use plutonium, antimatter, or something equally esoteric, can't be recharged, and can't be discharged quickly enough to explode. Assume that a cell will store indefinitely if not in use, and is good for two years of continuous use unless otherwise specified.

Cells might also be simple high-capacity storage batteries. In that case, they last only half as long, but can be recharged at any power plant, including that of a spaceship, in about a day. And they *might* explode if short-circuited . . .

Power cells are heavy for their size. The consequences of breaking a cell depend on what is in it; the more destructive the contents, the harder they are to break. Antimatter or plutonium cells will *not* be fragile.

Vehicles, robots and other things that cannot afford power interruptions will have two or even three cell sockets, so that if one is drained the other takes over. This allows a vehicle's cell to be changed in flight, or a robot to change its own cells.

Types of Cells

There are six sizes of power cells, designated by letter from AA (the smallest) to E (the largest). Power cells increase in power exponentially. An A cell is ten times as powerful as an AA cell, a B cell has ten times the power of an A cell, and so on.

AA cell: This cell is a disk the size of a pinhead, 1/16" in diameter and 1/32" thick. AA cells are used in brain implants, calculators, etc. They cost $2; 500 AA cells weigh 1 ounce.

A cell: An A cell is a cylinder 1/4" in diameter and 1/8" tall. They are used to power small radios and similar devices. An A cell costs $10; 25 weigh 1 ounce.

B cell: B cells are cylinders 1/2" in diameter and 1/2" tall. They are used to power various sorts of hand-held equipment, including small weapons. B cells cost $30; 20 weigh 1 pound.

C cell: This is a 1" diameter by 2" tall cylinder. C cells are the most common power source for personal weapons, tools and equipment. C cells cost $100 and weigh 1/2 pound.

D cell: A D cell is a cylinder 2" in diameter and 4" tall. D cells power military weapons and heavy equipment. Each D cell costs $500 and weighs 5 pounds.

E cell: Each E cell is a cylinder 4" in diameter and 6" tall. E cells power vehicles, support weapons and other power-intensive systems. An E cell costs $2,000 and weighs 20 pounds. Large vehicles, etc., may use banks of dozens of E cells.

Jury-Rigging

In an emergency, wrong-sized cells can be used. This requires an Electronics-2 roll and 3d+10 minutes of work; a failure means the gadget doesn't work, and a critical failure damages the gadget. A larger cell can be substituted for a smaller, lasting no more than twice as long. A set of 10 smaller cells can be substituted for the next larger size, usually lasting only a short time (details are up to the GM, depending on the Electronics skill of the tinkerer; on a good roll, the GM warns the technician what to expect from his jury-rig).

The GM may also rule that different stellar nations use different voltages or sizes for their power cells. This means an Electronics roll, of difficulty set by the GM, will be required to use your own power cells in strange equipment or vice versa.

Solar Panels

Starting at TL7, solar panels can substitute for power cells in any environment where the sunlight is at least 70% of that of Earth's. Size B and smaller panels will work under normal indoor artificial light.

Panels also come in sizes AA through E. Each may be substituted for the equivalent cell in applications requiring steady demand (including slow vehicles) but not for sudden high demand (like weapon use). Any suitable cell-operated device will have jacks where a panel can be plugged in. It automatically goes over to its power cells when light is cut off to the panels. Many devices can be bought with built-in solar panels (add half the price and weight below).

AA: 1/20 square inch. $2; negligible weight.

A: 1/4 square inch. $10; negligible weight.

B: 2 square inches. $50; negligible weight.

C: 16 square inches. $300; 5 ounces.

D: One square foot. $2,000; 2.8 pounds.

E: One square yard. $10,000; 25 pounds. 1/4 cy when stored.

Solar panels improve greatly as TLs increase. At TL9, halve cost and divide weight by 10. At TL10, halve cost again, and divide TL8 weight by 100. At TL11, divide TL8 by 1,000; at TL12, divide TL8 weight by 10,000.

Solar panels are relatively tough (DR 2) and damaged panels may continue to work at reduced levels (GM's option). Each point of damage that gets past the DR will destroy 12 square inches; it takes 12 points of damage to destroy one square foot of panel. A critical hit, or a deliberate use of clippers, cuts the connection from the panel to the device it powers.

Beamed Power

At TL13 and above, robots, vehicles and sometimes other devices might operate on power "beamed" from a central station. There will be many such stations on a civilized world; a colony may have only a few, and a new colony will have just one. A very large spaceship will be able to beam power to ground units in line of sight. This simply means that nobody has to worry about powering vehicles . . . unless something happens to the power station. A power receiver costs and weighs as much as the equivalent cell(s).

Cosmic Power and Precursor Artifacts

At TL15, GMs may rule that everything comes with a built-in, permanent power source, or draws power from the cosmic flow. This eliminates all concern with power supplies.

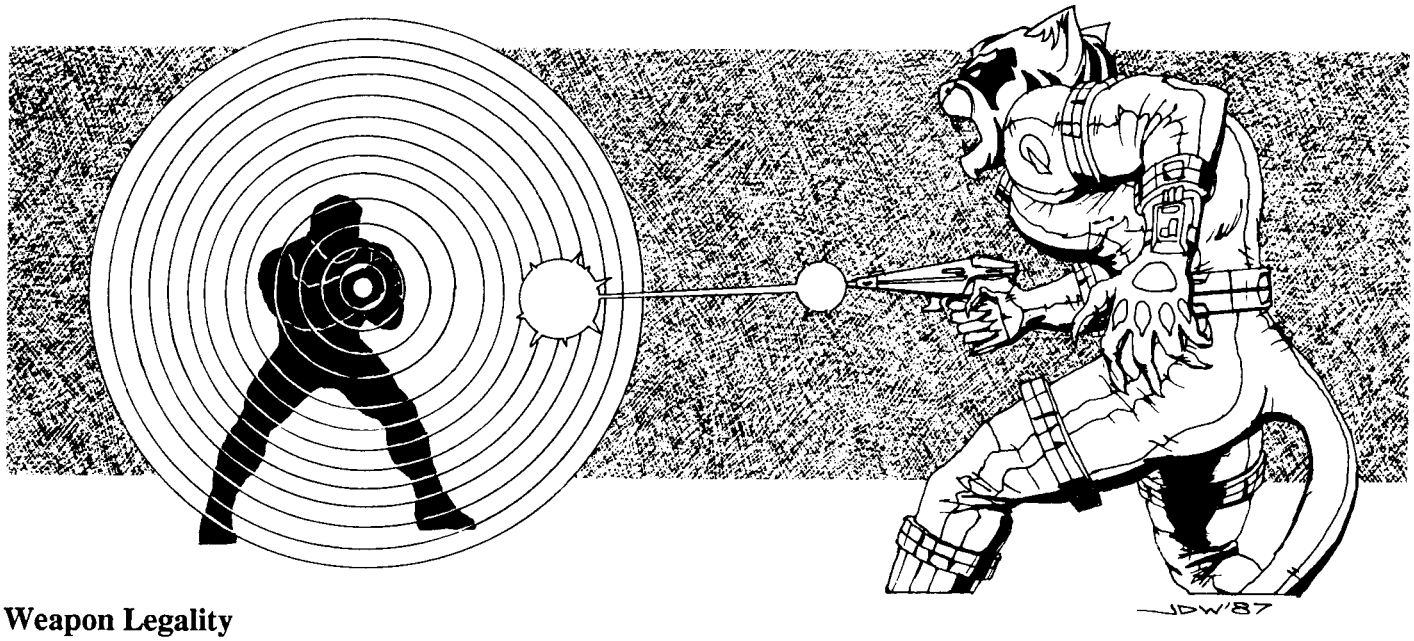
Precursor artifacts may have this kind of power. Then again, they may require Precursor power cells, which are *not* in stock at the corner store . . . PCs may need to make an IQ roll at a significant penalty (don't bother with Electronics; you never saw anything like this before) just to figure out where to *put* the cells. There may be no way to adapt any present-day power to a Precursor device — or, if there is, extensive study may be required first, with the chance of a significant accident (see p. 56).

5 WEAPONS

This chapter offers a selection of futuristic weapons. GMs should decide which ones to make available. Perhaps there is only one standard weapon technology . . . everyone carries a laser. But if the campaign is set in a huge and diverse universe, with dozens of races and thousands of years of history, there may be *many* types of weapon available.

We have assumed that "civilian" weapons won't get much deadlier on a shot-for-shot basis; that's not necessary. They *will* become smaller, lighter, more penetrating, and, for the most part, recoilless. Military weapons are deadly; if you face them, wear armor or don't get hit. However, their ranges will not increase indefinitely; most firefights will take place within 300 yards, and (except for special sniper weapons) hand-weapon range beyond that is a liability, not an asset.

The tables use the same format as the weapons tables in the ***GURPS Basic Set,*** Third Edition. Costs and weights assume a loaded or charged weapon, including one magazine if the weapon uses magazines. Power cells are described on p. 53.



Weapon Legality

One question starfarers always ask, when reaching a new world, is "What weapons can we carry?" Each weapon has a *Legality* rating. In general, the more lethal the weapon, the lower the Legality.

Class 6: Wholly nonlethal items, like short-range stunners.

Class 5: More powerful nonlethal weapons, like stun rifles, and low-tech armor.

Class 4: Hunting weapons, like single-shot laser rifles. Knives and other low-tech weapons.

Class 3: Light concealable weapons, like most pistols, and light body armor.

Class 2: Medium weapons, such as single-shot disruptors.

Class 1: Military hand weapons like automatic rifles.

Class 0: Heavy personal weapons like hand grenades and squad-level military weapons.

The class of weapons and armor that will be *legal* in any given locale will generally depend on the local government's Control Rating (see p. 22). However, effective Control Rating may be reduced in some societies (e.g., 20th-century USA) where the citizens insist on the right to bear arms. It may be increased in others (e.g., 20th-century England, where the cop on the beat isn't allowed a gun). The effective CR determines who will be allowed to have what kind of weapon. A very violent society may have a *negative* CR with respect to weapons!

Note also that starship passengers aren't likely to be permitted any weapons at all, and even the crew won't want to use heavy weapons in space, for fear of damaging the ship.

Legality = CR+2 or more: Any citizen may carry the item.

Legality = CR+1: May be carried by anyone except a convicted criminal or the equivalent. Registration is required, but there is no permit fee.

Legality = CR: A license is required to own or carry the item. To get a license, one must show a legitimate need. Generally, a license costs 1d×10% of the price of the item itself.

Legality = CR-1: Prohibited except to government agents, police, and bonded security troops.

Legality = CR-2: Prohibited except to police SWAT teams, military units, and perhaps secret intelligence agencies.

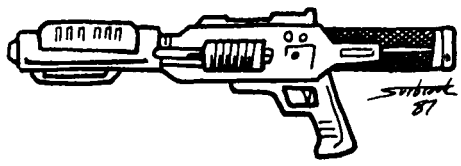
Legality = CR-3 or worse: Only permitted to the military.

So, for instance, on a world with Control Rating 4, anybody could carry a stun pistol (Legality 6); registration would be required for a stun rifle (Legality 5); permits would be required for hunting weapons (Legality 4); and ordinary citizens could own nothing heavier.

TL8+ Melee Weapons

Weapon	*Type*	*Amt.*	*Reach*	*Cost*	*Wt.*	*ST*	*LC*	*TL*
Force Sword	Imp./Cut	4d/8d (5)	1	3,000	2	—	3	11
Neurolash I	Spcl.	Spcl.	1	650	2	—	5	10
Neurolash II	Spcl.	1d	1	2,000	2	—	2	10
Vibroblade	Imp./Cut	+1d (5)	**	**	**	**	3	8

** varies by weapon type



TL8+ Ranged Weapons

Weapon	*Malf*	*Type*	*Damage*	*SS*	*Acc*	*½D*	*Max*	*Wt.*	*RoF*	*Shots*	*ST*	*Rcl*	*Cost*	*LC*	*TL*
Blaster	**Ver.**	**Imp.**	**6d**	**10**	**6**	**—**	**300**	**2**	**3~**	**20/C**	**5**	**-1**	**2,000**	**3**	**9**
Blast Rifle	**Ver.**	**Imp.**	**12d**	**14**	**13**	**300**	**800**	**10**	**3~**	**12/C**	**6**	**-1**	**3,000**	**4**	**9**
Disruptor	**Crit.**	**Spcl.**	**2d+6**	**13**	**10**	**500**	**1,000**	**9**	**3~**	**20/C**	**—**	**0**	**2,500**	**2**	**9**
Electrolaser	Crit.	Spcl.	2d+1	8	4	60	120	1.5	1	10/C	0	0	1,200	3	9
Electrolaser Rifle	Crit.	Spcl.	3d+1	9	12	100	300	5	1	5/C	0	0	1,800	2	9
Electromag Gr. L.	Crit.	Spcl.	Spcl.	10	8	—	1,000	10	1	5	—	0	5,000	0	8
Electromag Mortar	**Crit.**	**Spcl.**	**Spcl.**	**20**	**15**	**—**	**6,000**	**70**	**1**	**20**	**15T**	**0**	**15,000**	**0**	**8**
Flamer	**Crit.**	**Spcl.**	**5d**	**4**	**12**	**70**	**150**	**4**	**1**	**8/C**	**6**	**0**	**1,300**	**2**	**9**
Gatling Laser	**Ver.(Crit.)**	**Imp.**	**20d**	**10**	**20**	**4,000**	**12,000**	**75**	**4**	**150/E**	**15T**	**0**	**20,000**	**0**	**9**
Gauss Needler	Ver.	Imp.	1d+2	10	4	100	300	1.5	12	100/B	—	0	2,000	2	8
Gauss Needle Rifle	Ver.	Imp.	2d+1	14	11	500	1,000	6	20	100/B	—	0	2,500	2	8
Grenade, Sleep	Crit.	Spcl.	Spcl.	—	—	—	—	1	—	1	—	—	250	2	8
Grenade, Poison Gas	**Crit.**	**Spcl.**	**Spcl.**	**—**	**—**	**—**	**—**	**1**	**—**	**1**	**—**	**—**	**250**	**0**	**8**
Grenade, Blackout	**Crit.**	**Spcl.**	**Spcl.**	**—**	**—**	**—**	**—**	**1**	**—**	**1**	**—**	**—**	**350**	**2**	**9**
Heavy Laser Pistol	**Ver.(Crit.)**	**Imp.**	**2d**	**9**	**8**	**300**	**800**	**3**	**4**	**12/C**	**—**	**0**	**1,500**	**2**	**8**
Holdout Laser	Crit.	Imp.	1d-1	10	4	50	100	—	1	5/B	—	0	500	0	9
Laser Pistol	Crit.	Imp.	1d	9	7	200	500	2	4	20/C	—	0	1,000	3	8
Laser Rifle	Crit.	Imp.	2d	15	13	450	1,200	5	3~	12/C	—	0	2,000	4	8
Military Laser Rifle	**Ver.(Crit.)**	**Imp.**	**2d**	**12**	**15**	**1,500**	**2,000**	**9**	**8**	**140/D**	**—**	**0**	**4,000**	**0**	**8**
Needler	**Ver.**	**Imp.**	**1d+2**	**9**	**1**	**100**	**300**	**1**	**3~**	**100**	**—**	**-1**	**500**	**3**	**8**
Needle Rifle	**Crit.**	**Imp.**	**2d**	**13**	**9**	**300**	**800**	**5**	**3~**	**100**	**—**	**-1**	**1,200**	**4**	**8**
Nerve Pistol	Ver.	Spcl.	Spcl.	8	4	15	30	2	3~	30/C	—	0	1,000	2	10
Paralysis Gun	Ver.	Spcl.	—	6	4	—	25	5	1	15/C	—	0	1,500	3	10
Paralysis Rifle	Ver.	Spcl.	—	7	10	—	50	8	1	8/C	—	0	1,500	3	10
Screamer	**Ver.**	**Spcl.**	**6d×2**	**4**	**10**	**250**	**500**	**10**	**1**	**10/C**	**—**	**0**	**3,000**	**1**	**9**
Stunner	**Crit.**	**Spcl.**	**—**	**4**	**3**	**12**	**20**	**1**	**3~**	**40/C**	**—**	**0**	**800**	**6**	**9**
Stun Rifle	**Crit.**	**Spcl.**	**—**	**12**	**10**	**300**	**1,000**	**4**	**3~**	**20/C**	**—**	**0**	**2,000**	**5**	**9**
Tangler	Crit.	Spcl.	—	6	8	—	20	6	1	5	8	-4	1,000	5	8
Tripod Flamer	Ver.	Spcl.	12d	6	20	100	300	45	1	40/D	12T	0	10,000	0	9

~ "single shot" weapon, but trigger can be pulled three times per turn.

ST: Values listed with a T mean that the weapon uses a tripod mount, and only apply if the user tries to "Rambo" it by picking up the weapon and firing from the hip. Firing such a weapon from its mounted position requires no minimum ST.

Shots: This column shows the number of shots the weapon gets from a magazine or power cell. If a cell is used, the type of cell is shown — e.g., 100/B means 100 shots from a B cell.

Malf: The die roll on which the weapon malfunctions. Almost all ***Space*** weapons have a Malf of Crit. or better. *Crit.* means the weapon malfunctions only on a critical miss when the roll on the Critical Miss table indicates a malfunction. *Ver.* means the weapon requires a *verification roll,* another roll against skill. Any failure is the malfunction from the table; any success is simply a miss. *Ver.(Crit.)* means the verification roll must be another critical miss for the weapon to malfunction. Any other result is simply a miss.

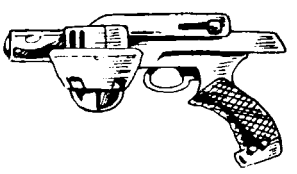
Type: The type of damage the weapon does — impaling (imp.), crushing (cr.), an explosion (exp.), or a special effect (spcl. — see the text description of the weapon).

Ammunition: Costs and weights are given with each weapon description. Clips, magazines or power cells normally require three turns to replace: one to remove the old magazine or cell (dropping it to the ground), one to Ready the replacement, and one to insert it. Fast-Draw skill may be learned for replacing clips and power cells (these are separate skills) to cut total reload time to 1 second. Energy weapons use power cells; see p. 53.

See p. B119-121 for general rules for automatic weapons.

Ammunition Table

Weapon	*Shots/Mag*	*Empty Mag.*		*Full Mag.*		*Ammunition for Reload/Box*		
		Cost	*Wt.*	*Cost*	*Wt.*	*Shots*	*Cost*	*Wt.*
Gauss Needler	100/B	$30	¼	$55	1	100	$25	¾
Gauss Needle Rifle	100/B	$40	½	$65	1¼	100	$25	¾
Needler	100	$20	¼	$35	¾	100*	$15	½
Needle Rifle	100	$30	½	$45	1	100*	$15	½
Tangler**	5	—	—	$50	¾	—	—	—



* A gas cartridge ($3) is also required for each 100 shots.

** The Tangler magazine is disposable, with 5 shots.

TL8+ Critical Miss Table

On any critical failure except a natural 18, a TL8+ weapon has *misfired.* Roll vs. the appropriate Weapon skill (or Armoury or Electronics if you have it) for "immediate action" to clear the misfire. A critical success returns the weapon to service in 1 second. A success returns it to service in 1d seconds. A failure means the weapon is really broken; repair will require another roll — Armoury — and 2d hours. A critical failure on the Immediate Action roll, or a natural 18 on the original skill roll, sends the user to this table.

3, 4 — The weapon breaks, or a critical circuit shorts out. It can be repaired (with the proper tools) in 1d-1 hours, by a successful Armoury or Electronics skill roll. If the attack is with a grenade or explosive device, it simply fails to go off.

5, 6 — The firing mechanism fails. An armourer can repair it; each attempt requires 3d minutes.

7 — The feeding mechanism or circuitry has failed. Solid-projectile weapons can be used for single shots (reload time 5 seconds). Others will not fire again until repaired (Armourer roll; each attempt requires 1d-1 hours, minimum 1.

8 — A dud round, magazine or power cell. Roll randomly if more than one might apply. It must be replaced, but the weapon is unharmed.

9, 10, 11 — The weapon jams or shorts out completely; grenades or explosives fail to detonate. It will require a successful skill roll (Weapon skill -4, Armoury or Electronics; see p. B53) to unjam or reconnect the circuit or correctly reset a grenade's fuse. If the weapon is cheap, the skill is at a -3 penalty. Time required will be 2d seconds.

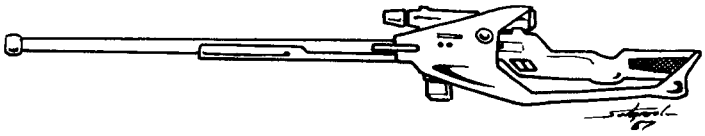
12 — A dud, as #8 above.

13, 14 — Same as #5, 6 above.

15 — Same as #7, above.

16, 17 — You accidentally shoot yourself in the foot (or drop a live grenade) while attempting to fix the problem. Roll to see which foot you hit.

18 — The weapon explodes. You take the damage amount of the weapon in crushing damage (1d for a laser pistol, for example, or 3d for a force sword), with the following additions: If you had been *aiming,* you are also blinded for 5 minutes (unless wearing anti-glare goggles). If the weapon was a grenade, it goes off in your hand, doing normal damage.



Mechanical/Electronic/Biochemical Critical Failure Table

Use this table whenever it seems appropriate. In particular, refer to it when alien or Precursor equipment is being investigated; when scientists are experimenting; when very-high-tech gadgetry is being repaired; when damage control is attempted on a spaceship; or (GM's option) when a critical failure is rolled during use of a very-high-tech weapon.

3, 4 — Your equipment shorts out catastrophically; a vital part breaks; your chemicals interact cataclysmically. Roll 2d for the number of hours/days/weeks (as GM rules appropriate) it takes to repair damage, get replacement parts, or remix the proper chemicals to compensate for the set-back.

5 — You set off an explosion, doing 2d of damage to yourself and anyone in an adjacent hex.

6 — Same as #5, above, but doing only 1d damage.

7, 8 — You botch the experiment or repair badly, but can repair your mistake with the loss of only 1 day or 1 hour of time (as appropriate); your next roll is at -3 to skill.

9-11 — You almost make a serious error, but catch it in time. No time is lost, but your confidence is shaken. You have a -3 on your next roll for success (if that was the final roll, roll again at a -3).

12, 13 — You lose ½ day or ½ hour of time (as appropriate), and have a -3 to your next attempt.

14 — You think you may have used the wrong procedure, but you're not quite sure because your notes (or the repair manual) have been misplaced, gotten out of order, etc. Roll IQ-3 to know for sure (GM determines truth). If you miss the IQ roll or you did goof, either start from scratch or attempt to complete the work with a -5 to your skill roll (your choice).

15 — A serious error. Biochemical experiments produce a toxic chemical cloud; electrical repairs administer a sizeable shock; and mechanical repairs end in a heavy component falling on you. Roll HT-5 or go to 0 HT. If you make your roll, you still take 1d of damage and pass out for 20-HT minutes.

16, 17 — As #15, but you automatically go to 0 HT and take an additional 2d damage. If working with electricity, you take a point of damage every five seconds until someone shuts the power off. You can do nothing during this time except use psionic abilities (at -6) if you have them.

18 — A major explosion. Effects are as #16, 17 above, except that you take 4d damage after going to 0 HT. Anyone within 10 hexes takes 2d damage. Better hope someone stays conscious and gets you to an automedic or freeze tube quickly!

Weapon Availability

Medieval Melee Weapons

All the lower-tech weapons described in the ***GURPS Basic Set*** are available — but they are not always easy to find on developed worlds. At TL5 or better, steel weapons are considered to be one quality grade better than the price paid (i.e., the costs listed in the ***Basic Set*** tables will buy Fine weapons). At TL8+, "super-fine" durasteel swords and knives can be made, adding +3 to damage and costing 20 times normal price.

Swordsmanship may seem unnecessary to a starfarer . . . but travelers marooned a low-tech world will soon find "primitive" skills to be lifesavers.

"Primitive" Firearms

Many TL7 and lower firearms are available on some worlds. In very homogeneous high-tech cultures, however, such weapons are considered quaint or barbaric — if they are remembered at all. Those wishing to add such weapons to their campaigns may use the weapons tables in the ***GURPS Basic Set, GURPS Autoduel,*** or ***GURPS High-Tech.***

Weapon Quality

Weaponry will often be available in *fine* or *very fine* quality. Fine beam weapons or guns will get a +1 to hit at all ranges and are much more durable than standard weapons. They cost twice the listed prices.

Very fine weapons get a +2 to hit at all ranges. They cost three times the listed prices. They may not be available on all worlds or at all tech levels.

Any of these weapons, except the tripod flamer, electromag mortar and Gatling laser, can be found in "cheap" versions that cost 60% of the listed price. However, a cheap weapon has a greater chance of misfiring or breaking; a roll of 16 is a critical failure, and all attacks with one are at -1. GMs may occasionally make "very cheap" weapons available, at 40% of normal price; a roll of 15+ is a critical failure, and all attacks are at -2.

Black Market Weapons

Weaponry illegal on a particular world can usually be bought anyway . . . on the black market. Successful rolls against Streetwise or Merchant-3 skill are necessary, and modifiers should be applied based on the world. Subtract the world's Control Rating; +2 if the world is a criminal sanctuary; +2 in any starport Startown; +1 for each time you've successfully contacted a dealer on that particular world. Subtract 2 for Legality 0 weapons, and 1 for Legality 1 weapons.

A critical success means you've found exactly who you're looking for, and he has just what you need. A critical failure means the searcher is mistaken for a police spy, or contacts a police "sting" operation! Each roll requires one day of search for one person (or cooperating group).

Black market dealers charge 10-60% above normal prices. Successful use of Merchant skill can lower the price by 10%; a critical success gives the normal price, while a critical failure *doubles* normal price, no matter what the dealer was asking originally (take it or leave it!). Of course, a dealer may not have what you want – or his gear may be defective or substandard (appropriate Armoury or Electronics specialty to tell). The GM determines this, based on the needs of the campaign or scenario.

Weapon Improvements at Higher TLs

Power: All power-cell-using equipment gains shots or increased operating time at higher tech levels: an extra 50% of power (or 50% more shots) for each tech level after the one in which the device was first introduced. This is because the high-tech cells *contain* more power.

Energy Weapons: Energy weapons include all beam weapons, all Gauss weapons and powered melee weapons such as vibroblades and force swords. For each TL after the types' first appearance, add +1 to an energy weapon's damage for every 1d of damage it normally inflicts. For weapons with damage adds, 3+ points of damage adds also gives a +1.

Range also increases. Add 10% to ½D and Max range per TL after the weapon first appears.

Unlike number of shots, damage and range only increase for three TLs after the weapon's introduction.

Example: A TL9 Tripod Flamer normally does 12d damage, with ½D range 100 and Max 300. It gains +3 damage per TL after 9, so at TL10, this would be modified to 12d+12 damage (which can be translated to 15d+2 – see *Modifying Dice + Adds,* p. B114). Its ½D and Max ranges improve by 10%, adding 10 to ½D (for 110) and 30 to Max (for 330). At TL12, it would do a whopping 12d+36 (or 22d+1), and would have ½D 130 and Max 390. At TL13, our Tripod Flamer has the same range and damage as it had at TL12.

Needlers: Regular and Gauss needlers get 20 more shots per magazine at each TL after the TL of introduction.

Other Weapons: Conventional slugthrowers and other chemical or spring-powered weapons do not increase in damage.

Weapon Descriptions

Blasters

Blasters are high-energy beam weapons that fire a bolt of charged particles carried on a low-powered beam. The particle-beam effect does impaling damage which includes a surface explosion effect, so targets may experience knockback (see p. B106). Blasters do produce some recoil, so they can't be fired successively without penalty, like lasers. However, the recoil only gives a -1 to subsequent unaimed shots.

Hand blasters and blast rifles both use C cells; a pistol gets 20 shots, a rifle gets 12. For an extra $100, blasters can be modified with a B-cell socket; a B gives two pistol shots or one rifle shot.

Disruptors

These weapons are actually microwave-frequency lasers. Also known as "scramblers" or "curdlers," they cause the cells of living tissue to explode. They do impaling damage, but any damage which gets through armor is tripled rather than doubled!

Nonliving targets take half damage rather than tripling, except for electronic equipment (including robots) which takes full (not tripled) damage. Armor protects normally from disruptors, except that metal armor (any kind) and reflec both have PD 8. Metal reflects microwaves! Any radiation-resistant vacc suit coating will also give this PD 8 against disruptors. The armor will spark madly, but the wearer will probably be unharmed.

Disruptors are rifle-sized but recoilless, and get 20 shots from a C cell. They are not affected by smoke, gas, etc.

Electrolasers

These beam weapons, also known as "shockers," "zap guns" and "stat guns," stun and damage via discharges of electricity. They fires a low-power laser beam to ionize the air, following it instantly with an electrical charge that follows the path of the laser to the target.

Electrolasers are most effective in dry climates. In moist, humid climates or in rainy weather, they are less accurate, as the electrical bolt tends to jump off the laser path to follow other paths of low resistance. This gives a -2 to hit in moist, humid environments, and a -6 to hit in rain, drizzle or heavy fog. They are practically worthless in a vacuum; since there is no air to ionize, the discharge arcs randomly to some nearby metal item.

Armor protects normally from an electrolaser, unless it is metallic. Metal armor conducts the electrical charge, so it is worse than useless. It *attracts* the charge, giving the attacker a +2 to hit if the target is wearing more than 20 lbs. of metal.

The weapon has two settings: stun and kill. Changing settings is a "Ready Weapon" action.

"Stun" fires a lower-power bolt. Roll damage normally, but instead of actually taking the damage, the target must make a HT roll, minus half the damage that got past DR (rounding damage up). A failed roll means the target is stunned. The effects are similar to those of a stunner – unconsciousness or incapacitation for 20-HT minutes – but the target is at a -2 DX for an additional 20-HT minutes after recovering from stun.

"Kill" does the full listed damage. If any damage penetrates the armor, the target must also roll immediately against HT

minus half the damage taken. If the roll is failed, his heart *stops*. He will die in HT/3 minutes (round down) unless someone performs CPR to save him. This requires one minute per attempt, with a successful First Aid-4 or Physician roll.

An electrolaser pistol gets 10 shots from a C cell. A rifle gets 5 shots. Electrolasers can fire only once per turn.

Electromag Grenade Launcher

This weapon requires Guns (Grenade Launcher) skill. The electromag grenade launcher is a short, stubby shotgunlike weapon, similar to 20th-century grenade launchers, that holds a clip of five grenades of any of the types listed below. It uses a powerful magnetic impulse to propel them.

Grenades are usually set for contact detonation, though they may be timed instead. Grenades may be mixed in the clip. The launcher will fire 100 grenades on a D cell, one per turn. Grenades may be loaded and fired one at a time, but it takes one second to load each grenade and one second to fire. Misses will result in scatter; see p. B119.

Electromag Mortar

The electromag mortar is a heavy base-mounted tube, similar to the grenade launcher. It fires heavier shells, singly or from a 20-shell magazine, over greater distances. It will fire 60 shells on a D cell. Performance is otherwise like the grenade launcher.

All the grenade types described below are available as mortar shells as well. In general, cost and weight double. A gas mortar shell covers a circle with a radius of 8 hexes. A fragmentation or concussion shell from a mortar does 6d damage at TL7, 6d×4 at TL8. Fragmentation effects are normally 2 dice over a circle of radius (10 yards × dice of concussion damage), but shells can be ordered that limit fragmentation range to any desired amount, down to that for the frag grenade of the same TL.

Flamers

Flamers fire a relatively short-range plasma discharge. They are brutal, clumsy weapons. A flamer only fires once per turn, but the discharge lasts for a full second. The dice rolled for damage may be divided between targets in the same arc of fire as described for area weapons on p. B121. If the targets are more than 1 hex apart, 1d of damage is lost for each extra hex.

The main advantage of flamers is that the wash of superheated plasma "flame" can injure or kill even an armored target unless his suit is fully sealed and airtight. Other armor protects with only half its DR; the wearer takes a minimum of 1d-2 damage (doubled for a shot that hits the head), regardless! A sealed suit loses integrity (becomes unsealed against the next flamer attack to that hit location) on a roll of 15 or less, *minus* 1 for every 10 points of DR at the location hit, and *plus* 1 for every successive turn of fire. A success by 10+ indicates that the suit material burns! Each turn it burns, flaming armor loses 2 DR and does 1d-2 damage to the wearer.

Paper, cloth, and wood automatically ignite if hit by a flamer discharge; plastics and similar materials ignite on a roll of 15 or less, minus 1/10 the target's DR as described above. Reduce the die roll by 1 for every *successive* turn the flamer hits it. Ignited items burn until extinguished. Successive shots continue to do damage on a burning object. The hand flamer uses the Beam Weapons skill. Hand flamers use a C cell, and get 8 shots.

Tripod Flamers require Gunner skill and get a +4 on any roll to ignite something or to unseal a suit. They are heavy semi-portable infantry weapons, terrifying even to a fighter in heavy armor. Anyone hit takes a minimum of 1d damage, doubled for a shot that hits the head. They get 40 shots from a D cell.

Force Swords

Force swords are energy weapons that consist of a powered hilt, similar in size and appearance to that of a regular sword hilt. When activated, a "sword blade" of annihilating energy, held in shape by a magnetic field, extends from the hilt. Similar in length to a broadsword or katana blade, the energy blade can be used just like a sword to do devastating cutting or impaling damage. A force sword may be activated as it is being readied, on a successful Fast-Draw roll. Otherwise, it takes one turn to activate it. In either case, it takes one further turn for the blade to form and stabilize.

Armor protects at 1/5 DR vs. a force sword. Any limb that takes twice the damage needed to cripple it (see p. B127) from a force sword on any one hit is lopped off, and the wound cauterized; excess damage is lost. Any weapon that successfully parries a force sword — except another force sword — is considered broken, unless the parry was a critical success.

Force swords are powered by a C cell in the hilt. It lasts for 5 minutes of continuous activation. Most swords have two or more cells, since one cell may not last through the battle.

A force sword can also be used as a very powerful cutting tool, doing its regular damage against any material. For a large, flat surface, such as a wallboard or steel slab, the listed HT is the amount of damage you must do to make a 3-inch cut. For example, to cut a 24-inch slice in a slab of half-inch steel, you must do 320 points of damage — 40 points per 3 inches of steel cut. This damage may be done over any number of turns, but you must overcome the DR of the material *every turn.*

For an extra $500, length may be varied from dagger-sized to about 5 feet. Varying the length requires a ready-weapon action, and allows the reach to be altered from C to 2.

Gauss Needlers

Gauss needle weapons use the Guns (Needler) skill. They use a magnetic impulse to fire heavy slivers of steel. They are automatic weapons, and effectively recoilless.

Needle damage which gets past armor is multiplied by 2. However, rigid armor (anything except open-weave material like mail, Kevlar or monocrys) has double DR against needlers.

Gauss needlers produce a sharp crack as the needle breaks the sound barrier. However, this sound is hard to localize; a Hearing-2 roll is necessary to locate the firer by sound alone.

Each Gauss magazine contains a B cell, which is almost completely discharged in firing its 100 needles. Needles for rifles and pistols of the same type are interchangeable, but the magazines are not. Ammo for spring needlers and gauss needlers is not interchangeable.

Grenades

Many types of grenade are available; some are listed below, and others (those listed in ***Autoduel***, for example), are available on any world of TL6+. All grenades weigh 1 pound, and are armed and set the same way. First, either the grenade is set for contact explosion (i.e., once it is activated and released, it will explode as soon as it hits something), or a time delay is set from 1 to 5 seconds. Second, an activator is pressed and the grenade is thrown or fired. It takes one turn to set or change the delay on a hand grenade and another to press the activator and throw the grenade. If the grenade is loaded in a grenade launcher, the delay or contact setting must be preset. Activation is automatic when the grenade is fired.

The ability to put a hand grenade where you want it is the Throwing skill (not Thrown Weapon skill). Throwing is a Physical/Hard skill (see p. B49). The distance a character can throw a grenade depends on ST (see p. B90).

Even a missed roll may get a grenade close enough to damage the target. If the skill roll is missed, take the number the roll was missed by, and add 2 dice. This is the number of hexes off-target the grenade lands. For direction, roll one die: Designate "1" as north, then count clockwise around the faces of the target hex. If a critical miss is rolled, see the Critical Miss Table.

A TL7 *Fragmentation Grenade* does 3 dice of concussion damage at TL7, and 2 dice of fragmentation damage to anyone in range (30 yards). At TL8, a similar grenade does 6d×2 of concussion damage, plus 2d cutting damage. The fragmentation radius is limited to 10 yards to make it a more useful close weapon. At any TL, standard frag grenades are $25, 1 lb.

A *Concussion Grenade* has the same cost, weight, and concussion damage as the equivalent fragmentation grenade, but fragmentation damage is limited to that caused by the ground at the explosion site — see pp. B121-122.

Gas Grenades create a cloud 11 hexes across — that is, the target hex and five hexes in every direction. Gas clouds may disperse within a few seconds, or linger for minutes, depending on the wind; in general, divide 300 seconds by the wind speed in mph. Most gases have no effect once dispersed, but some virulent poisons will cause injury even when greatly diluted.

Sleep Gas: For every turn spent in a sleep gas cloud without holding his breath, a character must roll HT-4. If he misses the roll, his ST goes to 0 and he falls asleep. If he makes the roll, he takes 1 point of fatigue. If ST drops to 0, he falls asleep. If he gets out of the cloud, he may regain the lost ST normally. Those who fall asleep remain so as long as they continue to breathe the gas, and for at least 30-HT minutes after that. When that time is up, the victim may roll HT each minute to awaken. He may be awakened normally by a successful First Aid roll. $50; 1 lb; Legality Class 2.

Poison Gas Grenades of many kinds are available; they are distinguished by different colored markings on the grenades. See p. B132 for some typical gases. Although gas masks and holding your breath will offer protection from sleep gas and some poison gases, only a full-body airtight suit will protect against a contact agent absorbed by the skin. Prices vary widely.

Blackout Grenades release a nearly opaque cloud of thick, inky black smoke that covers the area of effect (same as a gas cloud). Everyone in the cloud functions as though in complete darkness; any action requiring sight is at -10, or is impossible (see p. B92). Attempting to fire at a target in the cloud gives the same modifier. Infrared sighting will reduce the penalty to -5, and other sensors or senses, such as radar or sonar, will be unaffected. Night Vision and Light Enhancement scopes are useless. Lasers (except for X-ray lasers) cannot penetrate the cloud. Anyone in the cloud without breathing gear also must make a HT roll each round or take 1 point of damage, choking on the thick smoke. $30, 1 lb.; Legality Class 2.

Lasers

Lasers fire beams of coherent energy. A laser has no recoil, either for successive shots in the same turn or for successive groups in a burst. It is thus so accurate that the dispersion of shots is less than the diameter of the beam.

Because of this, automatic-fire laser weapons use special rules. When a laser is fired on full automatic setting (see p. B119-120 for automatic fire rules), successive shots from *all* groups fired in the same turn at the same hit location are effectively a single beam. Instead of making defense rolls and applying armor or force screen DR separately against each "round" that hits, only one defense roll is made. If it fails, the damage from all rounds striking the target is *totalled* into a single damage roll *before* subtracting DR.

Semi-automatic lasers cannot be held on target precisely enough to get this armor-penetrating bonus. The mechanical action of firing multiple shots is enough to disperse them. Thus, such weapons are useful for hunting but not for combat against armored foes, and have a higher Legality.

Lasers require the Beam Weapons (Laser) skill. They do impaling damage, so damage that gets through DR is doubled. Reflec armor is very effective against lasers, as are some mirrors and other reflective surfaces. In rain, fog or smoke, lasers do half damage or less. Smoke bombs block lasers entirely.

Any laser hit to the eyes does double damage, and blinds the victim unless he can make a roll of (HT-damage). Anti-glare goggles give a +5 to this roll. He may recover later; roll as for other crippling injuries, but, again, roll at HT-damage.

Standard lasers use C cells; a pistol gets 20 shots, a heavy pistol or rifle gets 12. For an extra $100, lasers can be modified with a B-cell socket for emergencies; a B gives 3 pistol shots or 1 heavy pistol or rifle shot.

For an extra $100, a laser can have a variable beam, making it useful as a tool. Welding uses one "shot" every five seconds; cooking a meal would use one shot per minute; a weapon can even be used as a flashlight, expending one shot every 5 minutes. A laser weapon can also be used to light a fire, expending a trivial amount of energy.

For an extra $50, a laser weapon can serve as its own laser sight. The weapon then has a two-stage trigger; first pressure on the trigger activates a low-intensity aiming beam that places a visible dot where the weapon is pointed. More pressure fires the weapon. A laser sight adds 2 to Acc and halves the weapon's SS number (round up).

Military Laser Rifles are slightly heavier than standard laser rifles, and are capable of automatic fire. They use D cells, and get 140 shots from each.

Holdout Lasers are palm-sized hideaway weapons, similar in function to old-time derringers; they are +3 to Holdout skill to hide. They can be disguised as anything small — cigarette lighter, pen, happy stick, etc. They use a B cell, or a set of ten A cells; either way, they have 5 shots. An Armoury roll can replace the cell(s), but the weapon is designed to be disposable; effective skill is a cumulative -2 for each shot after the 4th, as the barrel lining vaporizes.

Constructed of plastic, holdout lasers are virtually undetectable as weapons until fired. A radscanner might detect one's power source at a -7 to normal skill.

Gatling Lasers have four rotating barrels; each can pulse once per second, giving it a RoF of 4. Gatling lasers are area effect weapons, and use the Gunner skill. They are tripod-mounted, and give 200 shots from an E cell. The weapon's 75-pound firing weight breaks down into three 25-pound loads (barrel, tripod and power system) for carrying. It can only fire if the gun and power system are joined. Disassembling or reassembling the weapon takes two turns for one man or one turn for two. The connections are virtually idiot-proof; IQ or DX rolls should be required only for those totally unfamiliar with the weapon.

The weapon can be fired off the mount with ST 15 or better. Used this way, it has SS 15 and Acc 4.

It takes 3 seconds to switch power cells. Damage is 15 dice, which can be treated as 3d×5; roll 3d and multiply by 5. Use the laser autofire rules — if all four shots hit, it can do up to 60d damage!

X-Ray Lasers (TL10) fire pulses of X-rays rather than visible light. An X-ray laser ignores reflec armor, and is more effective than a standard laser against other armor as well. Halve the DR of any armor or force screen against an X-ray laser. Smoke, weather and other factors that hinder normal lasers are totally

ineffective against X-ray lasers. Power cells give only half as many shots with an X-ray laser. Double the cost to make any laser weapon an X-ray device; legality is automatically 0.

Needle Guns

Standard needlers use the Guns (Needler) skill. They fire thin needles by means of a gas-propelled spring, and are sometimes called "spring guns." They are silent, semi-automatic weapons. They have a slight recoil: -1 to each successive shot.

Needlers carry their gas charge in their ammo magazines. Magazines can be reused, but new, commercial ammo should be used if at all possible. It is very difficult to make needler ammo, because the tolerances are so close. An Armourer-5 roll, and good equipment, is required.

Because these weapons produce no sound or heat, and use no power cells, they are not detectable by standard scanners. They may be made entirely of nonmetallic parts (double cost at TL8, no extra cost at TL9+). Such weapons are useful to assassins.

Neurolashes

These devices stimulate the nervous systems of living targets to feel excruciating pain. They are commonly used as duelling weapons, or by slavers. They require Knife or Shortsword skill.

Armor with a DR over 2, or reflec, protects fully; lighter armor and open-weave armor like monocrys do not protect at all. Anyone hit by a neurolash must roll HT-3, +/- Will modifiers. High Pain Threshold gives a +3 bonus, while Low Pain Threshold doubles all penalties. If the roll is successful, the victim can still function, but the pain will cause him to be at -2 to ST, DX and IQ — and all skills based on those attributes — for 15-IQ turns (minimum one turn). If he was hit on a limb, that limb is useless for the same time.

If he fails the HT roll, the victim is in such agony he can do *nothing* for this time. A critical failure will cause unconsciousness for 20-HT minutes (minimum 1 minute).

Each additional hit lowers the resisting HT roll by 1 (e.g., the second hit is resisted at HT-4). With each successive hit, start recovery time over. Penalties to attributes are *not* cumulative.

Type I neurolashes are small, rodlike weapons, resembling short plastic batons with a protected hand grip. They use a B cell, and can strike 50 times before losing power. Without power, a neurolash is just a baton.

Type II neurolashes, sometimes called "tinglers," are the same, except that if they affect a target at all, they also do 1d of actual damage. They can hit only 5 times before losing power.

The only way to tell the types apart without close examination (and an Armoury roll) is the damage.

Nerve Pistols

These weapons cause a neurolash effect when they hit (see above) but can affect their targets from a distance. Again, they ignore armor with DR 1 or 2, and are stopped by heavier armor or reflec. Like neurolashes, they come in Type I and II — or, for $100 extra, with settings for both effects. They can fire 30 times on a C cell, but any Type II effect counts as 2 shots. Changing the setting is a firing action.

Paralysis Guns

These beam weapons affect the nervous system, causing instant paralysis if the target fails a HT roll, or a -2 to DX and a -1 to IQ (and all related skills) if he succeeds, for 30-HT minutes. If the target is paralyzed, he is conscious of everything around him, but cannot move (though psi powers can be used at -1).

Armor offers no protection against a paralysis beam unless it is totally sealed. Sealed armor protects totally, regardless of its DR. A paralysis gun has no effect against anything unliving (except electronics — see below), and may be ineffective against members of certain nonhuman races as well — particularly chlorine-breathers and those with silicon metabolisms.

P-gun radiation can scramble delicate computer and communication circuitry. Military ships have shielded circuitry; civilian ships usually don't. On any miss with a P-gun, any unshielded circuit within range has a 1/3 chance of being put out of service. Shielded circuitry costs ten times normal cost for most devices; "optical" computer systems are also shielded.

Paralysis weapons are common law enforcement tools. The P-gun is recoilless. It may only be fired once per turn, and gets 15 shots from a C cell (8 for a rifle). They use the Beam Weapons (Neural) skill.

Screamers

These weapons produce concentrated sound . . . a high-pitched, rasping squeal. They don't operate in vacuum.

A screamer literally tears the flesh from its victim's bones. If damage from the weapon exceeds more than double that listed for any limb, the limb is completely torn off. Any hit to the head requires a roll against HT or the target's eardrums will be shattered, rendering him deaf until the eardrums are replaced. Wearing a completely sealed helmet is the only way to avoid this, but if the helmet's DR is exceeded by the screamer's damage, the eardrums will still be vulnerable.

Any armor hit by a screamer loses 3 DR at the location hit, unless it was protected by a force field. Natural armor (fur, scales, etc.) loses as many points of DR at that spot as damage it blocks. Reflec armor is useless against a screamer.

Screamers are recoilless and use the Beam Weapons (Sonic) skill. A screamer rifle gets 10 shots from a C cell. For an extra $200, a screamer can have a stun setting, at which it works exactly like a stun rifle, with each stun shot using half as much power as a screamer shot.

Stunners

Stunners fire focused beams of sound that assault the target's nervous system, rendering him helpless or unconscious. Stunners come in two models: short-range hand stunners and longer-ranged stun rifles. Because of their nonlethal effects, stunners are legal on all but the most restrictive worlds. They are useless in vacuum, since air is required to carry the sound.

Anyone hit with a hand stunner must roll HT-3 to avoid its effects (HT at 12 yards or more). If a limb is hit, a failed HT roll incapacitates the limb for 20-HT minutes; on a head or body hit, the victim is "asleep" for that time. Victims recover quickly when the time is up, but cannot be revived before then. If the HT roll is a critical failure, the effects last three times as long.

A stun rifle is more powerful. Anyone hit must roll HT-6 or be stunned, as above (HT-3 at 300 yards or more).

Armor is only partially effective against stunners. For every 5 points of DR at the target point, the victim's effective HT is raised by 1. Thus a complete armor suit with a DR of 15 would allow the target to avoid hand stunner effects on a roll of HT, instead of HT-3.

Stunners have no recoil and use the Beam Weapon (Sonic) skill. A hand stunner gets 40 shots from a C cell; a stun rifle gets 20 shots from a C cell. For an extra $100, stunners can be modified with a B-cell socket for emergencies; a B gives 4 pistol shots or 2 rifle shots.

Tanglers

Tanglers are short, stubby two-handed weapons that resemble 20th-century riot guns. They fire egg-sized capsules that release

a number of strong, sticky strands to wrap around and completely immobilize a target. The Guns (Tangler) skill is used to fire them. Recoil is high; -4 to skill for each successive shot.

The victim may try one Contest of Strength per minute to break the strands; together, they have ST 20. Alternatively, if the victim is fully clothed, an Escape-3 roll (one try every 10 minutes) will let him wriggle out of his clothes and escape. Any failed attempt to break free or wriggle out, though, results in the strands constricting, causing 1 point of damage. If one is hit by multiple tangler rounds, each additional round adds 5 to the ST of the strands, and -1 to any Escape attempt.

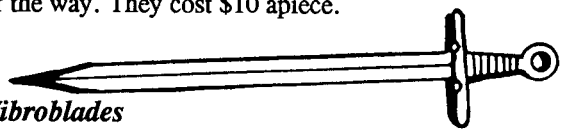
10 hits from intense heat, as from a laser or flamer, will free a captive, but he will take full damage from the weapon if he isn't otherwise protected. The strands are too tight, as well as too sticky, to be cut off. The proper way to remove them is with Anti-Tangler aerosol spray. A can costs $100, weighs 2 lbs., and will treat 25 captives, one per turn.

Neither the PD nor DR of armor protects against being hit by tangler strands, as they simply wrap around it as well as the person wearing it. However, any armor with DR2+ protects totally against the constriction damage. Force fields *will* turn back the tangle strands, causing them to fall harmlessly to the ground. And anyone hit by the charge has an extra Dodge roll to evade the strands before they close.

The strands lose their constricting ability after one day, and then begin to lose ST at the rate of 1 per 2 hours.

A tangler may only be fired once per round. Tangler ammunition comes five to a disposable magazine, which weighs 5 lbs. and costs $50. The magazine includes its own gas propellant. Cheap Tangler ammo has strands with less ST — from 15 on down to 10 or so. Beware of bargains.

Tangler mines are also available. They can be triggered electronically or by foot pressure, and have the same effect as a normal Tangler round; the victim gets a (DX-4) roll to jump out of the way. They cost $10 apiece.



Vibroblades

These blade weapons vibrate thousands of times per second. This adds 1d (5) to the regular damage of the weapon. Because the blade vibrates so rapidly, its movement is invisible, and it is impossible to tell a vibroweapon from a regular weapon of the same type. A Hearing roll made from 1 hex away will detect a faint hum that marks the vibroweapon for anyone familiar with it. Anyone whose weapon parries a vibroblade or is parried by it will realize its nature on an IQ roll.

Vibroweapons are powered by B cells. To find the life of the cell, divide 1 hour by the weapon's weight in pounds. Thus, a half-pound knife runs for 2 hours, but a 5-pound sword vibrates for only 12 minutes.

Turning on the vibro effect when the weapon is in hand takes one turn. A successful Fast-Draw roll, for one practiced with the weapon, activates it as it is drawn. When not activated, it performs like a normal weapon.

A vibroblade can also be used as a saw, as described for a Force Sword (above) to cut through most materials. It does thrust+2 damage against the DR and HT of the material being cut (see p. B125).

Any cutting weapon can be made in vibro versions. Regular knives of all sizes cost $200 extra in vibro; regular swords of all sizes cost $400 extra and are less common. Any other weapon (e.g., a vibro battleaxe) would be very unusual, and would cost $1,000 more than the regular weapon, if it could be found at all.

Weapon Accessories

Power Holster (TL8): Available for any pistol-type weapon or knife. Consists of three parts: a wrist sensor unit, a homing sensor on the handgrip of the weapon, and a breakaway holster. When the wrist sensor detects nerve impulses that mean the wearer wants to draw, the holster ejects the weapon toward the hand. This lets the weapon be readied instantly.

For game purposes, treat this as a separate Fast-Draw skill. However, Fast-Draw (Power Holster) rolls always have a +2. Failure indicates the weapon isn't gripped properly and still requires a turn to ready. On a critical failure, the weapon bangs the user's fingers and falls; on a natural 18, the user may be shot or stabbed in the foot! Gives 100 ejections on a B cell. $1,000, 5 lbs. Price doubles if the weapon is unusual and requires a custom-made power holster system.

Laser Targeting Scope (TL7): Attached to any pistol or rifle weapon, this item adds 2 to the weapon's Acc and halves its SS number (round up). It projects a low-power laser beam to display a dot at the point where the weapon will hit. About 200 shots on a B cell. $250, ½ lb.

Head-Up Display, or HUD (TL8): Consists of two parts: a sensor mounted on any weapon, and a pair of special goggles (or a built-in helmet visor). The goggles project a holographic reticle that shows the wearer exactly where the gun is pointing, reducing SS by 2. Runs a year on a A cell. HUD goggles, $500, ½ lb. Weapon fitting, $500 per weapon, weight negligible.

Personal Armor

Characters facing high-tech weapons are unlikely to last long unless they avoid combat totally or wear armor. At high TLs, armor once again catches up with hand weapon damage. Heavy military armor will stand up to incredible punishment. But such armor, like military weapons, is rarely available to civilians!

Kevlar (TL7)

A woven plastic material. It protects very well against crushing and cutting attacks, but less well against impaling damage, which penetrates the weave (and laser fire, which just melts it). Its protection depends on the thickness of the armor:

Light: PD 2, DR 4 (PD 1, DR 2 vs. impaling). $200, 3 lbs. for a vest; $500, 7 lbs. for a full suit.

Medium.: PD 2, DR 8 (PD 1, DR 2 vs. impaling). $300, 5 lbs. for a vest; $750, 12 lbs. for a full suit.

Heavy: PD 2, DR 12 (PD 1, DR 2 vs. impaling). $400, 7 lbs. for a vest; $1,000, 16 lbs. for a full suit.

Also, even if a cut or bullet is stopped, a certain amount of kinetic energy gets through to do crushing damage. When an attack is rolled against a Kevlar-armored target, any "5" or "6" rolled indicates *one hit* that affects the wearer despite the armor, in addition to any damage that actually penetrates.

Kevlar armor is Legality Class 3. A vest covers the torso and groin only, and can be concealed under clothing. Vests take 10 seconds to put on and 5 to take off. Double these times for suits.

Monocrys (TL8+)

Similar to Kevlar, but woven of a two-phase single-crystal metallic fiber. It is treated exactly like Kevlar (above) in all ways, except that against non-impaling attacks, it has twice the DR of Kevlar, at twice the cost. When an attack is rolled against a monocrys-armored target, any "6" rolled indicates *one hit* that affects the wearer despite the armor.

Ablative Armor (TL7-9)

A heavy, treated cloth that offers protection against lasers and blasters in particular. It ablates, or vaporizes, as it is hit, carrying away part of the destructive power of the beam. It is also effective to some extent against other weapons. It's much more useful against a single assassin than it is in a firefight.

Against lasers, flamers and blasters, ablative armor gives PD 4, DR 6. Against all other weapons, PD 1, DR 1. Double these DR figures at TL8, and again at TL9. However, the ablative effect means that each 4 hits stopped by a particular location reduce that location's DR by 1.

Ablative armor is Legality Class 3. It comes in vests that cover the torso only, or full suits. Vests weigh 15 lbs. and cost $100, and take 10 seconds to put on and 5 to take off. Full suits weigh 40 lbs., cost $300, and take 20 seconds to put on and 10 to take off.

Reflec Armor (TL8+)

Light, highly reflective armor of polished metallic fibers that reflects laser fire, and that of other beams to a lesser extent. It is useless against other attacks. It can be worn over other armor, giving its PD against all weapons (rather than the PD of the interior armor). Reflec gives PD 6, DR 2 against lasers and flamers; PD 3, DR 0 against other beam weapons, including blasters but not sonic weapons, and PD 0, DR 0 against all other weapons. It protects completely from normal fire (but not flamers) for 3 seconds, after which normal damage is taken.

Reflec is Legality Class 3. A jacket (covering torso and arms only) costs $150 and weighs 1 lb. A suit covering the entire body costs $300 and weighs 2 lbs. It takes 20 seconds to put on a reflec suit and 10 to take it off; 10 and 5 seconds for a jacket.

Reflec helmets (made of light plastic, silvered) weigh ½ lb. and cost $25. Or any helmet can be made reflective, getting the PD of reflec, for $50.

Combat Infantry Dress (TL8+)

Combat Infantry Dress consists of a chemically-coated and contamination-proof jacket and pants worn as an external garment; the suit comes with pockets, attachment points and harnesses for holding weapons or gadgets.

The wearer's chest and abdomen are protected by durasteel plates inserted in a compound fiber mesh which provide PD 4, DR 40 over the torso (areas 9-11 and 17-18). Armorplast plates and compound fibers protect the arms and hands (areas 6, 7, 8) with PD 2, DR 12. Similar pants are available to protect the legs (locations 12, 13-14) with PD 2, DR 12; armored boots cover the feet (15-16) providing PD 3, DR 15. At each TL above 8, add 10 to DR of each component.

A CID jacket with gloves weighs 25 pounds and costs $300; the gloves on their own weigh 2 pounds and cost $30. CID pants weigh 10 pounds, costing $140. The boots weigh 5 pounds and cost $70. A complete suit, excluding helmet, weighs 40 pounds and costs $510. If the entire suit (gloves, pants, jacket, and boots) is worn with the Combat Infantry Helmet, it is totally sealed against chemical and biowarfare agents and unbreathable atmospheres, though it is not pressurized for vacuum.

It takes 45 seconds to put on Combat Infantry Dress, or 20 seconds to remove it, or ⅓ this time if only the jacket or pants are to be worn and the suit is left unsealed.

Combat Infantry Helmet: Normally worn with the rest of the Combat Infantry Dress, this is a full-face, full protection helmet. Two CBR filter units (see below) are built into the cheek pieces, giving full protection against military chemical, biological and radioactive contaminants. The filter medium must be replaced (the cartridge costs $40 and weighs ¼ pound) every 48 hours in a CBR environment. When swung down and locked into place on the attachment points of the torso armor, the visor provides a complete airtight seal for operations on a hostile battlefield or in a contaminated atmosphere.

The helmet has PD 4, DR 18, except for the visor (covering the face, location 5 from the front) which has PD 2, DR 10. 8 pounds, $240. At higher TLs, add 10 to DR for each TL after 8.

Most military units add a standard set of accessories to the helmet: a HUD ($500), a voice-activated 128-channel short-range communicator with scrambler ($100), and chin-activated multiview visor (light intensification, antiglare and thermal imaging) ($1,200). Rather than using individual power cells, the system runs off a single C cell for 6 months. These accessories add 2 pounds to the helmet weight and $2,000 to its cost at TL8.

Infantry Combat Armor (TL9+)

Infantry Combat Armor is a full-body suit of articulated metal and ceramic-plate armor, designed to enable a soldier to fight and survive in any environment. With the helmet visor closed and the helmet's integral CBR filter locked into place, it is totally sealed and airtight, protecting against any chemical or biological contamination or hostile atmosphere. With the addition of a life-support pack (2.5 pounds, $750) and air tanks it can function as a vacc suit. The full range of vacc suit accessories (see p. 49) are available for it.

A rigid BPC/ceramic corselet protects the torso (locations 9-11 and 17-18), providing PD 6, DR 65. Articulated plates of BPC over compound-fiber mesh cover the arms and legs (locations 6, 8, 12, and 13-14) giving PD 4, DR 50. Armored gauntlets protect the hands (7) and feet (15) with PD 3, DR 25. The helmet protects the head with PD 6, DR 50 except for the visor, which is PD 4, DR 35 (location 5 from the front). At higher TLs, more advanced armor materials are used; increase DR by 15 at all locations for each TL over 9.

Infantry Combat Armor takes 60 seconds to put on and 40 seconds to remove; this is halved on a successful Vacc Suit roll.

The armor weighs 60 pounds and costs $2,550, including helmet but no special accessories. Standard helmet accessories include a holographic HUD, short-range communicator with scrambler ($75), and multiview visor ($600). The system runs off a single C cell for 6 months, and adds 2 lbs. and $1,075.

Powered Combat Armor (TL10+)

Powered Combat Armor is a heavily armored exoskeleton which amplifies the wearer's ST and provides protection against attack. Because of its cost, it is usually restricted to special units – marines, palace guards or elite assault forces. Powered Combat Armor is one step away from a military battlesuit; anyone who can use one can operate a battlesuit, but not its weapons.

The body of the suit is protected by 1" plates of biphase carbide (BPC) over shock-absorbing padding, giving the wearer PD 6, DR 100 over the torso (locations 9-11 and 17-18) and PD 6, DR 75 over the limbs and head. The gloves (location 7) and faceplate (location 5 from the front) have PD 6, DR 50. At each TL above 10, Powered Combat Armor gains DR 25.

The exoskeleton gives the wearer a ST of 20; ST may be

increased to 30 at a cost of $4,000 per point of ST added. The wearer makes any DX-based skill rolls at -1. If the suit loses power the user can still move, but will have to use his own ST to carry over 100 pounds of armor!

Powered Combat Armor takes 4 minutes to put on and 2 to take off. Each suit must be specially fitted to its wearer; refitting a suit takes 2 hours and requires an Armoury+2 roll. Failure means another attempt is required; critical failure damages the suit and requires repair by Mechanic (Powered Armor).

The helmet has an integral sensor visor, holographic HUD and medium-range communicator, all tied into a voice-activated personal computer (Complexity 4 at TL10) built into the helmet.

Powered Combat Armor is airtight and pressurized for vacuum, with a radiation PF of 20. The suit has a life-support pack, a 24-hour food and water supply, a waste-relief system and a 12-hour air tank. Other vacc suit options (see p. 49) may be added, at extra cost. The suit is powered for one week by a D cell, costs $30,500 and weighs 105 pounds.

Cybersuit (TL11+)

The ultimate form of "smart" body armor, the cybersuit resembles a skin-tight vacc suit with a small backpack.

It functions as a fully sealed vacc suit capable of withstanding up to 100 atmospheres of pressure. It absorbs sunlight for power to recycle waste and exhaled carbon dioxide, giving it a 6-week air and water supply. The suit's backpack also includes a D cell (which will run all suit systems for a day without sunlight), and a week's supply of concentrated rations.

A cybersuit consists of a multi-layered, three-dimensional molecular weave of diamond-based fibers, and microscopic computer-controlled electric motors. Guided by pressure sensors lining the interior of the suit, the fabric of the suit acts like artificial muscle, duplicating the wearer's every movement, instantly and without resistance, as if the suit were not there at all. More pressure sensors covering the suit's surface feel the shape of whatever the user touches and transmit it through the suit. As a result, DX is not reduced in a cybersuit, and its weight does not count as encumbrance for the wearer.

The suit's muscles are normally programmed to match the user's normal ST, but the user can set it to amplify ST instead, increasing ST to a maximum of 20.

Every cybersuit incorporates laser sensors which warn the wearer if a laser sight or active designator is being used against him (giving a +1 to Dodge) and a chameleon surface that automatically changes color, pattern and infrared signature to blend in with its surroundings, giving a -3 on any roll to spot the suit visually or by infrared. The wearer can use voice control to override the suit chameleon circuits. Civilian spacers often use this feature to decorate their suits with garish colors or designs.

A cybersuit protects the wearer with PD 5, DR 80. DR increases by 20 per TL over 11. Because of its unique construction, the cybersuit has no joints or vulnerable points.

Up through TL16, cybersuits are the commonest form of light military armor, usually worn with a force-field belt of some sort at TL13 and above. After TL12, cybersuits can be found almost anywhere, and surplus suits are regularly worn by explorers, belters and traders. Cybersuits are Legality Class 1. They weigh 35 pounds and cost $20,000.

All vacc suit accessories are available, but the cost of the suit includes a helmet with sensor visor, short-range (500 miles) communicator with neutrino receiver, and a holographic HUD. For an extra $5,000 and five pounds a cybersuit can incorporate a layer of thermal-superconducting armor (see below). These "military" cybersuits are Legality Class 0.

Thermal-Superconducting Armor (TL11+)

Also known as energy armor, this is a thin layer of material able to absorb and reradiate electromagnetic energy. It can be added to standard combat armor suits, or to any other sealed suit such as a vacc suit. It *halves* the damage done by lasers, X-ray lasers, gamma-ray lasers, flamers, shaped charges, fusion guns or microwave disruptors before the suit's DR is subtracted. It has no effect on other types of beam weapons or on projectile weapons. For example, if a laser beam did 51 hits, damage would be halved to 25, and then the suit's normal DR (or half its DR if the weapon was an X-ray laser) would be subtracted.

Thermal-superconductor layers are the main reason TL11+ armor can resist the X-ray and gamma-ray weapons in use at TL13+, and all military armor should incorporate it. It adds 5 pounds to armor weight and $5,000 to cost.

Medieval-Styled Armor

Armor patterned after medieval chainmail and plate may be made of improved metal alloys or high-impact plastics or ceramics. It may be purchased piecemeal or as a single suit. Weights and prices are given by comparison with the medieval armor listed in the ***GURPS Basic Set.*** Though such armor may seem frivolous, it is very popular for bodyguards, for duellists, for performers, and for travelers on low-tech planets, who wish to be well protected without being blatantly foreign.

At TL7, improved *modern steel* becomes available. Chain and plate versions are as listed for medieval versions, except DR is increased by 3.

At TL8, *Durasteel* versions increase DRs by 12; cost and weight are the same. Also available at TL8 are *Armorplast* versions (plate only — not chain), of high-impact plastic. This is much lighter, though not quite as damage resistant, as durasteel. Armorplast armor halves the weight of armor components, and increases DR by 8. Cost is as given in the ***Basic Set.***

At TL9, *BPC* plate in quarter-inch layers halves the weights, doubles the cost and increases DR by 24.

Force Shield (TL11+)

The force shield is a flat, circular energy field that performs the same function as medieval shields — to block attacks. Duellists often use one of these in conjunction with a force sword. It gives a PD of 4 against *any* attack from the front; a bullet or beam hitting it may be deflected, but total armor and shield PD cannot exceed 8. It has no DR, but no attack can damage it. It allows a Block defense against any weapon that can be blocked. See p. B50 for skill description.

The shield is generated by a solid bracelet worn on the wrist. It will function for 30 minutes on a C cell. $500; ½ lb. For $1,000, a force shield can be adjustable, giving the user the option to enlarge it to PD 5 (lasting 15 minutes) or PD 6 (5 minutes). Legality of any Force Shield is 5.

Wards (TL11)

These are stationary devices that use the same principle as the Force Shield; they project a flat, circular force field that can deflect bullets or beams. A typical ward unit works for 2 hours on a D cell, and casts a field 12 feet in diameter. If the ward is used as a "fence," half this field will be underground (this has no effect on the ward or the ground). The field has PD 8 and DR 2. Gas will not pass through it. A person can step through it, but there is resistance. Roll ST to cross at a walk, or ST-2 to cross at a run, but take 1d-4 impact damage if you run through it.

This ward weighs 20 lbs. and costs $1,000. Legality is 5. Larger and stronger wards may be available, but the expense rises rapidly!

6 MEDICINE

At high tech levels, medical and healing techniques improve greatly — see p. B128. Even death is not necessarily final.

The GM must decide which of the following medical techniques will be available, and at what prices. For instance, even if full-body replacement is available to the very rich, ordinary star-tramps may have to get along with prosthetics. Some repressive governments may also keep advanced medical treatment as a reward for the favored few.

Note that any medical technique which provides a permanent "improvement" for a character should, for good game balance, cost both character points and money.

First Aid and Medical Care

Above TL7, first aid *techniques* are no different from earlier ones, but new developments like Quickheal (p. 69) and sensaskin (p. 70) make a big difference. TL8 first aid takes 10 minutes and restores 1d of damage, but requires the use of plastiskin (p. 70). If this is not available, first aid is as per TL7: 20 minutes, repairing 1d-1 damage. TL8+ First Aid is as for TL8, with the *addition* of any specific ultra-tech healing aids actually available.

Physicians: As described on p. B128, a doctor can help patients suffering from ordinary wounds or illness, as follows:

Medical TL	*Frequency of roll*	*Patients per doctor*
TL8	Twice daily	50
TL9	Twice daily	50
TL10	Three times daily	50
TL11	Four times daily	100
TL12	Five times daily	100
TL13	Six times daily	100
TL14	Eight times daily	200
TL15+	Ten times daily	200

Certain injuries are treated differently. Replacement limbs are covered under Cloning (below). Damage from radiation is insidious and deadly, because it destroys the cells themselves, and is covered on pp. 76-77.

Physicians at TL9+ are even more dependent on their equipment (especially computers) and drugs than their lower TL counterparts. Without their ultra-tech equipment, TL9+ doctors function at TL6 levels.

Medical Costs

Cost of medical care varies widely between societies. Some, especially socialist societies, will give some or all care free; others will charge the costs below. The higher the society's Control Factor, the more questions one will have to answer at *any* "legal" hospital.

All costs are geared to standard humans (or to the primary race in your universe). For variant humanoids, mutants or genetically enhanced humans, add an additional 10-60% to the cost (either randomly, at 1d×10%, or based on the degree of variation from the norm). Costs for aliens will double, if they are at least relatively humanoid, and increase by up to 600% (1d×100%) if they are more alien. Likewise, treatment for humans will be more expensive in alien territory.

Medical care comes in three levels:

Outpatient care — Physician skill of 12. $150/day.

Hospital care — Physician skill of 14. $750/day.

Automedic care (see p. 70) — $3,000/day.

Luxury care (private room, doctors, etc.) — Physician skill of 16. $3,500/day.

Fighting Disease

Inoculations

Even at lower tech levels, inoculations are available to make the user immune to many specific diseases. At TL8, almost every known disease can be prevented by a specific inoculation. Any star-traveling civilization will provide these as a matter of course; you'll have to "update your shots" before you travel.

Unknown diseases are another matter. New planets are likely to carry their own infections. Scouts and colonists are at special risk; GMs may entertain themselves by inventing loathsome diseases. The specter of an alien plague is a frightening one; suspected disease carriers will be barred from civilized worlds.

Panimmunity

Artificial organisms, tailor-made for each individual, are injected into the body. They recognize "friendly" cells, and attack others. If you accidentally get someone else's immunity

shot, the effect will be as though you had caught a bad case of the flu, and there will be no benefit.

Panimmunity is permanent, and the better the bio-engineering techniques of the society, the more thorough it can be:

Level 1 (TL9): +3 to HT to resist any disease. Suggested cost: $1,000.

Level 2 (TL10): +8 to HT to resist any disease. Suggested cost: $5,000. GM may require PCs to pay 5 character points.

Level 3: (TL12) Full panimmunity: the equivalent of the Immunity to Disease advantage, with no minimum HT required. Suggested cost: $20,000 — though it might be free to members of the Scout Service. However, the advantage must be paid for: 10 character points.

Cloning

Cloning is a TL8 technique by which an identical body can be grown from an individual's cells. There are no rejection problems when you have an organ or limb transplant from a cloned body. Thus, any lost limb, or even an eye, can be replaced.

Cloning facilities are only available at major hospitals at TL8 (at TL9, your family doctor may be able to do it). It takes 6 weeks to force-grow a clone. Typical cost to grow a single limb, eye or organ is $5,000. Or you may grow a whole clone body for $10,000 and keep it as a source of spare parts. However, it costs a further $1,000 a month to maintain it.

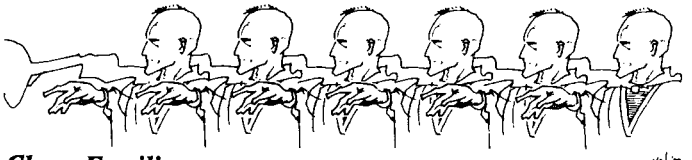
The actual transplant operation might cost another $10,000 per part replaced. Two months' bed-rest will then be required while nerves knit. (Reduce this time by a week for each TL above 8: minimum time 1 day!)

A character who starts with a physical disadvantage such as a missing eye or limb must buy off that disadvantage if the limb is replaced.

Citizen Clone

A new clone body is physically mature (normally seeming about 25 years old, or the current age of the original, whichever is less), but mentally blank. Thus, few see anything wrong with using a clone body as a source of transplants. However, it is also possible to educate a clone and bring him or her into society.

In some societies, such clones are given minimal training and used as servants and workers. In others, cloning is simply another way to produce offspring. In this case, though, the newly-created clone is forced to the level of maturity the parents want, from baby to adult.



Clone Families

Societies which embrace cloning may produce "clone families." Such a family might consist of any number of genetically identical individuals. They might all be the same age; they might act like a real family, of all ages. Simple genetic alteration might let some be male and some female — but otherwise, they would look alike, think alike and act alike. Members of such a group could cooperate very well. A ship crew, or the population of a whole town, might be formed of clones, all trained in different specialties. A clone family might be a Patron to its members.

Social Hazards of Cloning

Some societies may be threatened by unregulated cloning. Possibilities include:

Rich people cloning themselves repeatedly, out of vanity.

Use and abuse of clones (especially of very attractive or famous people) as pleasure-slaves or living toys.

Use of a clone body to "prove" that a criminal is dead — while he continues his career under another name.

Militaristic governments might try to produce super-armies by cloning their most capable, loyal soldiers — especially if braintaping (see below) is also possible.

To forestall such possibilities, most governments of Control Factor 2 and above will regulate cloning. Unauthorized cloning of an individual is almost always illegal. Clones may or may not have civil rights, and these rights may depend on the original intent of the clone's creator.

Brain Transplants

The ultimate transplant, feasible at TL8, is to put an old brain and spinal cord into a whole new clone body. If this is feasible, the operation will always cost at least $50,000, and take two months of recovery. Since brain cells don't regenerate, this doesn't offer immortality . . . but it can extend the life span.

The GM should "set the clock back" on any attributes the PC had lost to age, restoring them to the level appropriate for that person at his new age, *and* charge him character points to pay for the improvement, just as though improved stats were being bought (normal cost, not doubled).

Keep separate track of the brain's age (which will control rolls for IQ loss due to aging) and the body's age (which controls aging losses of the other three attributes).

Braintaping

This TL9 technology allows an individual's mind to be read mechanically, and "played back" into his clone. This costs $5,000, and takes one hour and hospital facilities. The clone is no longer mindless; it is a mental duplicate of the original. There may sometimes be a need to duplicate people — once or many times. But the usual reason for braintaping is to have a "back-up," so that if the original dies, the clone can take his place.

When a clone is "activated" after the legally-proven death of the original, most societies consider the clone to legally *be* that person, with all his rights and property. Some societies charge a hefty Revival Tax, though!

There are two ways to transfer memories. One is direct programming: the original visits the clone storage facility and programs the clone with his memories. This may be repeated as often as desired, at $2,000 a visit. If not reprogrammed within a month, the clone's mind goes blank.

Alternatively, if the original corpse is available, all its memories up to the moment of death can be read directly into the clone for $5,000. This must be done within a day. However, use of Suspend drug (p. 69) will buy an extra 2 days; freezing the body will let it keep for 10 days (not cumulative with Suspend). The body must be reasonably intact: HT no worse than -5×HT, and brain undamaged and not radiation-scrambled (see p. 77). The PC will remember his death, and must make a Will roll or acquire an appropriate new Phobia (see p. B27) from the trauma.

The second method is to store memories mechanically. This is called a "braintape." TL9 braintapes require the use of a Mechanical Memory Storage Device, or MMSD. This takes up 2 cubic yards and weighs 800 lbs. TL10+ techniques can store all a person's memories in a "mere" 100 gigabytes of storage media (see p. 52). Either way, mechanical memory storage takes 2 hours and costs $25,000 per update. But it lasts indefinitely.

Once a clone has been awakened and has had experiences of his own, attempting to program him with new memories, by either method, will simply drive him mad.

Game Effects of Braintaping

If a clone is activated from a braintape, it has only the memories and skills that the PC had when memories were last transferred. The new body is effectively 25 years old unless the owner chose to make it appear older; adjust stats as described above under *Brain Transplants.*

In either case, the newly-awakened clone will start out at DX-6 and IQ-2, as the mind adapts to its brand-new body. Make a HT roll each week; a successful roll regains 1 point of each; a critical failure is a temporary setback that loses 1 point of each.

Social Effects of Braintaping

First and foremost: You can *never* be sure that someone is permanently dead. Cell samples can be frozen; braintapes are easy to hide. Even if a foe is legally dead, and no longer has access to his money or property, he can return to haunt you.

Braintaping also makes it possible for many copies of an individual to exist. Most societies disapprove (though some don't care, and allow people to duplicate themselves at will, producing the clone-family effect). If an individual is sentenced to death, his clones and braintapes will be destroyed as well.

Therefore, some societies require braintapes to be un-copyable. Playing them into a clone automatically erases the tape. Braintape recording and clone growth will be strictly supervised by such governments, though bootleg clone labs will exist.

At the GM's option, TL10+ technology can allow a braintape to be played into a blank-mind clone of *someone else.* This leads to fascinating and horrible possibilities.

Suspended Animation

Another way of cheating death — or at least postponing it — is suspended animation or *freeze.* This technology typically becomes available at TL9. Anyone in suspended animation ceases to age or deteriorate — even if they are clinically dead. In this way, an injured or dying person can be preserved, perhaps long enough to reach a medical facility with the means to cure him. And if the means aren't yet available, and he (or his heirs) can afford it, his body can be placed into storage in hope that a cure will become available later. Or, if cloning and memory transfer is feasible, a freeze tube will keep the body "on hold" until a clone can be prepared. An occupant will not decay, deteriorate or even begin to do so until 1d hours after removal.

The other use of freeze tubes, of course, is for slower-than-light starships (see p. 86).

Putting someone into freeze, or taking him out, takes an hour. Freeze tubes use a combination of deep-freeze and drugs to preserve the occupant, as long as the power remains on (a freeze tube can run on an E cell for six months in a room of normal temperature). No other maintenance is needed.

Generally not portable units, these are usually installed in a sickbay or hospital. A freeze tube, with dedicated monitoring computer, costs $55,000. 750 lbs., 2 cy.

Freeze tube storage costs $250/day for short periods, or $50,000 annually; discounts of from 10% to 60% off the annual fee are available for long-term storage of 50 years or more. This price includes a very safe, well-guarded storage space.

Regeneration

At TL12, hospitals use an electric current to stimulate regrowth. This is part of the standard treatment for normal wounds and so on.

A higher-powered version, the "regeneration field," can even regrow lost limbs and body parts, though there are dangers in this. The patient must roll HT+4 for each treatment, or suffer bizarre side effects. If this HT+4 roll fails, roll again vs. HT. On a critical success of this second roll, the side-effect is beneficial (increased abilities, psi powers). On any other result, the effects will be bad, ranging from mere loss of HT on a "success," to uncontrolled growth or development of new body parts on a bad failure. Once an individual has had side effects from the regen ray, he will have side effects any time it is used on him again — roll vs. HT to see how severe they are.

Treatments are $5,000 each. Several hour-long treatments may be necessary, no more than once per day. A finger or toe may be restored with a single treatment; a hand or foot in two; an arm to the elbow or leg to the knee in three; an entire arm or leg in six. Smaller organs of taste or smell such as tongues and noses take two sessions; the more complex organs, hearing or sight take longer — usually four for an ear and five for an eye. Internal organs usually take four to six sessions; brain damage requires eight.

A roll of Physician-2 is required to operate the regen ray. At TL12 this is not a portable unit, and is installed in a sickbay on a ship or in a hospital. It is very delicate and easily broken if handled roughly. $60,000, 1 ton, 1 cubic yard.

Regeneration At Higher TLs

For each TL above 12, halve the cost of the treatment and the time it requires, and give an additional +1 to the HT roll, both to avoid side effects and to see what the side effects will be.

Also, each increase in TL halves the cost, size, and weight of the apparatus. By TL15 it is sturdy and highly portable, and may even be seen on the battlefield.

Aging

In some future universes, the human life span will be greatly extended. This is an optional change to the rules on p. B83.

Starting with TL8 societies, aging rolls do not start until a character reaches a natural age of 70. The increases in frequency for aging rolls that normally fall at 70 and 90 years of age are also set back by 20 years each.

At TL9, aging rolls are not made until age 90, and their frequency increases at ages 110 and 130.

At TL10+, aging rolls begin at 110 and frequency increases at ages 130 and 150.

And, of course, because of the TL adds to the HT roll in all aging checks, loss of attributes due to aging will become even rarer. This will also raise the age at which the Age disadvantage is legal for a character; if age checks don't begin till age 70, being a 56-year old is no disadvantage at all.

If anti-agathic drugs (see p. 68) are also available, aging may be stopped almost completely.

Other Types of Healing

Other processes may exist in some universes — psionic healing and restoration, for example, or alien techniques. Or human minds can be placed in robot bodies. Perhaps the Precursors had the secret of immortality . . .

Bionics

At TL8, missing limbs can be replaced by realistic mechanical ones: *bionics.* With plastiskin coatings, these parts can be made to look and even feel natural. Bionic replacements will be less popular if cloned limbs are available, but they'll still exist.

It is possible to build bionic parts that are very different from the originals – better, stronger, and so on. Details of most such super-parts are beyond the scope of this book. They would count as advantages – requiring the user to pay character points. But even "standard" bionic replacements have some advantages over the original equipment.

Bionic parts weigh about the same as a natural limb or organ, and are treated the same unless specified otherwise. Remember that these bionic parts are attached to regular flesh. Superhuman feats are likely to damage nonbionic areas of the body.

Abilities and Costs of Bionic Parts

Costs given are for TL8; halve costs at TL9 and again at TL10. The GM may allow other bionic replacements, at appropriate costs. These costs are for the part only. The operation to attach a part costs $20,000 ($30,000 for a pair of eyes); this price is halved at TL9 but not reduced further at higher TLs.

Second-hand parts will sometimes be available. They'll be cheaper; they may or may not be a bargain, and there may be damage that is not immediately evident. Because of their value, bionics are never discarded until they are totally destroyed . . . giving the phrase "loot the bodies" a whole new meaning.

Hand: Adds 1 to DX for manual tasks, and gives ST 12 for gripping and hand-to-hand damage purposes. $12,000. For ten times the cost, either DX+ 2 or ST 13 is available; for 50 times the cost, both are available. Cost is 1/8 cost of ST or DX increase.

Arm: As for a hand, except that ST of a bionic arm, and the hand on the arm, is 14. $25,000. For ten times the cost, either DX+2 or ST 15 is available; for 50 times the cost, both are available. Two-handed feats require two bionic arms to get the benefit of the modifiers. You cannot buy both a bionic hand and a bionic arm, as the arm includes the hand, though the hand can be strengthened separately. Cost is 1/4 the standard cost of the ST or DX increase.

Leg: Each bionic leg increases Move and Jumping distance by 25%, rounded down. (You must kick off from the bionic leg on a jump to get the bonus.) It also adds 2 to kicking damage for that leg. $25,000. Cost is 10 points per leg.

Eye: A bionic eye corrects any weakness of vision, but does not give any bonuses. However, improved eyes, giving vision bonuses up to +5, are available. Likewise, eyes that give the Night Vision advantage are available. In addition to the cash cost, character points must be paid for acquiring these advantages. Standard eyes are $35,000 each. Improved eyes must be bought in pairs to work properly: $45,000 each for +1, $60,000 each for +2, $100,000 each for +3, $150,000 each for +4, $200,000 each for +5. Adding Night Vision to any eye costs $15,000. If only one eye has Night Vision, a patch must be worn over the other eye at night, or the conflicting signals will give the user a -2 to any Vision roll.

Ear: Standard bionic ears give normal hearing. Improved ears, giving Acute Hearing up to +5, are available. In addition to the cash cost, character points must be paid for acquiring this advantage. $20,000 a pair, plus another $15,000 a pair and 2 character points for each +1 to hearing.

Installing Bionic Parts

A roll against the lower of Surgery and Electronics (Bionics) is required to attach a bionic part. Bionic eyes are harder – a further -2 to the roll.

At TL8, a month of bed rest is necessary after a bionic operation, to allow the nerve/electrode splices to mesh. At TL9, this is two weeks; at TL10+, one week.

Damage to Bionic Parts

All bionic limbs have PD 1, DR 3. It takes 2 hits to cripple a bionic eye or ear, 4 to cripple a bionic hand, or 6 to cripple an arm or leg. Damage to a bionic part does *not* produce any stunning effects, temporary loss of DX, or other "pain" effects.

Repairs to Bionic Parts

Bionic parts, of course, will *not* heal, and can only be repaired or replaced. Repair costs depend on the amount of damage the part has taken. If a bionic limb has lost half the HT points necessary to cripple it, the cost to repair it will be 25% the cost of the original part. If it has taken exactly enough to cripple it, repair is 50% original cost, and so on. However, if the bionic limb receives more than twice the amount of damage needed to cripple it, it is effectively destroyed and cannot be repaired at all; it must be replaced.

Both Electronics (Bionics) and Mechanic (Bionics) skills are necessary to repair bionic parts; time to do a proper job is 2d-TL hours, with a minimum of an hour. Emergency repairs in the field may be attempted with either skill. Success will not restore lost HT to the parts, but might allow them to function again if they've been crippled. Such repairs should take at least one minute per skill roll.

Social Effects of Bionics

Those who receive bionic replacements will have to deal with their own differences – and with how others view them. Becoming a robot in whole or part might be considered a Social Stigma in many campaigns, especially on lower-tech or provincial planets. PCs might suddenly find themselves Second Class Citizens – or worse, considered Property of another in order to be allowed to exist at all. They could suffer losses in Appearance, depending on the nature and sophistication of their bionics, and receive additional reaction penalties on a world where Intolerance against robots, cyborgs or other nonhumans exists.

SF Wonder Drugs

A variety of drugs may be available. And pharmaceutical companies are always interested in discoveries from far planets.

These drugs are generally geared to the metabolism of humans (or whatever the major race is). Most will have no effect, or no good effect, on alien metabolisms. Xenovarieties of these drugs, if they exist at all, usually cost from 10% to 60% more than listed price, depending on how common is the race for which they are designed.

As always, the prices given are suggestions, and the GM is free to change them as his campaign may require. Prices don't necessarily drop as TL increases. Most societies will restrict some of these drugs to doctors (licensing requirements vary, but

usually Physician 14+ is the absolute minimum). However, even restricted drugs can generally be had on the black market, at higher prices.

Some drugs come in pill form; some in vials to be injected by pneumospray; some in both.

Adders (TL8)

This is a generic name for a group of drugs that temporarily add to ST, DX, IQ, HT or Move. One "dose" adds 1 point. The effect usually only lasts for a few hours. After it wears off, the affected attribute suffers a penalty, equal to the original bonus and lasting twice as long.

To obtain the effect desired, a user must make a HT roll at -1 for every dose taken. If the roll is successful, the attribute is raised by the number of doses taken, for a number of hours equal to the amount by which the HT roll was made (minimum 1 hour if HT rolled exactly). If the roll fails, the attribute is raised by 1 for one hour, regardless of the dose, but the decrease after the hour is up will be the same as if the entire dosage had been effective. On a critical failure, the drug will *decrease* the attribute by the amount of doses taken, for one hour.

Once an Adder has been taken, no different type can be taken until the effects of the first wear off (or wholly unpredictable side effects may occur!). If more of the same Adder is taken within a 24-hour period, a new HT roll is made, at the penalty that would have been required if all those doses had been taken at once. The good effects, if any, are only those of the new dose, but the letdown period is calculated as though all the drug had been taken at the time of the latest dose.

Adder users often feel very good under the effects of the drug — similar to the Overconfidence disadvantage — and are at least mildly depressed after it's worn off. Some black-market adders, especially DX adders, are addictive.

These drugs are usually only available to doctors, though they are abundant on the black market, and are often issued routinely to members of military and mercenary organizations. They come in pill form (takes 30 minutes to work) at $25/dose, or hypo form (works immediately) at $50/dose.

Analgine, or Painaway (TL9)

This drug masks pain totally for a period equal to half the user's HT in hours. Any penalties normally inflicted by extreme pain are ignored totally. A Painaway user does not roll for stun or other damage effects until his HT reaches 0, nor does he take any penalties to hit from combat wounds — he just doesn't feel the injury at all. Unfortunately, because of this, a character may take more damage than he realizes, and thus suffer worse in the long run. The GM rolls secretly for any damage taken by the user, and doesn't tell the player what happens until his character falls over or is specifically checked for wounds.

Additionally, a user's IQ (and all related skills) are lowered by 1 point until the drug wears off.

Once the Painaway wears off, the user will feel the pain of his wounds. Taking additional doses will keep the pain away, but each extra dose lasts one hour less than the first, until the drug is no longer effective. Then at least 24 hours must pass before a dose can be effective. Taking more than one dose at a time will have no effect, except to lower IQ by an additional point per extra dose.

Unfortunately, analgine is addictive. If more than 3 doses are taken in a 24-hour period, the user must roll vs. HT to avoid addiction. Roll again for each later dose taken within 24 hours of the *last* dose, until use stops. If addiction develops, the user needs a daily dose to avoid normal withdrawal symptoms. There are no other side effects, except that a "gine-head" is likely to hurt himself and not notice! The drug is highly addictive, so Analgine addiction is a 15-point disadvantage.

Legally sold only to licensed physicians, but widely available on the black market. Comes in pill or vial. $50/dose.

Anti-Agathics (TL10)

Anti-agathic drugs slow down the aging process. Each dose effectively stops aging for one year. (Actual aging is at a rate of about 1 week per year.) Unfortunately, once an individual stops taking the drugs, he must make up all the aging rolls he skipped, at a rate of one roll per week. Thus, he rapidly ages to his actual chronological age, which often results in death.

A dose of anti-agathics is actually a set of two injections and six pills, all of which must be taken within a day's time. Some societies reserve anti-agathics for leaders, key scientists, and so on. In others, it is available to anyone who can pay the price: $25,000 per dose. Black-market anti-agathics are cheaper, but may be less effective or have side effects.

Antirad (TL9)

This medication contains a number of different drugs, with the combined effect of partial protection against radiation. Antirad can be taken before radiation exposure (up to a week before), or within an hour afterward. One dose halves the effective amount of rads from a new exposure; 2 doses will halve exposure again, and so on (see pp. 76-77).

An Antirad user must roll vs HT+3, *minus* the number of doses taken within the past week. A failure causes the permanent loss of 1 DX. Note that Antirad does *not* heal existing damage; it merely prevents new damage.

Available only to licensed physicians and medics, except when purchased in emergency medkits. Comes in vial and pill form. $150/dose.

Ascepaline (TL9)

This drug instantly — but temporarily — restores HT to its full level no matter how much damage the victim has taken (as long as he's still conscious when he takes the drug). The user must make a HT roll. The amount by which he makes his roll, plus 2 hours, is how long he'll remain temporarily healed (minimum 2 hours). However, while under the influence of the drug, both ST and DX are at -2.

If he misses the HT roll, the drug will still work for 2 hours, but he'll be at -4 to ST and DX; if it's a critical failure, the drug will do real damage equal to half the amount he's already lost.

When the drug wears off, the user's HT will drop to what it was when he took the drug, plus any additional damage taken, plus 1 point from the drug itself. Further doses cannot be taken until after the patient has healed naturally or through other means. Ascepaline is generally sold only to licensed medics. It can be found on the black market, but not as easily as other types of drugs. Comes in hypo form only. $150/dose.

Genericillin (TL10)

This is a very powerful general-purpose antibiotic. It doesn't treat *all* diseases, but it's always a good thing to try. When an unfamiliar malady is encountered, Genericillin adds 1d-1 to the effective HT of anyone rolling to resist or shake off the disease (roll the HT bonus and record it the first time each new ailment is encountered). In general, it adds 4 to HT against most normal Terran diseases.

Cumulative doses have no side effects, except that after a few weeks of regular use, the whites of the eyes become slightly greenish. A dose remains active in the body for about a week.

Useful for Terrans only; poisonous to most other races (though some have equivalent antibiotics). Available only to licensed physicians and medics, except when purchased in emergency medkits. Comes in vial form. $100/dose.

Gravanol (TL9)

This drug lets the user function under increased gravity. A dose of Gravanol will last a week, and eliminate any medical hazards of two G-Increments of extra gravity. Thus, normal Earth humans using Gravanol can safely take up to 1.59 Gs with no HT effect. Extra doses don't give extra tolerance.

Unfortunately, Gravanol is highly addictive. Roll vs. HT after every full week of use, with a cumulative -1 per successive week after the first. Any failed roll means you are addicted. Since Gravanol is legal, highly addictive, and fairly cheap, *starting* with a Gravanol addiction is a 5-point disadvantage. How ever, the addiction is worth no points if acquired in play. A Gravanol addict needs a dose only weekly, not daily.

Comes in pill form: $70 per dose.

Hypercoagulin (TL8)

When injected into a patient with a bleeding wound, this causes instant coagulation and a cessation of bleeding within 1d+4 seconds. It restores 1 point of HT, and prevents any further damage from loss of blood. The drug should be injected as close to the wound as possible. An injection prior to sustaining a wound will have no effect unless a wound is received within five minutes after the injection.

Overdoses of this drug can kill; for every additional dose within a 24-hour period, roll HT, minus the total number of doses taken. A failed roll means the patient's blood becomes so thick that his heart stops. Full medical facilities (a full blood replacement and possibly a heart transplant) will be required to save his life. The drug is normally only available to licensed physicians, though two doses come in every emergency medical kit. Comes in vial form only. $25/dose.

Quickheal (TL9)

A dose of this drug will heal 1d of any type of wounds. This takes 10 minutes for the drug in hypo form, 1 hour for a pill. The patient must also receive first aid, or at least bandaging; Quickheal won't close a gaping wound! It has no effect on HT lost to radiation, disease or other non-wound injuries.

If a second dose is taken within 24 hours, it may be less effective. The patient must roll vs. HT, with a -2 modifier per dose after the first in the same 24-hour period. If the roll is missed, the drug has no beneficial effect, and the patient will become nauseous and disoriented, with a -1 to both DX and IQ for 24 hours. On a critical failure, he'll take 1d of damage.

Quickheal can be found in most first aid and medic pouches. It may be purchased legally by anyone on many worlds, and by doctors or through prescription on most others. It is abundant on the black market even on worlds where it is for some reason illegal. Hypo form, $50/dose; pill form, $20/dose.

Revive Capsules (TL8)

These are small, easily breakable capsules. When held under the nose of a stunned or unconscious person and snapped open, the vapor inside will usually revive him completely; roll vs. HT+5 to regain consciousness, come out of stun, etc. No HT is regained, but the patient is awake. Revive capsules can be purchased freely in drug stores in all but the most repressive societies (CR 6). $5/dose.

Note for lower-tech GMs: As early as TL5, "smelling salts" were used. At TL6, ammonia inhalant capsules are found in first aid kits. Either will give a HT roll to wake up.

Superstim (TL8)

This drug instantly restores 1 die of Fatigue loss. Roll vs. HT; the Fatigue is banished only for a number of hours equal to the amount by which the roll was made (at least one). The only side effect is this: when the time is up, the user gets all that Fatigue back, plus 2 more.

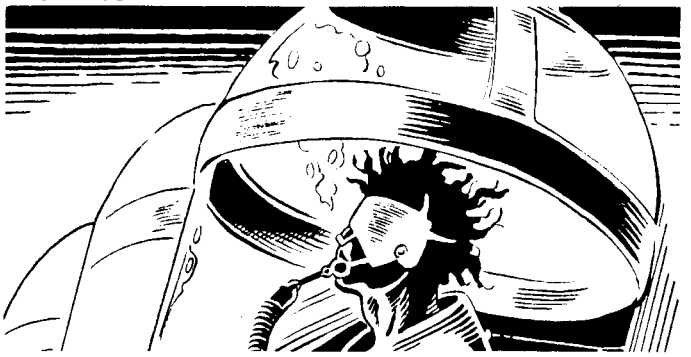
For each dose taken after the first within 24 hours, the HT roll is at -1. Multiple doses of Superstim can cause the user to "crash" when he finally stops taking it. If Fatigue goes past 0, the extra points of Fatigue are taken as lost HT instead. There are no other side effects.

Widely available. Pills (taking effect in 30 minutes) cost $25/dose. Hypos (work immediately) cost $50 per dose.

Suspend (TL9)

Suspend slows down all biological functions. Thus, it can keep a badly injured person alive longer. If it is injected into a dying person, it will retard cell death (but it *must* be injected before the heart stops!). A person injected with Suspend — even if he's died — can be taken to the proper medical facilities for treatment, freeze storage or regeneration. He won't heal at all while on the drug, but he won't get any worse either.

The effects of a dose of Suspend last for 48 hours, after which the metabolism returns to normal, or deterioration of a corpse begins again. A corpse cannot be dosed again. A living person can, but each subsequent dose requires a HT roll. When a roll is failed, that dose is ineffective; Suspend will not work on that person for (30-HT) days. Injecting more than one dose at a time has no additional effect. Suspend is relatively rare on the black market, and is legally available to licensed doctors only. Comes only in hypo form. $650/dose.



Torpine (TL10)

Torpine puts the user into a healing trance; he becomes unconscious for 24 hours. At the end of that time, all damage taken is totally healed. However, the user comes out of the trance totally exhausted from the demands put on the system; his ST is at 1. He will also be famished and must eat as soon as possible to fully regain his ST. Superstim will *not* restore this ST loss. However, it can be used in an emergency to break the healing trance. If this is done, the amount of HT regained is proportional to the time spent in trance, but ST is still 1.

Because Torpine speeds the metabolism, each use is likely to add to the user's effective age. Roll vs. HT on coming out of the healing trance. On a critical success, the user doesn't age. On a success, he ages by a month. On a failure, he ages by a number of months equal to the amount by which the roll was missed. A critical failure ages him by two years!

Torpine is normally only issued to doctors (though it is available on the black market). Comes only in hypo form. $250/dose.

Artificial Tissue

Plastiskin

A fleshlike plastic patch that holds wounded flesh together, taking the place of normal skin. (It even takes on the color of one's skin, so that only on close examination is it evident.) When the flesh beneath it heals sufficiently, the plastiskin patch falls off. Plastiskin is found in any TL8 first aid kit; without plastiskin, TL8 first aid counts as TL7. Plastiskin can also be used to cover tattoos, etc., for disguises. Costs $10 per 6-inch-square patch.

Sensa-Skin

Sensa-skin is a TL11 artificial tissue. It can be grown or formed into sections that, when applied to a living body, attach themselves and become a part of it. The subject is able to feel through the sensa-skin's surface, just as if it were his own skin.

Sensa-skin "cultures" can also replace missing portions of flesh for cosmetic purposes. Sensa-skin can grow hair, or simulate skin and flesh, or even chitinous armor, scales, feathers and the like – though such specialties usually cost several times more than regular sensa-skin.

Once sensa-skin is attached, it will not come off unless a special chemical neutralizer is applied. The same section can be reapplied after the neutralizer has worn off (in an hour). After a sensa-skin patch is left in place for the subject's HT× 3 days, it becomes part of the body and can only be removed by surgery.

Sensa-skin has revolutionized disguise. Preshaped, molded facial masks and entire body suits of sensa-skin/flesh can completely change appearance. A human could actually become an alien with fur, a tail, even claws if grown into the sensa-skin "paw." Or a male could become a female with "real" breasts and so on – or vice versa. Therefore, sensa-skin has become highly valued among the criminal classes, as well as among espionage agents, as a quick, easy – and reversible (unless kept on too long) – alternative to plastic surgery.

To apply a section of sensa-skin correctly requires a Surgery or Physician roll at -2. Premolded shapes used as disguises may be applied by a successful Disguise roll.

There are some dangers in handling sensa-skin. Anyone attempting to apply a section – or even just picking one up – must make a DX roll to avoid attaching it to his own flesh, unless he's completely covered (no bare flesh at all). If he fails, it's instantly attached itself. Fortunately, it takes no skill at all to apply the neutralizing spray.

Use of a sensa-skin patch in first aid will restore an *additional* 2 points of damage, even if the first aid consists of little more than slapping the patch on (simple bandaging). The only roll required is the DX roll to avoid attaching it to the wrong place.

$50 per six-inch-square "first aid" patch (generally available), much more for specialized forms (usually available only to licensed surgeons).

Sensa-Skin Neutralizer (TL9): Small spray tube of a solution which will loosen and remove sensa-skin patches before they become permanently attached (within HT × 3 days after application). Each shot will loosen a three-inch-square patch (or less). Ten shots per tube. $150.

Medical Equipment

Pneumospray Hypo (TL7): A hand-held pneumatic hypodermic, penlight size, that injects drugs with compressed air. The hypo must be touching the patient to function. Its charge can easily penetrate clothing with DR of no more than 1. It takes two turns to remove an empty vial (or pneumocharge) and replace it with a ready new one. Air cartridges are good for 100 injections. $125, weight negligible. Replacement cartridges, $10.

Emergency Medkit (TL8): A belt pouch with 5 revival capsules, 5 plastiskin patches, a pneumospray hypo and 2 doses of Hypercoagulin. Adds 1 to First Aid skill. Has room for another 10 doses of whatever medication is desired. $300, 1 lb.

Medical Pouch (TL8): A doctor's bag, with room for twice the above, plus standard bandages, sedatives, stimulants and so on (purchased separately). Has room for whatever other drugs the physician wants to add (at TL9+, for instance, he will certainly include Quickheal). Includes a full set of physician's and surgeon's tools for the TL. Cost and weight don't drop at higher TLs; the contents just get better. This kit is the minimum requirement to use Surgery, Diagnosis or Physician without penalty. Adds 2 to First Aid skill. A TL8+ Physician performs as TL6 without this much gear. $700, 15 lbs.

Medscanner (TL9): A compact, short-range scanner with dedicated medical computer, designed to make specific medical diagnoses when used by a trained doctor. Its effective range is only 1 yard (doubling at each TL over 9). While a bioscanner can identify life forms and tell if they are sick and/or dying, it won't tell exactly why. But a medscanner will give detailed diagnoses on known races – to anyone trained in its use. On a successful Electronics Operation (Medical) roll, it adds +3 to Diagnosis skill, +1 per TL over 9. A medscanner will also detect implants if the roll is made by 3 or better. $900, 1 lb.

Diagnosis Table (TL9): A 7' × 3' × 3' padded, computerized table with a full range of biological and medical scanners. The patient lies on the table; scan results are projected onto an overhead screen. Gives a +5 to Diagnosis skill, as described above for the Medscanner. Not a portable unit; the table must be installed in a sickbay on a ship or in a hospital. $12,000, 250 lbs., 3 cy. At TL10, halve the price, and it gives a +6 to skill. At higher TLs the diagnosis table is rarely seen; the patient is usually just put in an automedic (below) for diagnosis.

Automedic (TL9): Looking like a gleaming ultra-tech coffin, the automedic will attempt to diagnose and heal anyone placed in it. No doctor is required; the patient is fully isolated and kept sedated. If the injury is one that a physician can deal with, the automedic rolls vs. the appropriate skill as though it were a physician. It is stocked with a full range of drugs and medical supplies, and has surgical waldoes to let it operate if necessary.

An automedic has a dedicated computer with skill 14 in First Aid, and 13 in Diagnosis, Physician and Surgery; add 1 to skill for each TL above 9. While it can cure most ills and heal most wounds and injuries, it cannot bring back the dead. It also has no imagination, so new diseases or strange problems may stump it – in which case it puts the patient on Suspend and calls for help!

Critical automedic failures are unpleasant to consider. Damaged or sabotaged automedics are also deathtraps.

At TL9, $50,000, 600 lbs., 4 cu. yards. Drug pack refill (usually every 25 uses), $5,000, 50 lbs. Usual cost of automedic use, if you are placed in one in a hospital, is $3,000 per day.

At TL10, they take only 500 lbs., 3 cy. At TL11+, 400 lbs., 2 cy. Costs remains the same.

ENVIRONMENTS 7

The universe contains a huge variety of different environments. Gravity, atmosphere, extremes of temperature . . . all can be fatal to the unprepared.

Gravity

Gravity is measured in "Gs," or "gees," with 1 G being Earth-normal gravity. When a character is created, his "standard gravity" may be defined. If no standard gravity is defined, assume the character is native to 1 G.

Changes in gravity make things heavier or lighter. This changes things like jumping and throwing. For instance, if a "1-lb." object is being thrown under 2 gravities, it weighs 2 lbs.

For purposes of calculating Move scores, gravity changes *encumbrance.* Multiply each character's encumbrance by the local gravity *before* calculating the Move score. Also, calculate the change in the character's own weight, and add this change to encumbrance — or subtract, if gravity is lighter. (This means that encumbrance should be recalculated each time a different planet is visited. GMs who find this a waste of time may fill their universes with 1-G worlds.)

Gravity has no effect on *weapon use or damage.* Even though you can pick up heavier weapons under changed gravity, you can't fight well with them. And primitive weapons do the same damage under any gravity, because their *mass* is unchanged. The exception is zero-gee — see below.

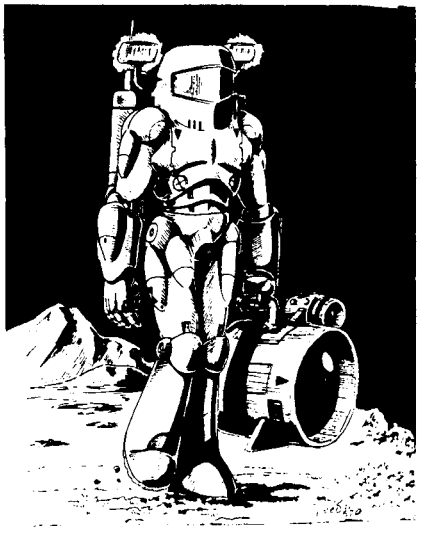
G-Tolerance and G-Increments

All creatures function best in the gravity they are native to, but some creatures can tolerate changes in gravity better than others can. The amount of change you can tolerate without problems is the *G-Increment.* Normal humans (and other creatures) are assumed to have a G-Increment of .2 G. This means that each change of .2 G in the gravity will have a cumulative effect, as described below. Round gravity down. For an ordinary person native to Earth, 1.19 G is treated as 1 G (no penalty), but 1.2 G is treated as a one-increment penalty.

An increased ability to tolerate changes in gravity is the *Improved G-Tolerance* advantage, described on p. 33.

G-Increments have to do with the way in which DX and HT change with gravity. ST changes are the same for everyone, regardless of their G-Tolerance, because they reflect actual weight! Characters native to worlds of different gravity will figure their G-Increment from a different base level. For instance, if your native gravity is 1.3 Gs, you will suffer the same effects at 1.5 Gs that a normal Earthman would at only 1.2.

However, figure all other gravitational effects as for standard characters. Don't try, for instance, to figure out what a heavy-worlder's encumbrance would be on his home planet and work from there to find his movement on a light world. It all cancels out.



Gunfire In Varying Gravities

Bullet ranges are affected by gravity. Divide listed Max range by local gravity to get local Max. Other ranges are not affected by gravity, though ½D will be very slightly less if air pressure is high.

Required ST to handle a weapon without recoil affects increases by 1 for each loss of .2 G, as the user's weight goes down. It does not change in increased gravity.

Ordinary guns recoil very badly in microgravity; ST to hold recoil is increased by 5, and vented gases give the user a cumulative -1 to hit for each shot already fired, until the user moves away or waits a minute. Guns designed to be used in microgravity or zero-G are sometimes available; they vent their gases to the side, which also stabilizes them. Prices are usually tripled.

Climbing Up and Down

When climbing long distances up or down stairs, ladders, trees, and so on, use the Climbing rules on p. B79, but modify speeds as follows for variable gravity:

High Gravity

If gravity is more than 1 G, multiply the time required under Earth gravity by *twice* the local gravity, minus 1. In 1.2 G, a climb takes 1.4 times as long, so a 10-second (Earth) climb takes 14 seconds.

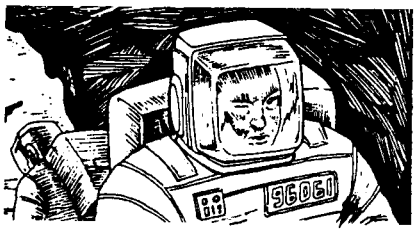
Low Gravity

Under less than 1 G, multiply the time that would be required under Earth gravity by the local gravity. In .5 gravity, climbs take half as long, and so on.

Microgravity and Zero G

At less than .2 G, climbing is more like controlled flying. Use the formula given above, but maximum speed is 5 yards per second (you are just grabbing a handhold occasionally to guide yourself). Long climbs use the same speeds as short ones.

In zero G, you don't climb at all; see the next page.



Falling People and Things

To compute damage due to falling under gravity other than Earth-normal, figure the damage that would have occurred under Earth gravity, as per p. B114. Then multiply it by the actual gravity. Thus, a fall that is computed to do 12 points of damage (before armor, resistance, etc., are taken into account) would do 24 points of damage under 2 gravities.

Use a similar procedure for determining damage done by falling objects.

Those interested in absolute realism should be aware that "terminal velocity" – the maximum speed an object can fall before air resistance stops further acceleration – is increased in high-G and decreased in low-G. More important, terminal velocity is lower in thick atmosphere, higher in thin atmosphere, and unlimited in vacuum! So the "effective maximum fall" (200 yards for most objects; 50 yards for people, who have high air resistance) may vary widely. A general formula: terminal velocity is multiplied by .25 in Very Dense atmosphere, .5 in Dense, 1.5 in Thin, 2 in Very Thin. It is unlimited in Trace or No atmosphere.

High Gravity

High gravity makes everything heavier. This increases encumbrance, as described above. For instance, suppose a person weighs 120 lbs. on Earth, and has a load weighing 60 lbs. On Earth, this is simply 60 lbs. of encumbrance. But on Asparia, with a gravitational pull of 1.5 G, that load weighs (1.5 × 60), or 90 lbs. And the person also weighs 50% extra, or 180 lbs. So his total encumbrance is 150 lbs. – 90 lbs. of gear, 60 extra lbs. of his own weight. This means he will move slowly and fatigue rapidly. In very high gravity, your own body weight is enough encumbrance to fatigue you, and mechanical aids can be necessary just to get around. Exoskeletons (p. 50) and contragrav chairs (p. 50) may be common on high-G worlds.

High gravity also affects other stats, as well:

Strength (for jumping, throwing things, etc.): Multiply the distance normally thrown or jumped by the ratio of normal gravity to local gravity. Under 1.2 G, you throw things (or jump) (1/1.2), or .83, times as far.

Dexterity and DX-based skills suffer as well, because everything falls too fast and your muscles are under extra strain. Reduce DX by 1 for each G-Increment *unless* the character has the G-Experience advantage (p. 33). In that case, reduce it by 1 for every *two* increments.

In high gravity, something as minor as a stumble can lead to injury. If someone falls (a likely result of many sorts of failed skill rolls!), treat it as a 2-yard fall *at the local gravity.* Damage can mount quickly. Roll for location of the injury, ignoring torso results and rolling again.

Health is also reduced under high gravity, because the heart has to work harder. Reduce effective HT by 1 for every two full increments. This *does* mean the character has fewer hit points. These "lost" hits are immediately recovered if the traveler gets back to lighter gravity.

Intelligence and IQ-based skills are reduced by 1 for every 2 increments of increased gravity, because of reduced blood flow to the brain and general fatigue. Exoskeletons don't help this (except for some special models that are much more expensive). Lying in a fluid bath (or riding a CG chair – see p. 50) relieves the IQ problem, but you can't do much physical work that way.

Low Gravity

Low gravity makes everything lighter. Encumbrance will decrease as weight drops. Encumbrance may quickly reach zero, since the reduction of a character's body weight counts as *negative weight* for purposes of encumbrance. For instance, take the 120-lb. character described above. On Porter's Rock (.5 G), his 60 lbs. of gear weigh only 30 lbs. And his 120-lb. body weighs only 60 lbs. He has "saved" 60 lbs. of body weight to apply against the 30 lbs. he is carrying. His encumbrance is negative 30 lbs.

Important: Negative encumbrance does *not* mean negative weight! "Encumbrance" is an artificial concept which includes a character's body weight. "Weight" can never be negative. Even a helium balloon has weight.

However, your negative encumbrance *does* give a Move bonus. Each 30 pounds of negative encumbrance give a +1 to Move, up to a +3 bonus. Example: Under .5 G, a 120-lb. character weighs 60 lbs.; if no gear is carried, that 60 lbs. is all negative encumbrance, giving a +2 to Move. *Yes, this is an approximation; we won't be able to reality-check it for a few years. It allows for clumsier walking due to low gravity, and makes the simplifying assumption that heavier people are larger and stronger.*

Whenever taking advantage of this Move bonus, however, a character must make a DX roll (at a penalty for low gravity – see below) to avoid losing his balance in the unfamiliar gravity. If he misses it, he falls down. Moving at normal rates (as though on a world with standard gravity) requires no roll.

Low gravity affects other stats, as well:

Strength for jumping or throwing things: As described above for high gravity. Take the ratio of accustomed gravity to your local gravity. Under .2 G, you jump 5 times as *far.*

Dexterity and DX-based skills are affected in various ways. For most purposes (sword fighting, throwing things), reduce DX by 1 for each increment of gravity *unless* the character has the G-Experience advantage (p. 33). In that case, reduce it by 1 for every *two* increments. For activities like lockpicking that would not be affected by gravity, there is no penalty. And for a few things (a DX roll to catch a falling object, for instance), DX is *increased* by the above amount, because things fall more slowly in low gravity. The GM must decide whether low gravity helps or hurts a given effort.

Intelligence and *Health* are not affected by lower gravity.

Microgravity

Microgravity means any gravitational field of less than .2 G. In microgravity, nothing has significant "weight," but mass remains.

Encumbrance is rarely important in microgravity, unless the PCs are carrying their spaceship. HT is unaffected. (Characters with lowered HT from bad hearts or similar systemic problems may experience an effective increase in HT in near zero-G, at the GM's discretion.) Thrown objects may go a *long* way; calculate their new weight and use the expanded throwing table in the sidebar.

A character's DX in microgravity depends on his Free Fall skill. Whenever a "normal" DX roll would be required, substitute a Free Fall roll instead. When any DX-based skill is attempted, use that skill level or the Free Fall level, whichever is worse.

Any microgravity maneuver except the most simple requires a roll against Free Fall skill, or the maneuver fails in some way. (Simple maneuvers would include pulling yourself hand over hand along ladders, walking with magnetic boots, or using ordinary hand items. Maneuvers requiring a skill roll include firing high-recoil weapons without flying backwards; attempting to throw or catch items; acrobatics, and so on.) Seriousness of the failure depends on how badly the roll is missed. If you are tossing a lifeline to a friend who missed his own Free Fall roll and is now floating off into space, a missed roll simply means the line has missed him. But if your roll is a critical failure, you miscalculate and go floating into the void to join your companion.

GMs can use failed Free Fall rolls to set up situations in which skill and ingenuity will be tested. On the other hand, if the PCs all have high Free Fall skills (15+), GMs should dispense with all but the most critical rolls.

Note that in the microgravity of (for instance) an asteroid with a 10-mile diameter, it is easy to throw things entirely away (escape velocity is only 32 miles per hour), and a strong man could jump into orbit.

Zero Gravity

True zero gravity is found only in space, spaceships, and nonrotating orbital stations. Free-fall situations use the same rules as microgravity, above, with a few additions.

In free fall, things hang unsupported. A single person can move a very heavy object . . . very slowly! And *stopping* something in free fall is just as hard as starting it. If you have something to push against, you could start a ton of steel moving through space in zero G. And if that moving ton of steel traps you against your ship, it will crush you to death . . . very slowly.

In free fall, thrown objects fly in straight lines, forever . . . until they hit something.

Speed in zero-G depends on how hard you can push off from a surface or massive object. You may launch yourself at any speed up to ½ your ST. Launching requires a full turn during which you can do nothing else — unless you can make a Free Fall roll at -3 to skill. If you succeed, you may do something else with any free hand. (But all weapons fire is at -3 — and high-recoil weapons may send you off in the wrong direction — see below.) Once moving, you continue to move at the same rate until you catch or hit something which stops you.

On the turn you hit or catch something, roll against Free Fall skill. If you miss the roll, you take an extra turn to recover. A critical miss means a hard landing; take 1d-2 damage (armor protects from all but 1 hit of this) and bounce back at a rate of 2 hexes/turn, moving until you are stopped. You must make a HT roll or be stunned as well.

You may attempt to slow your movement or change direction by throwing an object or firing a high-recoil weapon (any weapon with a -4 snap shot penalty). Each attempt requires a Free Fall roll. If you succeed, you slow down by 1 hex/turn, or change direction by 60 degrees. If you fail, you will change direction randomly (GM determines in any sadistic manner). A critical failure starts you spinning, and requires a Free Fall-3 roll to right yourself; you may try once per turn.

Movement in zero-G using vehicles, thruster packs, hand thrusters and so on is governed by the rules or skills appropriate for the item. Movement along a bulkhead, hull or other surface in magnetic boots is at standard Move for characters with Vacc Suit skill, and Move-1 for those without the skill.

To use fists or a primitive weapon (such as a sword) in zero G, roll vs. weapons skill or Free Fall (whichever is less) to hit. If you hit, roll vs. Free Fall to avoid being sent floating away by the "equal and opposite reaction" of your strike.

Throwing Things in Microgravity

Multiply the object's Earth weight by the local gravitational field to get its local weight. Read across from this weight to the distance number. Multiply this number by the thrower's ST to get the distance, in yards, that the object can be thrown.

This table differs from the one on p. B80, because objects of incredibly light local weight can still be massive enough to be thrown easily. But it goes all the way out to the top weights, because now *huge* objects get down to the 200-lb. throwable range. Whatever you throw, remember the "equal and opposite reaction" on the thrower.

Local Weight	*Distance*
1 oz.	64.0
2 oz.	32.0
¼ lb.	16.0
½ lb.	8.0
1 lb.	4.0
1½ lbs.	3.0
2 lbs.	2.0
3 lbs.	1.9
4 lbs.	1.5
5 lbs.	1.2
7½ lbs.	1.0
10 lbs.	.8
15 lbs.	.7
20 lbs.	.6
25 lbs.	.5
30 lbs.	.4
40 lbs.	.3
50 lbs.	.25
60 lbs.	.2
80 lbs.	.15
100 lbs.	.1
200 lbs.	.05

Under *any* gravity, the distance you can throw an object straight up is exactly half the distance you can throw it horizontally.

Space Sickness

Anyone entering free fall must roll vs. Free Fall+2. A failed roll means they become *spacesick* — disoriented and nauseated by the constant falling sensation. A spacesick character feels generally ill and has a -2 to all rolls (-5 on a critical failure, plus choking as per drowning, p. B45). He gets one roll (HT or Free Fall, whichever is better) each 24 hours to recover. A critical failure on this roll makes the sickness worse, as described above.

Some people are especially prone to this disorder. This is the *Space Sickness* disadvantage, p. 34. A naturally spacesick person is spacesick all the time he is in free fall; he doesn't roll to recover. All his rolls are at the -2 level even if the initial HT roll was a success. He chokes and has the -5 to all rolls on *any* failure of the initial HT roll.

Corrosive Atmospheres and Equipment Leaks

Corrosive atmospheres will eventually eat through even the best protection, leaving the wearer exposed to deadly gases.

The degree of corrosiveness governs the intervals at which the GM checks a suit or vehicle for failure. In a mildly corrosive atmosphere (high-oxygen, nitrides or ammonia, for instance), this may occur once per week. In an extremely corrosive one (such as fluorine), you might check every hour. The presence of liquid water makes corrosive atmospheres even more dangerous, since acids can form.

At each interval, roll 3 dice. Subtract 3 or 4 from the result for a heavily armored vehicle, 2 for a moderately armored one, 1 for a light vehicle or heavy suit. Other modifiers can be added; for instance, vehicles in bad repair are much likelier to leak. And an immediate check is required whenever a vehicle is damaged or badly shaken up.

A result of 14-16 means a slow leak. A 17 is a fast leak. An 18 indicates explosive "blowout." Specific results of each leak depend on the type of gas; see main text. Even a trace of fluorine, for instance, will send its victims to the hospital in minutes.

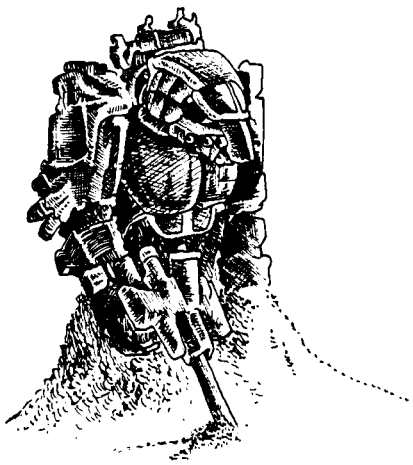
In a superdense atmosphere, any uncorrected leak will blow out at the next check interval. Otherwise, just add 3 to the roll for a slow leak, or 6 for a fast one.

If the outside pressure is Earth-normal or less, vehicle cabin pressure can be kept above outside pressure, so outside air can't leak in. But this is impossible with denser atmospheres!

Some leaks can be detected by eye or nose; some can be detected by vehicle leak-detection gear or pressure sensors; and some just come as a fatal surprise to the occupants.

Patching a vacc suit leak requires 3 seconds and a Vacc Suit roll (all vacc suits have an exterior patch kit, easy to reach). If the first attempt fails, repeated attempts are at a cumulative -1 each time.

Patching a vehicle requires a Mechanic roll, modified as the GM sees fit.



Different Atmospheres

Atmosphere Types

The different types of atmosphere are described on p. 109. Here, we'll concern ourselves with their effects on human adventurers. Note that the details of a poisonous atmosphere usually don't matter to someone without breathing gear. They die. Only in case of a very minor suit leak or malfunction will exposure to a really poisonous atmosphere be survivable.

Hydrogen: Non-poisonous, but quickly diffuses through plastic or rubber, and is very explosive in the presence of oxygen. Definitely a hazard for careless space-dogs.

Oxygen-Nitrogen: This is the only atmosphere breathable by humans. Even if the gas mixture is right, pressure differences (see below) may make it less than ideal. But if the atmosphere happens to be superrich in oxygen, IQ and ST may be slightly increased — or, at least, penalties caused by gravity may be ignored.

Polluted: This is an oxy-nitro atmosphere with contaminants. The effect of the contaminants may range from merely irritating (wear filter masks or take 1 point of damage each day) to deadly (treat as poison gas of GM's choice). Note that not all types of pollution are immediately obvious to the explorer. If pollution is not detected with sensors (see p. 47), a Physician or (if a library is available) Research roll may be attempted *once ill effects are noticed,* to determine the problem and suggest a solution. If the first roll fails, repeat attempts can be made daily, at a cumulative -1 per attempt. Some forms of contamination are subtle indeed, and there will be severe penalties to the rolls; these worlds can be death traps. Metal dust; microbes; allergens; complex biological poisons released in trace amounts by plants . . . scientifically-minded GMs may come up with a wide variety of atmospheric hazards.

Carbon Oxides: CO_2 is unbreathable, and poisonous in large concentrations. A 15% concentration requires a HT roll every minute to stay conscious; the roll is at -1 for every added percent of CO_2. At 25%, roll vs. HT hourly, and lose 1 HT for each failed roll.

Carbon monoxide may also be present; it is deadly. Its symptoms are headache and dizziness in tiny amounts, unconsciousness and death at higher ones. At concentrations over 1%, roll hourly vs. HT; each failed roll costs 1 IQ, HT, and DX. At concentrations over 2%, roll every ten minutes, at half the time interval *and* -2 for each % over 2%. If a victim is gotten away from the monoxide, he'll recover. If not, he will die with a cherry-red face.

Nitrogen: Unbreathable but otherwise inert and harmless, except at *very* high pressures, when it causes nitrogen narcosis. The effect is that of happy drunkenness: roll vs. IQ every 30 seconds to avoid. The sufferer will not realize he has become irrational, but any observer can easily tell!

Reducing Atmosphere: Harmless but unbreathable. Includes hydrogen (see above) and methane, which can be recognized by a sweetish, oily odor.

Ammonia: Corrosive and poisonous, but easily detected by its choking odor. Exposure to ammonia requires a HT roll; a failed roll costs one hit point. Roll every minute for small concentrations, oftener for large ones. Each failed roll also reduces the victim's Vision roll by 1, as his eyes burn and water. After 2 hits are lost, convulsive coughing begins (-3 to DX until clean air is reached). Severe exposure requires the survivors to roll HT-2 or be blinded.

Chlorine: Corrosive and deadly poisonous. Also easily recognized by odor. A few breaths of 1% chlorine will kill. Even .005% is dangerous: roll as for ammonia, but all rolls are at HT-2, and the blinding roll is against HT-4. Another roll vs. HT-4 is required to avoid lung damage (1d of *permanent* HT loss!).

Fluorine: As for chlorine, but worse; all rolls are at another -2.

High-Oxygen: Oxygen in concentrations higher than Earth-normal is corrosive. An oxygen leak will make its victims feel bouncy and aggressive. At this level there is no danger except overconfidence (all IQ rolls at -1). When eyes and nose start to burn, the level is becoming dangerous. Roll as for ammonia, but at +2 to all rolls, and with no chance of blinding. However, too much oxygen also greatly increases fire hazards.

Nitrides: Corrosive compounds with a distinctive odor. Treat as for ammonia.

Sulfur Compounds: Compounds with *strong* odors. Usually a sulfur leak will be noticed long before it is dangerous. Otherwise, treat hydrogen sulfide as ammonia (but flammable), sulfur trioxide as chlorine, sulfur dioxide as ammonia.

Pressure Differences

Different levels of atmospheric pressure are described on p. 109. Atmospheric pressure has the following effects:

Very Thin or Trace atmospheres might as well be vacuum. Humans can't breathe them, even if oxygen is present.

Thin atmospheres provide less oxygen. Those breathing it will move slower and fatigue more quickly; increase all fatigue penalties by 1. If a respirator (p. 49) is worn, this penalty does not apply. Vision rolls are at -1 (or more) unless the eyes are protected from evaporation and supplied oxygen by goggles.

Dense atmospheres can be breathed with some discomfort (-1 to all HT rolls). Or a reducing respirator may be worn.

Very dense atmospheres require a reducing respirator to breathe.

Superdense: Any superdense atmosphere, regardless of composition, requires armored suits. If some of the constituents are poisonous, this presents a separate problem.

Vacuum

The good Lord must like vacuum . . . so say spacers. After all, He made an awful lot of it. Vacuum in itself is not deadly (see sidebar), so ship crewmen may survive briefly without air. They may even deliberately enter vacuum without protection or air *if they have to.*

You can't hold your breath in vacuum, and you might rupture your lungs if you try. The only safe way to enter vacuum is to exhale and leave your mouth open. You can then operate on the oxygen in your blood for (HT) turns if active, or (HT×4) if moving slowly, or (HT×10) turns if passively waiting. Double these times if you hyperventilate first; quadruple them if you used pure oxygen. Halve these times if you were caught by surprise and didn't even have time for one deep breath.

Once out of breath, one Fatigue is lost per turn; when ST reaches 0, the victim falls unconscious. Four minutes later, he dies. There is a chance of brain damage (permanent -1 to IQ) if the victim is saved after more than two minutes without air; roll vs. HT to avoid this.

Rapid Decompression

If a ship loses a lot of air to a meteor strike, or if a respirator suddenly goes bad, a spacer may find himself trying to adapt to rapidly falling pressure. Popping ears are a sure sign of a pressure change (IQ+4 to notice for anyone with space crew experience, IQ for anyone who has gotten even a basic passenger briefing). If your ears keep popping, pressure is still going down. If the situation is not stabilized quickly, the spacer must get to a pressure suit or emergency ball, or be in vacuum.

Pressure loss is a terrifying thing on board ship. The GM may require all aboard to make IQ rolls to avoid mental stunning; again, experienced crew should get a +4.

Extreme Heat

Temperatures that are merely uncomfortable can be dealt with as Earthmen always have: stay in the shade and don't move around too much. On planets where the climate is Hot, increase fatigue by 1 whenever it is assessed at all. If the climate is Very Hot, increase fatigue by 2 if it is assessed.

At TL8, vehicles can traverse deserts hot enough to melt lead. At TL9, permanent colonies can exist in such places. This is not likely to be needed except in very unusual circumstances (e.g., secret outposts, mines for very rare substances). In general, the environment within such a colony would be very comfortable but . . . if something goes wrong, everyone will die quickly. For suits and vehicles traveling on a hot surface, use the leak/integrity rules (see sidebar).

Extreme Cold

At TL7+, insulation is good enough to allow vehicles and colonies to withstand any degree of cold, even that of an iceball world in interstellar space, as long as there is a power plant to provide heat. Again, unless something goes wrong, the atmosphere in such a colony would be quite comfortable. But a malfunction wouldn't doom the inhabitants immediately; the temperature might drop gradually, giving time to make repairs or call for help. See *Freezing,* p. B130.

Explosive Decompression

"Blowout," or *explosive decompression,* happens when an area suddenly goes from normal pressure to little or none. This could occur, for instance, when a ship loses all its air to a meteor strike, or when someone is tossed out the airlock.

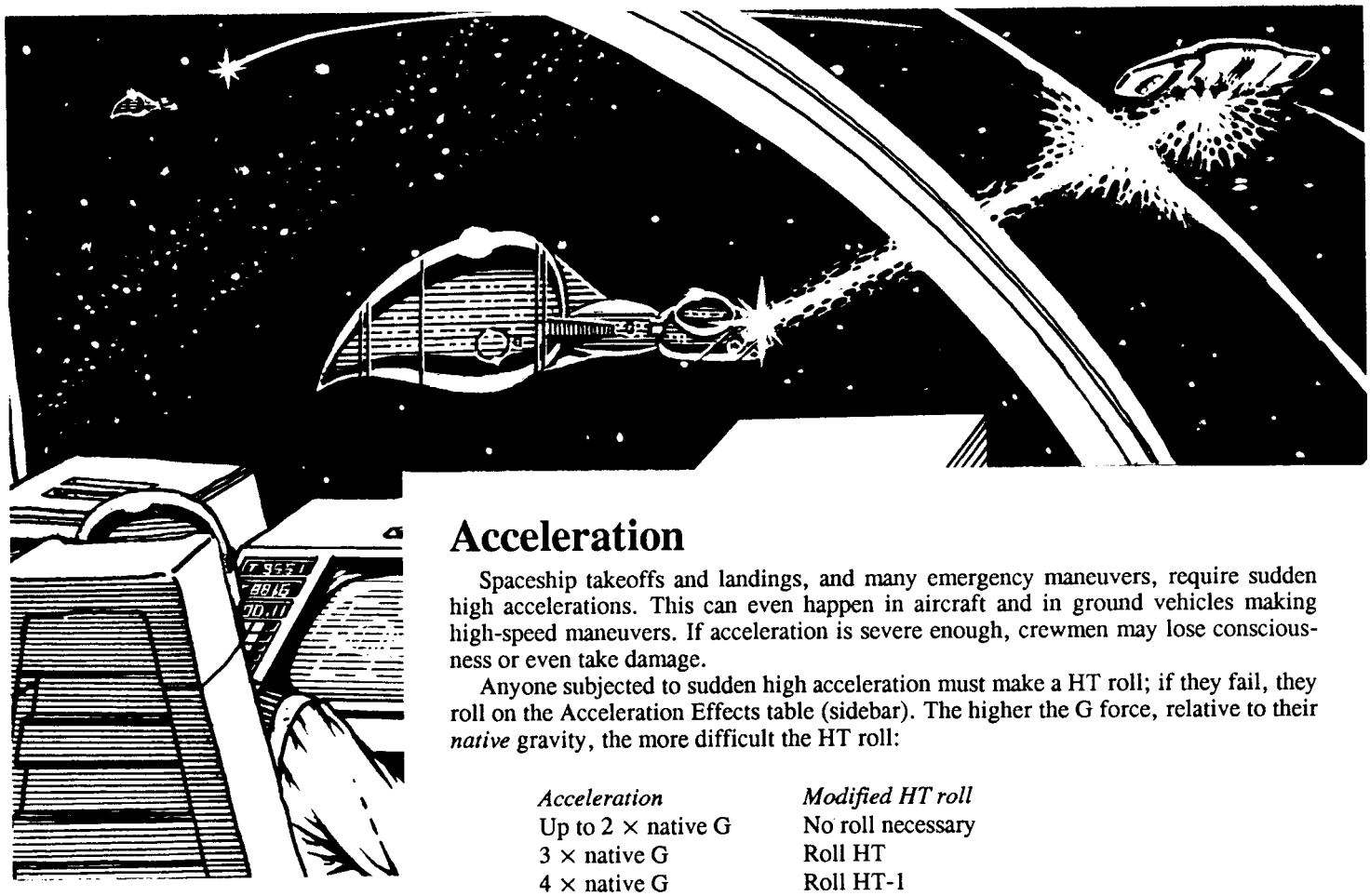
Fifty years of pulp fiction to the contrary, explosive decompression does not turn its victims inside-out and quick-freeze them. What *does* happen is that the body fluids begin to boil away. Small blood vessels rupture, and the mucous membranes dry out. The eardrums pop violently. The victim takes 1d of damage, but *does not die* until he runs out of breath, as described in the main text. However, if rescued, he must make separate rolls, as follows, or suffer *permanent* ill effects as follows:

HT+2 for each eye, to avoid blindness;

HT to avoid -1 DX due to "bends" from boiling blood;

HT-1 to avoid permanent Hard of Hearing disadvantage.

If the victim is not rescued, his body's liquid will boil off to space within a few hours. The remaining fragile, powdery husk will weigh only a few pounds. Memories and personality cannot be recovered from the dehydrated brain, though DNA (for a clone) could be saved if a sample were taken within a few minutes of death and kept frozen.



Acceleration

Spaceship takeoffs and landings, and many emergency maneuvers, require sudden high accelerations. This can even happen in aircraft and in ground vehicles making high-speed maneuvers. If acceleration is severe enough, crewmen may lose consciousness or even take damage.

Anyone subjected to sudden high acceleration must make a HT roll; if they fail, they roll on the Acceleration Effects table (sidebar). The higher the G force, relative to their *native* gravity, the more difficult the HT roll:

Acceleration	*Modified HT roll*
Up to 2 × native G	No roll necessary
3 × native G	Roll HT
4 × native G	Roll HT-1
5 × native G	Roll HT-2
6 × native G	Roll HT-4
7 × native G	Roll HT-6
8 × native G	Roll HT-8

And so on . . . another -2 HT for each native G.

Any maneuver is a new acceleration; roll again. If the initial acceleration is survived without ill effect, each crewman must roll *hourly* on the table above . . . but these hourly rolls are at an effective acceleration 3 Gs less. A healthy person can take up to 5 Gs for a long time, lying down, in great discomfort but little danger.

Anyone in a station especially designed to protect acceleration has a higher effective HT. A normal bunk gives a +1 to HT; a hammock or padded bunk gives +2; a padded control chair +3, and a fluid acceleration bath gives +4. But anyone trying to stand up rolls at a -2, and takes damage for a 2-yard fall at the appropriate gravity if the roll is failed!

Remember: If a ship is accelerating, the effects will only be felt while the drive is on; once it ceases, regardless of the ship's speed, there are no acceleration effects.

Gravity Compensators

If a ship has gravitic generators that act to compensate for acceleration, simply ignore G forces up to the level they can compensate. (Example: If a vessel accelerates at 7 Gs and its compensator can handle up to 4 Gs, treat it as 3 Gs when determining acceleration effects.)

Acceleration Effects

When a character fails his roll to deal with acceleration, roll 2 dice and add the G-force involved to the result. Since no roll is needed for acceleration of less than 3 Gs, the minimum possible roll is 5.

5 — Unconscious 2d turns.
6 — Unconscious 3d turns.
7 — Unconscious 4d turns.
8 — Unconscious 6d turns.
9 — Unconscious 10d turns.

On all the results below, the victim is unconscious for 10d turns *and* suffers damage:

10, 11 — 1d-3 damage.
12, 13 — 1d-2 damage.
14, 15 — 1d-1 damage.
16 — 1d damage.
17 — 1d+1 damage.
18 or more: 1d+2 damage.

Assess additional damage (1d + the G-force) if a crewman is caught wholly by surprise and thrown to the floor, the deck, against the side of a vehicle, etc.

Radiation

Starfarers may be exposed to radiation due to hostile environments (thorium mines, planets too close to a hot star); accidents (solar flares, nuclear engine failures); or acts of war. However, radiation detectors are simple and cheap even at TL6. Anyone who expects to be exposed to radiation can prepare in advance and thus know exactly how much he took.

Radiation exposure is measured in *rads*. The more rads you take, the more likely you are to suffer ill effect. Each time a large radiation dose is taken, roll vs. HT on the table in the sidebar. For cumulative exposure, roll every 24 hours; e.g., at 5 rads/hr., roll each day at 120 rads.

Record the total amount of radiation and the date. A second exposure within 10 days is considered to be the sum of the two exposures. A second exposure within 30 days is considered to be an exposure equal to the new exposure plus half the original one. And 10% of any exposure is retained permanently; thus, if you take 100 rads of radiation in the year 2300, a second 100-rad dose in 2320 would be considered as a 110-rad dose for purposes of the HT roll.

A quick dose of radiation (from a bomb, for instance) is simply measured in rads. Background radiation (from a solar flare or fallout, for instance) is measured in rads per hour. If the background radiation is 5 rads/hour and you stay out for 6 hours, you accumulate a 30-rad dose.

Some typical radiation doses:

1-megaton fission air or space burst at 2,000 yards: 6,600 rads

Fallout on ground 1 hr. after 1-megaton fission ground burst: 300 rads/hr after 1 hour, 130 rads/hour after 2 hours, 39 rads/hour after 5 hours, 7 rads/hour after 1 day.

Radiation from a solar flare or fission plant accident: 1,000 rads/hour or more.

Fallout

Small radioactive particles, such as those produced by a groundburst explosion, produce fallout. NBC suits don't stop the radiation from fallout, but they keep the wearer from *ingesting* fallout. If you swallow or breathe fallout particles, you will get a continuing radiation dose from *inside*. Intensity of the dose, and time for the fallout particles to decay to harmlessness, depends entirely on the situation. But it's always unhealthy!

Protection from Radiation

Any material between you and the radiation source will help cut down on radiation. The thicker and denser the material, the better the protection factor (PF). A PF of 100 simply means that only 1/100 of the gamma radiation will get through the shield. (Radiation types other than gamma are easy to shield, and may be ignored if you have enough shielding to affect gamma radiation at all. The exception is cosmic radiation and solar flares — see below.)

A foot of earth has a PF of 8. (Thus, 2 feet of earth gives a PF of 8 × 8, or 64, and so on.) A foot of concrete has a PF of 18. Ship hulls have PF 2 if unarmored. A ship with armor or shields of DF 1 has a PF of 10. Each added DF of armor or shields multiplies PF by 10.

Vacc suits and exosuits can have a thin layer of metal which gives some PF against gamma rays (see p. 49). But such suits should *not* be worn for solar flare protection, because flare radiation sets off secondary radiation in metal, and rad damage is *multiplied* by the PF.

Radiation Treatment

TL6 offers no real radiation treatment. At TL7, drugs are available that can halve your effective rad dosage if a dose ($500) is taken 1 to 3 days in advance. Also at TL7, *chelating* drugs are available to get radioactive fallout out of your system; $500, halving damage after a week and eliminating the fallout entirely after two weeks. This has no effect on radiation already absorbed!

At TL8, advanced chelating drugs ($500) encapsulate and remove fallout immediately. Braintape technology can save a victim; anyone who survives the initial radiation exposure can still have their brain read, unless the dose was 5,000 rads or better. Each increase in TL raises this limit by 1,000 (higher doses scramble nerve tissue beyond that TL's ability to read).

At TL9, Antirad drug (p. 68) is available.

At TL10, expensive treatments ($3,000) are available to reduce your lifetime rad history by 10% per treatment. Each treatment takes about 3 days; they cannot be repeated more often than once per month.

At TL11, these antirad treatments reduce lifetime history by 25% per treatment.

Radiation Effects

Roll once for each exposure. Modify later exposures upward if earlier exposures have retained effects. Don't make HT rolls to recover from an earlier dosage if you take another dose over 50 rads. This table makes no attempt to deal with very-long-term or genetic effects of radiation!!

Under 100 rads: Roll vs. HT. Success means no visible effects. Failure means -1 HT for one week.

100-199 rads: Roll vs. HT. Success means -2 HT for one week. Failure means that, and nausea and vomiting within 24 hours; lose 1d each from ST, DX, and IQ. Then make a HT roll each day, regaining 1 ST, DX and IQ on each successful roll. A critical failure on the first roll indicates 2d HT loss, recovered normally, plus the normal failure results.

200-399 rads. Roll vs. HT. A critical failure indicates death within a week. Success gives the same result as failure for a 200-rad dose, above. Failure means the same result; in addition, in 1 to 3 weeks, hair loss occurs, and HT is lost again at 1 per day. A HT roll is made daily; on a critical success, the HT loss stops and normal recovery can occur; hair regrows. If no critical success is ever rolled, HT loss continues until the patient dies. Any survivor of this dose has HT reduced by 1 permanently.

400-799 rads. Exactly as above, but all rolls are at (HT-1), and any survivor has HT reduced by 2 permanently.

800-1,599 rads. Exactly as above, but all rolls are at (HT-3), and any survivor has HT reduced by 3 permanently.

1,600-4,999 rads. Exactly as above, but all rolls are at (HT-5). Very few patients survive, and those that do have HT reduced by 4 permanently.

5,000+ rads. Immediate shock. Roll vs. HT to stay conscious; lose 2 HT, and roll again to stay conscious, once per hour. Death will follow quickly after unconsciousness.

Radiation Detectors

Film badge: Turns dark in the presence of radiation; shows doses from .1 rad to 200+. Should be checked and changed often. $100 per box of 100. TL6 or above.

Radiation alarm: Triggered by a preset radiation level, adjustable from .1 to 2 rads/hour. Sets off a loud alarm. Does not tell the actual radiation level. $100. TL6 or above. At TL7, sensitive down to .01 rads/hour.

Wristwatch rad counter: Has a display to indicate radiation level, in rads per hour. $500, or $550 with built-in alarm as above. TL7 or above (only $100 at TL8 and up). May also be built into a helmet visor, vehicle dashboard, etc.

8 STARSHIPS

This is not a ship design system as much as it is a *meta-system* — that is, rules to let you, the GM, easily create a ship design system customized for your own campaign. Base this on the technological decisions you have made for your universe (see Chapter 2). These are exactly the decisions that a science fiction writer makes when setting the background for a story. This will let you tie your own decisions about technology into a simple, coherent ship design system.

Every single cost, size and mass in this section is a suggestion. It is up to the GM to choose the items that will be allowed, and draw up a list of components for his campaign. A sample TL10 design system, with the reasoning behind it, is on p. 89.

The costs and efficiencies of components can be varied, to change campaign balance or to provide interesting distinctions between worlds. For instance, the warpdrives made and sold on Salusia may be 10% larger and more massive than standard ones, but 20% faster . . . and repairable only by Salusian engineers.

Hull

The hull is the frame of the ship. A basic hull is more than a shell. It comes with decks, cables, metal skin (but not armor), stress bracing, and so on.

Hulls vary infinitely in shape; the important thing is the size. A hull's size is expressed in cy (cubic yards). Hull size determines how much can be packed into it; how much the bare hull masses; and price. Some general hull sizes:

Lifeboat: 5-200 cy.
Fighter: 5-500 cy.
Scout: 50-500 cy.
Corvette: 1,000-3,000 cy.
Freighter: 200-400,000 cy.
Colony ship: 30,000+ cy.
Destroyer: 15,000-20,000 cy.
Cruiser: 50,000-75,000 cy.
Battleship: 100,000-150,000 cy.
Dreadnaught: 200,000-300,000 cy.
Orbital fort: 100,000+ cy.

The higher the TL, the more choices the shipbuilder has, trading off between cost and mass. To use the table below, find the appropriate tech level on the left. The rows represent cost per cubic yard of ship size (hull volume) at each mass. For example, at TL10, the best hull material, costing $2,000 per cubic yard, masses .001 ton per cubic yard. But a hull ten times as massive (.01 per cy) costs only $200 per cy.

	$/cubic yard				
TL	*$2,000*	*$1,000*	*$500*	*$200*	*$100*
7	.01	—	—	—	—
8	.005	.01	—	—	—
9	.002	.005	.01	—	—
10	.001	.002	.005	.01	—
11	.0005	.001	.002	.005	.01
12	.0002	.0005	.001	.002	.005
13+	.0001	.0002	.0005	.001	.002

Armor

Any ship can add armor to the hull. The effect of armor is to reduce damage taken in battle; on the scale of the combat system which follows, there is no "passive defense" effect. Armor adds mass, but no volume. The table below is organized the same way as the hull table, above. The prices are per cy of ship armored, and the figures on the table are *added mass* per cy of ship armored.

At high TLs, shipbuilders can choose from several different sorts of armor, trading higher cost for lower mass. If a hull is unarmored, its Defense Factor (DF) starts at 0. If a ship's *final* DF, after modifications for stealth and hull size, is 0 or less, treat it as having a DF of .25. See p. 93.

The cost and mass given in the table below, multiplied by ship size in cy, will give the ship a defense factor of 1. Double armor cost and mass for a defense of 2, quadruple for a defense of 3, multiply by 8 for a defense of 4, and so on.

Larger ships have proportionately less surface area for their volume. For ships of 100+ cy, total armor cost and mass is only 70% of that shown. For ships of 1,000+ cy, 50%. For ships over 10,000 cy, 35%. For ships of 100,000+ cy, 25%.

Ship Statistics

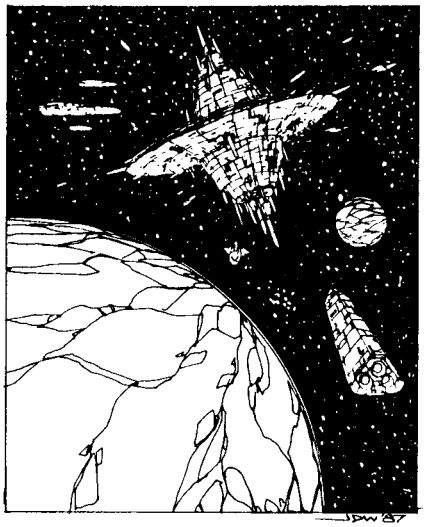
Prices given here assume that the ship is built from standard plans (see sidebar, p. 80). Used ships are cheaper; custom jobs cost more.

Ship Size is given in cubic yards, abbreviated "cy." Sometimes a spaceman will refer to a ship as a "200-tonner," when he really means it has a 200-cubic-yard hull. This is a holdover from the days of ocean-going ships, which measured size in terms of the weight of the water the ship displaced.

Component Volume is given in cubic yards, abbreviated cy. One cubic yard is 27 cubic feet, or (approximately) a space one yard-wide hex across by one yard high.

Component Mass is given in tons. The mass of an item is its weight at 1 G. If an item's mass is expressed in pounds, it is so trivial that it may be ignored when installed on a ship — but it could still be important if a person wanted to pick it up, or if many were loaded as cargo. GMs shouldn't let this shortcut be abused.

Ship Mass is the total weight of the ship in 1 G. It is expressed in tons. For most drives, mass governs ship speed (or whether the drive will work at all). *Rated mass* of a military vessel or passenger ship assumes a full load of fuel. For a cargo vessel, *light mass* assumes a full load of fuel but no cargo, *rated cargo mass* is the heaviest cargo the ship is supposed to carry, and *loaded mass* is the sum of light mass and rated cargo mass . . . that is, the maximum mass the ship should ever have.



	$/cubic yard				
TL	*$1,000*	*$750*	*$500*	*$250*	*$100*
7	.2	—	—	—	—
8	.1	.2	—	—	—
9	.05	.1	.2	—	—
10	.02	.05	.1	.2	—
11	.01	.02	.05	.1	.2
12	.005	.01	.02	.05	.1
13+	.002	.005	.01	.02	.05

Force Fields

At TL11 and above, force fields may become available. A force field gives the effect of armor . . . while the power is on. The force field generator has cost, mass, volume, and power consumption, just like other components. Size of the generator required depends on size of the ship.

Prices below are for TL11. At TL12, halve cost, mass, and volume. At TL13, divide cost, mass, and volume by 5. At TL14, divide them by 10. At TL 15, divide by 20.

As for armor, these figures are for a field generator that will give a defense factor of 1. Double cost, mass, and volume for a factor of 2, quadruple for a factor of 3, and so on, as for armor. (Obviously, small ships cannot carry heavy force fields!) If a ship has both armor and a force field, add the defense factors together.

Force fields also defend against all kinds of radiation. A DF 1 force field has a protection factor (PF) of 10 against radiation. A DF 2 field has a PF of 100, and so on.

Ship size protected	*Cost*	*Mass*	*Volume*	*Energy*
Up to 10 cy	20,000	2	1	2
Up to 100 cy	40,000	4	2	4
Up to 1,000 cy	100,000	10	5	10
Up to 10,000 cy	200,000	20	10	20
Up to 100,000 cy	400,000	40	20	40
Up to 1,000,000 cy	800,000	80	40	80

Streamlining

Streamlining is only relevant if the vessel is to enter atmosphere (either to land, or to refuel at a gas giant). And a sturdy enough ship, or one with contragravity, can perform even these missions without streamlining. See *Hull Integrity*, sidebar, p. 94.

Streamlining costs extra, and adds mass. Ordinary streamlining (an aerodynamic shape) adds 50% of hull cost and 10% of hull mass. Winged streamlining (an actual lifting body, and/or a winged ship) adds 100% of hull cost and 25% of hull mass.

A ship must have winged streamlining (or contragravity) to pilot well in atmosphere. Piloting rolls for ordinary streamlining are at -2. For ships with no streamlining, Piloting rolls in atmosphere are at -6. Add 4 to these rolls if the ship has contragravity.

Compartmentalization

Warships, prospectors, and so on can be built with extra compartmentalization. This means that more interior walls are pressure-tight, and there are more pressure doors.

Standard compartmentalization (no extra cost) means that most walls and doors are DR 6, HT 20, and pressure walls and doors, where encountered, are DR 12, HT 40.

Heavy compartmentalization (+50% to base hull cost and mass) means that most walls and doors are DR 8, HT 30. Pressure walls and doors are more common and are DR 16, HT 50.

Total compartmentalization (+100% to base hull cost and mass) means that every door is a pressure door unless the designer specifies otherwise. All walls and doors are DR 16, HT 50.

Stress Rating

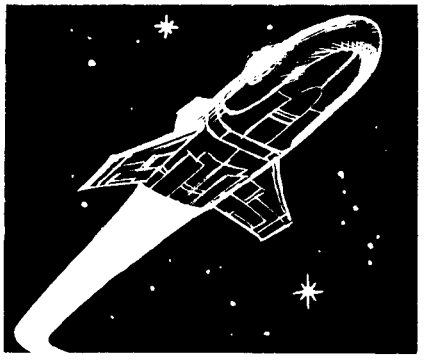
The stress rating of a hull refers to the amount of weight (not mass) that it can safely carry. Under 1 G, weight and mass are the same. A hull that will never land, or even accelerate at more than a fraction of a G, can safely have a very low stress rating. A ship that accelerates at 2 G (or lands on a 2-G planet) will need a stress rating equal to at least twice its mass, or it may be in trouble.

A standard hull is assumed to have a stress rating equal to its volume: a 100-cy hull has a stress rating of 100 tons. This is usually ample for a ship that will land under 1 G, and far more than a non-landing ship will need. To change a hull's stress rating, add (or

Ship Design for the Player

After the GM creates his list of available equipment, players use this list to build their ships. It is *not* recommended that GMs allow players to purchase every single sort of gadget and drive available here. The GM sets the prevailing TL in his campaign. But, for instance, a creative GM might decide that his campaign is mostly TL9, except that contragravity (TL12) is available. It is possible to have components from more than one TL installed on the same ship. Perhaps the ship has been remodeled, adding some modern gear to an older ship. Or a ship may contain new or even secret technology.

Intended Mission: A ship's intended mission is the purpose for which it is created. You never have to use a ship for its designed purpose — sometimes a cargo ship, slightly modified, makes a great pirate corsair. But you should have a clear idea of the ship's purpose before you start choosing components!



Ship Construction Checklist

To construct a spacecraft, follow these steps:

1. Decide on the type of ship you want.
2. Choose hull size, material, armor, compartmentalization and stress rating.
3. Install power plant, maneuver drive and/or stardrives. Allow for fuel or reaction mass if necessary.
4. Allot quarters for the crew and passengers, and buy life support.
5. Select weapons and defensive equipment.
6. Add sensors, computers, and any other instrumentation.
7. Install any gravity or contragravity devices, and other accessories, such as airlocks. Allocate space for cargo and for auxiliary vehicles, if any will be carried.
8. Determine final mass, volume, cost and power usage of all components. Check to make sure that the power plant provides enough power. Keep in mind that ships do not use weapons in hyperdrive, so a hypership can allocate that power elsewhere when it is in normal space.
9. Determine the ship's STL acceleration if it has maneuver engines.

Buying a Ship

Purchase of a starship is likely to be beyond the means of anyone but the Filthy Rich. However, several PCs may pool their wealth for a down payment on a ship. Note also that PCs who will have no homes but their ships may use all their wealth to buy that ship — see p. 38.

Buying it Used

In a culture where star travel is common, used ships will be common. As with used cars in the 20th century, let the buyer beware! Most used ship salesmen have high skills in Acting and Fast-Talk. A roll on Shipbuilding (Starships), or an appropriate Engineering or Mechanics roll, may be required to detect hidden flaws. Then the buyer must decide whether to walk away, or bargain the price down.

Availability of used ships is entirely up to the GM. An apparent bargain on a used ship is a great way to start an adventure.

Typically, used ship prices might be around 90% of new for a modern ship in good shape; 50-80% for a battered but spaceworthy ship of modern design; 30-40% for an obsolete or nonstandard ship in good shape; and 10-20% for an obsolete or nonstandard ship with no guarantees.

Outdated military ships are often available at surprisingly low prices; many navies consider a ship "outdated" as soon as somebody can build a better one. They are more likely to have hidden damage. In some jurisdictions, military ships must be disarmed before they are sold. In others, they come with weapons intact.

And some used ships were *stolen* . . .

Standard Designs

Most starships are built to order from existing hull plans. If your requirements are neither outlandish nor locally illegal, you can probably find plans for an appropriate ship (a set of plans would be about a 1-gigabyte database, $1,000 and up). Or the shipyard may offer use of *their* standard plans, at a discount. It is up to the GM whether to provide standard plans. The more common space travel is in your universe, the greater will be the variety of plans available.

The players may specify reasonable variations from the plans on armor, compartmentalization, life support, and other interior fittings. Changes in hull size, drives or power plant should add to the cost, at the GM's discretion.

Usual time to build a ship at a Class V port is four weeks for every 1,000 cubic yards, with a minimum of 6 months. Doubling the price will halve the time. Tripling the price will cut the time to ⅓. Four times the price, and a reaction roll of Very Good or better (using influence or bribery, as necessary) will cut the time to the actual minimum: one week per 1,000 cy.

Continued on next page . . .

subtract) 1% of cost and mass for each 2% by which the rating is increased (or decreased). So doubling the stress rating adds 50% to cost and mass.

If a hull carries weight exceeding its stress rating, it may fail. Make a Hull Integrity roll (see sidebar, p. 94) each time a hull undergoes acceleration or gravity which makes its weight exceed its rated stress, and once every hour if the hull accelerates in a straight line (or just sits under gravity) exceeding its rated stress. Subtract 1 from effective Hull Integrity for every 10% by which actual weight exceeds the stress limit.

Power Plant

Any ship needs a power source. Power is measured in *megawatts* (MW) — as a comparison, the Niagara Falls power plant produces some 500 MW. We will assume that electrical power will continue to be used, though the method of production will vary.

Several power sources are given below. The power output takes into account the power that must be diverted to keep the power plant, itself, under control. Note that fission, fusion and antimatter power become useful for ships one TL *after* they are practical for planetary installations.

When designing a large ship, it is a good idea to provide some extra power capacity. It may also be wise to have two or more separate power plants, even though this is more expensive, in case one is lost to accident or combat.

Chemical Fuel (TL7)

This isn't a power plant per se; chemical rockets are Slow reaction drives (see p. 82) that require *lots* of fuel but no separate power source. Below TL9, chemical fuel is the only way for a ship to take off from Earth gravity — see sidebar, p. 83. A spaceship whose only propulsion is chemical fuel will need a small power source (fuel cells or solar panels) to run life support and other ship's functions.

Fuel Cells (TL7)

Produces electricity chemically, using liquid oxygen and hydrogen as fuel, and producing water. A standard TL7 fuel cell masses 5 tons, takes up 1 cubic yard, and costs $50,000. It will provide 1 MW.

Fuel: To operate for a month, a 1-MW cell requires 300 tons of fuel: 33 tons of hydrogen (14 cy per ton) and 267 tons of oxygen (.88 cy per ton). Typical cost for orbital refueling: $100 per ton. These gases can be produced by worlds as primitive as TL6!

A *fuel processor* for fuel cells is simply an electrolysis device. Power from another source (such as solar panels) is used to break down water into liquid H_2 and O_2. There is a power loss of 10% in the cycle; to process enough fuel for 9 MW for one month's travel would require use of 10 MW for one month (or 20 MW for two weeks, or 1 MW for 10 months, or whatever). The equipment involved is trivial and is assumed to be part of every fuel cell.

To create fuel, the ship must find a source of water: an Earthlike planet, for instance, or an ice asteroid. Alternatively, a ship can store the water its fuel cells produce. This requires at least 10% extra tank space, but no additional mass.

Capacitors (TL7)

Stores electricity and releases it in a single burst. Known as early as TL5; powerful enough for starship use at TL7. Capacitors are handy for stardrives that require extra power to initiate a jump, enter hyperspace and so on. For game purposes, assume that the burst lasts a single second.

Capacitors are rated in MW-h (megawatt-hours) of *energy*. A 1 MW-h capacitor provides the same power as a 3,600-MW power plant — for *one second*. If a capacitor is rated at 20 MW-h, it can be fully recharged by 20 hours of output from a 1-MW plant, 2 hours from a 10-MW plant, one second (!) from a 72,000-MW plant, and so on. A TL7 capacitor masses 5 tons, takes up 1 cy and costs $20,000 for every 1 MW-h it holds.

Damage to capacitors can release all the stored energy at once, with explosive results.

Solar Panels (TL7)

Solar cells produce power from starlight. A "standard" solar cell array produces 1 MW in vacuum at light levels equal to those at 1 AU from Sol. Of course, this varies with brightness and distance to the star; doubling the distance cuts output by a factor of 4, so solar power is almost useless to ships at the edge of a system. (On the other hand, a standard array at 40 AU — the orbit of Pluto — from a B-class supergiant star produces roughly 350 MW!)

A standard panel masses 80 tons and takes up 80 cubic yards when stored; it takes about 30 minutes to deploy as an 8,000-square-yard array (6 hours if it must be done with manpower rather than automatically). Cost is $200,000.

Solar cells are very fragile, and would be destroyed almost instantly during combat. They will not survive acceleration greater than .1 G. Therefore, they are rarely deployed while a ship is in combat or under acceleration. Space dust and debris would also damage the panels if they were moving very rapidly.

Fuel Cells (TL8+)

A TL8 fuel cell masses .5 tons, takes .1 cy, and costs $50,000. It burns 150 tons of H_2/O_2 per month, to provide 1 MW. Beyond TL8, cost is halved.

Capacitors (TL8+)

A TL8 capacitor masses .5 tons, takes .1 cy, and $20,000 per MW-h. Above TL8, cost is halved, and other storage technology may be used instead of actual capacitors.

Solar Panels (TL8+)

Ten times more efficient, and thus only 8 tons, 8 cy, 800 square yards per MW, for $200,000. Above TL8, halve the cost. Every TL beyond 7 doubles the acceleration the panels can withstand. Thus, TL10 solar panels can withstand .8 Gs.

Fission Plant (TL8)

Produces power by splitting the atom. Fueled by refined radioactives (uranium is the best at TL8); when "used up," the fuel is still quite radioactive, and can be refined into fissionable material for weapons! Cost: $400,000 plus $200,000 per MW capacity. Mass: 2 tons, plus 2 tons per MW capacity. Volume: 4 cy, plus ½ cy per MW capacity.

Fuel: Uranium rods. Requires TL7+ technology to prepare; sells for at least $80,000 per rod (each rod provides 1 MW). Rods last about two years and are then good for a credit of $10,000 each on replacements. A rod packaged for safe shipment takes up .5 cubic yards and masses 3 tons; the space and mass of rods in use inside the plant is subsumed in the mass and volume of the reactor itself.

A compact *fuel processor* capable of turning suitable ore into fuel-grade fissionables costs $350,000, masses 10 tons, and takes up 8 cubic yards. It requires 2 MW of power. The processor includes a dedicated computer to control the operation; for routine refining, only Computer Operations skill is necessary (one roll per day). In case of problems, Mechanic or Nuclear Physics skills may be required. Finding appropriate ore will require Geology or Prospecting rolls; a radscanner will give a +3 or better! Under the *very* best conditions, a processor can be up and running within two weeks, processing 2 tons of ore per week thereafter; the best grade ore will yield one rod per 10 tons processed.

Fission Plant (TL9+)

Creates electricity directly from the heat of the fissioning materials by using superconducting wire. Very simple design; +2 on any roll to troubleshoot or repair. Each plant takes a base $40,000, ½ ton and 1 cy, *plus* $20,000, ½ ton and .1 cy per MW capacity.

Uses the same sort of fuel rods that the TL8 version does, but these rods are far more efficiently used. They cost $80,000 and take up the same ½ cy and 3 tons as cargo, but they each provide up to 10 MW over their two-year lifespans.

Producing these fuel rods requires TL9+ equipment. TL9 fuel processors have the same stats as their TL8 counterparts, but are safer (+2 to rolls). Beyond TL9, fission plants and processors cost half as much.

Fusion Plant (TL9)

Produces power by fusing hydrogen to helium. Each plant takes a base $1,000,000, 10 tons and 5 cy, *plus* $100,000, ½ ton and ½ cy per MW capacity.

A damaged fusion plant quits cold — there is no radiation hazard. They don't need refuelling; a tank of H_2 is built in and will provide power for 200 years (longer than the designers expect the plant to last).

Fusion Plant (TL10+)

As above, but far more efficient. Each plant takes a base $200,000, 1 ton and ½ cy, *plus* $5,000, .1 ton and .1 cy per MW. Beyond TL10, fusion plants cost half as much.

Buying a Ship (Continued)

This takes a minimum of 6 weeks, with work around the clock, and is the time it takes for military shipyards on a war footing to turn out naval craft. Special items may take extra time to install. Anything not available locally must be imported.

Smaller shipyards also take longer. A Class IV port will take twice as long on any hull over 10,000 cy, and three times as long on anything over 50,000 cy (if they will handle it at all). A Class III port isn't really equipped for shipbuilding at all. It can build a ship of up to 1,000 cy in four times as long. It can't build larger ships.

The price for a ship built to standard plans is simply the sum of the prices of all its components.

Custom-Building

If plans are not available, it will take a month to draw up complete plans (regardless of ship size). The fee for this is usually $1 per ton, with a minimum of $10,000. Triple this if the designer will not have the rights to sell the plans as "standard" after he finishes.

PCs with Shipbuilding (Starship) skill, at the appropriate TL, can prepare their own plans. A shipbuilding program will help! The GM makes a single skill roll. A failure wastes the month, but they can start over. A critical failure produces a plan that is so subtly flawed that the builders won't notice . . . but the GM can provide a catastrophe when the ship is first flown.

An advantage of custom-built ships is that nobody can tell from the outside exactly what they are like. A successful roll on Shipbuilding (Starship) skill will allow a determination of capacity, a good guess about power plant, and a wild guess about weaponry (turrets are obvious; their contents aren't!).

Refitting and Repairs

A used ship may not suit the buyer's exact needs, and will require refitting. A ship that takes damage will require repair. Either situation requires a shipyard (see p. 122). Within the guidelines given there, the GM judges whether the yard can do the required work.

Cost of refitting is the cost of all new equipment added, plus 30%. Old equipment may have some salvage value, especially if the PCs are good negotiators.

Cost of repairs is the cost of all equipment destroyed, plus 10%, plus half the cost of damaged but not destroyed items.

Time for repairs or refitting is generally equal to half the time it would take that shipyard to build a ship of mass equal to the mass of gear being replaced or installed. This may be modified by extra payments, as described above — and, of course, by the GM's judgment.

Finances

Only the sleaziest seller expects to be paid in cash. Indeed, offering a cash payment will probably amaze a legitimate seller. Ships are just too expensive. The customary way to buy a ship is to finance it through a bank (or a moneylender). The bank pays the seller when the ship is delivered; the buyer gets the ship; and the buyer makes payments to the bank for a long, long time. A very wealthy seller, or a government, may "carry the note" itself.

All rates are negotiable, and depend on local economic conditions, the apparent wealth, honesty and importance of the buyer, the need and greed of the seller, and the negotiating skill of the players themselves. Typically, a down payment of 10-20% is required (directly to the seller). If the ship is new, half this payment is made on order (nonrefundable, of course) and the rest on delivery.

Interest rates on the balance typically range from 8% to 16%. GMs inclined toward realism may work out actual amortization tables. A quick-and-dirty replacement: At 8% compound interest, pay 1% of the amount financed, every month, for 12 years. At 12%, pay 1.5% of the amount financed, every month, for 9 years. At 16%, pay 2% of the amount financed, every month, for 6 years. These payments include principal and interest; at the end of the period, the ship is paid off.

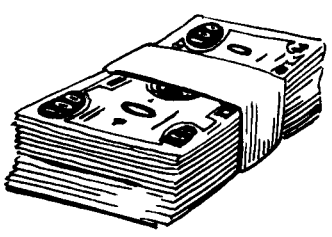
Example: A ship costs $11 million. The down payment is $1 million; the remaining $10 million is financed at 8%, with a payment of 1% ($100,000) every month. The ship will be paid off in 12 years.

The bank will require you to keep the ship insured, and may attempt to set other limits on your use of it, to protect their huge investment.

Buyers who come into money can always pay off the remaining principal amount (this is where an amortization table will come in really handy).

Buyers who default on their payments may have the ship repossessed. This can get interesting, especially if there's not a good selection of places to run to. Defaulters are favorite targets for bounty hunters. Some moneylenders take more direct measures (hidden programs in the ship's computer, or even hidden bombs) to insure that they get paid on time.

Now . . . how will the proud owners earn the money to make those payments? That's what the campaign is all about . . .



Antimatter (TL11)

Produces power by combining matter and antimatter, in very small quantities. Each plant takes a base $200,000, 2 tons and 1 cy, *plus* $1,000, .05 ton and .05 cy per MW.

Fuel: Antimatter costs $1,000 per gram of anti-hydrogen. Each gram will produce 1 MW for 2½ years (below the theoretical maximum; half the power generated is used to create the containment fields). A gram of antimatter *outside* the power plant, in its own containment equipment, takes up 1 cy and masses 1 ton. Containment equipment is heavily fail-safed (a possible watchdog is a built-in sentient computer). This is because the release of a gram of anti-hydrogen would be the equivalent of the detonation of a 24-kiloton nuclear weapon; it would vaporize a ship or wreck a city.

Antimatter (TL12)

As above, but more efficient. Each gram of anti-hydrogen runs a 1-MW plant for 5 years. Each plant takes a base $100,000, 1 ton and 1 cy, *plus* $500, .025 ton and .025 cy per MW capacity. Containment equipment is as above.

Pocket Antimatter (TL13+)

No more efficient, but smaller due to advanced shielding. Takes $1,000, .025 tons and .025 cy for each MW of capacity (there is no base size). Fuel use as above. Assume that it's fail-safe, and that TL13+ can contain antimatter in a small, light holder; otherwise, such miniature plants would be impossible.

Total Conversion (TL14)

The ultimate power plant — produces power by total conversion of matter, in *very* small quantities. Each plant takes $3,000, .1 ton and .15 cy per *ten* MW of capacity. Uses matter — any matter — for fuel, in trivial amounts.

Maneuver Drives

Maneuver drive, or normal-space drive, is required if:

(a) the ship does not have a FTL drive;

(b) the ship must take off from planetary surfaces, and can't use FTL drive to do so;

(c) the ship's FTL drive is not suitable for maneuvering within a planetary system.

Typically, warp-drive ships don't need maneuver drive, and jump ships do. Hyperdrive ships will need maneuver drive *unless* that hyperdrive is highly controllable.

Any maneuver drive produces thrust, measured in tons. The acceleration of a ship, in Gs, is determined by its thrust. If a ship masses 100 tons and has a thrust of 100 tons, it accelerates at 1 G. A 1,000-ton ship with the same thrust accelerates at .1 G, and so on.

Reaction Drives

A reaction drive is one that propels the ship by shooting something (*reaction mass*) one way to propel the ship the other way. (This is *not* the same as fuel. Fuel is used in the power plant to produce power.)

The higher the drive's TL, the greater the exhaust speed is possible. This means they can use less reaction mass. However, *much* more power is required per ton of thrust produced.

Drive power is set by the GM, based on overall tech level and his conception of the campaign. Weight, mass, and cost will be about the same for any of the three reaction drives listed below: $10,000, .1 cy and .05 ton per MW of power consumed.

Choice of Reaction Mass. What a particular drive uses for reaction mass is up to the GM. There are a wide range of possibilities. Likely candidates include hydrogen, water and cadmium. Liquid hydrogen costs $100/ton in orbit and takes up 18 cy per ton. Water can be cheap ($20 a ton in orbit), or it can be scarcer, depending on the circumstances. It takes up one cy per ton. Cadmium costs $200 and takes up .25 cy per ton. H_2 is bulky but is available everywhere; H_2O can't be scooped from gas giants, but it's very common among asteroids and on planets; Cd is compact but less common. Cadmium is also a poison, and the "cadmium blues" are an occupational hazard among drive-hands!

Slow

Produces a thrust of 1 ton per 13 MW of power input, with an exhaust speed of 1.8 miles per second. This drive needs a great deal of reaction mass. To accelerate at .0001 G for a week, this drive requires 18% of the ship's mass as reaction mass.

Chemical rockets are Slow drives that require no power plant; see sidebar, p. 83.

Moderate

Produces a thrust of 1 ton per 130 MW of power input. Might use hydrogen, water, etc, as exhaust. Exhaust speed around 18 miles per second. This drive could accelerate at .001 G for a week by using 18% of the ship's original mass as reaction mass.

Fast

Produces a thrust of 1 ton per 1,300 MW. Example: an ion engine using cadmium-vapor exhaust. Exhaust speed around 180 miles per second. This drive could accelerate at .01 G for a week, or .001 G for 10 weeks, by using 18% of the ship's original mass as reaction mass.

Reactionless Drives (TL9+)

The reactionless drive, or "thruster," requires power but no reaction mass. This violates physical law as it is understood below Tech Level 9. But it is the only way to make lengthy high-G maneuvers possible without incredible amounts of power.

Thrusters are built in standard sizes, for different applications; a ship may carry several thrusters to get to the right total thrust. Standard sizes are 1, 5, 10, 100 and 500 tons, 1,000 tons (1 kiloton), 5, 10, and 20 kilotons.

At TL9, a reactionless drive produces 1 ton of thrust per MW. For each MW consumed, the drive masses 1 ton, takes 4 cy, and costs $50,000. When used in atmosphere, TL9 thrusters produce a great deal of waste heat, making a takeoff as fiery as a rocket's.

At TL10, a reactionless drive produces 1 ton of thrust per MW. For each MW consumed, the drive masses .5 tons, takes 2 cy, and costs $20,000. There is much less waste heat; thrusters tend to slag the landing spot but don't incinerate the surroundings.

At TL11+, a reactionless drive produces 10 tons of thrust per MW. For each MW consumed, the drive masses .5 tons, takes 2 cy, and costs $20,000. There is no waste heat problem.

Speeds with Maneuver Drives

The fastest way to get anywhere is to accelerate halfway there, turn the ship around, and decelerate the rest of the way. This uses fuel for the whole trip. One can always save fuel by traveling more slowly, or by accelerating only part of the way. Some travel times for constant-acceleration trips:

Distance	*.0001 G*	*.001 G*	*.01 G*	*.1 G*	*1 G*	*2 G*
.2 AU	4.5 mon	5.7 wks	1.8 wks	4 days	31 hrs	22 hrs
.5 AU	7 mon	9 wks	2.9 wks	6.3 days	2 days	34 hrs
1 AU	10 mon	13 wks	1 mon	9 days	2.8 days	2 days
2 AU	14 mon	4.5 mon	6 wks	13 days	4.1 days	2.8 days
5 AU	23 mon	7 mon	9 wks	2.9 wks	6.3 days	4.5 days
10 AU	32 mon	10 mon	13 wks	1 mon	9 days	6.3 days
50 AU	5.5 yrs	23 mon	7 mon	9 wks	2.9 wks	2 wks
100 AU	7.8 yrs	32 mon	10 mon	13 wks	1 mon	2.9 wks

Stardrives

The drives described here are assumed to be TL10. We haven't attempted to describe specific improvements for each tech level above 10. A general recommendation: At the first tech level above introduction, prices and power use remain the same, but mass and space are (at least) halved. At the next tech level, mass and space remain the same, but prices are cut hugely . . . perhaps to 10% of the original cost.

Hyperdrive

A hyperdrive engine masses 1 ton and takes up (including engine room) 3 cy; it costs $40,000. A ship requires one hyperdrive engine for each 100 tons of its total mass.

Hyperdrive engines require a lot of energy to enter the hyperdrive state ("skip"), and a smaller amount of power while in hyperspace. Capacitors are necessary to make a skip, but most ships have enough power to recharge the capacitors while still in hyperspace. A typical energy requirement: .1 MW-h per ton of ship to skip, and .01 MW of power per ton of ship to maintain the ship in hyperspace for the rest of the trip.

Often a *rest time* of some sort is required between hyperskips. Reasons for the rest time might be to calculate the next skip; to let the crew relax from unpleasant side-effects of hyperspace; or to let local hyperspace, itself, relax from the stress of being crossed.

Escape Velocity

For a ship to reach Earth escape velocity with a chemical-fueled rocket, 99% of its mass must be fuel. This assumes accelerations peaking at 4 to 8 Gs.

The rocket assembly masses 1 ton, and takes up ½ cy, per 100 tons of thrust. It also requires huge fuel tanks: for a H_2/O_2 fuel, each ton of fuel requires 2.3 cy. This fuel would typically cost $20/ton on the ground, or $100/ton in orbit.

At TL9+, reactionless drives are available, and can be used for takeoffs. Any ship with a continuous acceleration of more than 1 G can blast straight up and escape Earth gravity. The table below shows time to escape Earth's gravitational field at various constant accelerations:

Gs	*Time*	*Gs*	*Time*
1.01	30 hrs	2	18 min
1.1	3 hrs	3	9 min
1.2	90 min	4	6 min
1.5	35 min	5	4.5 min

These numbers are based on the *difference* between the ship's acceleration and 1 G. Halve the trip duration every time the *difference* between acceleration and 1 G is doubled. For example, a 7-G ship takes 3 minutes to reach escape velocity.

Calculating the escape velocity of a world requires the formula

$$V_E = 6.9 \times \sqrt{g \times R} \text{ miles per second}$$

where V_E is escape velocity; g is the world's gravity in Gs; and R is the planet's radius in Earth radii.

Time to reach escape velocity is [V_E divided by (ship's acceleration - g)] × 165 seconds.

Winged Takeoff

Below TL13 or so, the best way for a ship to take directly off from a 1-G world is to *fly* into space. A ship with contragravity, can get into space with any thrust at all.

If the ship has winged streamlining, figure its effective mass, for takeoff purposes, as 1% of actual mass in Dense atmosphere, 2% in Standard atmosphere, and 5% in Thin atmosphere. Thus, if its maneuver drive produces thrust equal to 2% of its mass, it can take off from Earth.

If a ship can take off from a world, it can land there. It is also possible to land "dead-stick," with no power at all. This gives a -4 to Piloting rolls.

Assisted Takeoff

There are other ways to get a ship into the air . . . laser launch, catapults, "beanstalks" or skyhook systems. All require very extensive launch facilities. They might be suitable for merchants on regular routes, or for shuttles to non-landing starships, but not for explorers.

Getting a Ship Without Buying It

In most campaigns, a prime goal of the PC group will be to get — or keep — their own starship.

They can be members of a military or other government service, which assigns them a ship. Of course, the service will also assign them specific duties, unless they are special agents or assigned to detached duty.

They can be employed by a corporation that provides a ship. Again, however, most adventuring will be limited to that which serves the company's purposes (usually pursuit of profit).

If they join a pirate or other criminal gang, they may be supplied a vessel and allowed some measure of freedom. But they must give the organization a healthy cut of any profits, and make themselves available for special services from time to time. The latter will usually be dangerous and always be illegal.

PCs can be free traders or work as crew on a ship owned by an NPC. Free traders will not allow the PCs to take the ship off on profitless adventuring. Other owners might be more liberal in allowing PCs a say in the ship's next destination or purpose.

The PCs could steal a ship. This might be one they've purchased but are unable to meet payments on, one they've leased, or one they've hijacked. This should always be played out as an adventure. If FTL communications exist, players who steal a ship might find it difficult to get far enough away to evade capture. And some rental companies, as well as those to whom ship payments are due, take precautions. The engines (or life support!) may be rigged to shut down after a certain period of time. If the computer is sentient, it may become a dangerous opponent if the ship is stolen. It should require high skill to deactivate such precautionary measures.

A party might be fortunate enough to find a ship that they can claim as salvage, either adrift in space or abandoned on a planet. This is also best played out as an adventure.

The PCs might accept a very dangerous job with a ship as the payment. This might be a freelance mission for an intelligence agency or the military, for a private firm or even a criminal organization. Or perhaps for that very rich NPC who needs a favor: "Rescue my daughter from the Death Planet, and this ship is yours!"

Or the group can get along without a ship, by buying (or working) whatever passage they need. They might also put down a deposit and *lease* a ship. Most major starports have rent-a-ship centers. They must return the ship in time or suffer penalties (financial at least; worse if they've kept the ship overtime without a valid reason).

Jump Drive

A jump generator masses 2 tons and takes 8 cy; it costs $70,000. A ship requires one jump drive generator for each 500 tons of its total mass.

A jump drive requires energy only when it initiates the jump. Typical energy requirement for initiating a jump is 1 MW-h per ton of ship mass. A stargate requires 2 MW-h of energy per ton of ship transmitted, but stargates are huge and can afford large power plants and huge banks of capacitors.

Warp Drive

Warp engines come in different sizes. They produce FTL thrust, or "warp thrust," which works in a manner similar to the thrust produced by maneuver engines. One "warp thrust factor" (WTF) will propel 1 ton of mass at 1 parsec per day (1,100 times lightspeed). The maximum speed of warpships should be set by the GM. Up to that limit, though, the higher a drive's WTF, the faster the ship goes.

A standard warp engine costs $20,000, weighs 2 tons and takes up 5 cubic yards, *plus* $5,000, ½ ton and 1 cy for every 10 WTF produced. Each 10 WTF requires 1 MW of power. Thus, if a ship has multiple engines, it can lose one and still continue at reduced speed. The drive can be overloaded to get extra speed — see *Engineer*, p. 35.

Crew and Passengers

Mass and space must be allowed for each person aboard ship. This accounts for the people themselves, accommodations, facilities and corridor space. Life-support systems are discussed below.

For short flights, only seating space is needed:

Crew, in pilot chairs during flight: ½ ton each, 1½ cubic yard, $1,000 per position.

Passengers, seated during flight: ¼ ton each, 1 cubic yard, $500 per position.

For longer voyages, living accommodations are required. The figures below allow for both command positions and living space.

Crew, including corridor, bridge, other controls, and living space: 1 ton each, 25 cubic yards, $4,000 per crewman.

Passengers (steerage accommodation), including corridor and living space: ½ ton each, 12 cubic yards, $1,000 per passenger.

Passengers (standard accommodation), including corridor and living space: 1 ton each, 20 cubic yards, $3,000 per passenger.

Passengers (first-class accommodation), including corridor and living space: 2 tons each, 40 cubic yards, $6,000 per passenger.

Passengers (luxury accommodation), including corridor and living space: 3 tons each, 100 cubic yards, $30,000 per passenger.

Freeze capsules for crew or passengers in cold sleep: see p. 66. ½ ton each (full), 2 cubic yards, $55,000.

Required Crew

Crew requirements vary widely from the averages given here. Military ships will have larger crews, to allow for losses in combat. Transports often run with a bare minimum of crew, to save money. A civilian yacht might not have anyone with these titles, but somebody needs to do the job. Ships with a very small crew need very talented crewmen, since several jobs are doubled up.

In general, crew should have a skill level of at least 14 in the skill(s) appropriate to their positions. But, especially at high TLs, good computers can make up for a lot, and a luxury yacht can go from star to star even though nobody aboard knows anything about piloting, astrogation, or the engine room.

If the GM feels a ship is under-crewed, he should assess penalties to appropriate skill rolls, especially in stress situations when one spacer has to be in three places at once.

Command: At least one, plus one more for every five non-command crew. However, the officer who supervises engineers will usually be an engineer himself; the same goes for other specialties. On small ships, the commander usually doubles as pilot or gunner.

Pilot: At least one unless the ship is being trusted to a piloting computer. All but the smallest military ships will have three pilots and one specialist astrogator. On very small ships, the pilot usually runs the sensors.

Medical officer: As a rule, one full-time medic if there are more than 20 aboard (or 10 for over a month), plus one more medic or assistant for every additional 50 aboard.

Engineering: One engineer for every 60 tons, or fraction thereof, of the total mass of the maneuver drive, FTL drive, and power plant.

Life Support: One full-time life support tech if there are over 20 aboard; one more for every full 100 added. On small ships, Engineering deals with life support.

Service: One full-time service person — cook/yeoman/morale officer/etc. — if there are over 20 aboard; one more for every 50 added.

General maintenance: One full-time mechanic with Vacc Suit skill if there are over 10 aboard; one more for every full 50 people or 1,000 tons of ship, whichever is more.

Passenger service: Any passenger ship will have at least one crewman whose job is to look after the passengers. As a rule, there will be at least one such crewman for every full 50 cargo or steerage passengers, 20 standard, 10 first class, or 2 luxury passengers.

Gunners: On the average, one for each weapon system aboard ship. A weapon cannot be fired in combat unless it has an operator. However, this may be a gunner, a non-gunner operating at default, or a computer. A single ship computer, with proper connections and a gunnery program, can operate up to (Complexity × 100) weapons. See p. 51.

Other crew: Large ships, especially military vessels, will have full-time officers and specialists for communications, sensors, and so on; there may be landing teams, security staff, science crew, cargo specialists, and so on. See p. 31 for more ideas.

Optional Crew

Entertainers of various sorts will be found on luxury liners — sometimes more entertainers than passengers. They may or may not have any actual "crew" skills.

Marines and fighter pilots aren't really ship crew at all. Marines usually get steerage accommodations; fighter jocks usually have the equivalent of standard.

Backup crew may be carried in freeze tubes, to be awakened in an emergency. This is especially common on military vessels.

Life Support

The life support system provides heat, light, and (most important) oxygen to everyone aboard ship. Enough life support must be provided for all crew and passengers (except, of course, those in freeze). It is a very good idea to provide extra life support capacity, in case of accidents or unexpected passengers.

A *limited* lifesystem, such as might be found on a fighter, shuttle or lifeboat, requires .1 ton, .1 cy, and $500 for each man-day of support it provides. When capacity is used up, there's no more air. As long as the vessel has any power at all, a limited lifesystem continues to operate.

A *full* lifesystem, which works indefinitely, requires 2 tons, 4 cubic yards and $5,000, *plus* ½ MW of power, ½ ton, 2 cy, and $500 for each person to be supported.

A full lifesystem can be overloaded if necessary. Roll 3 dice after each day of travel with too many people, adding 1 to the result for each full 10% by which the number of people aboard exceeds lifesystem capacity. On an adjusted roll of 13 or more, the lifesystem begins to break down, losing 10% of its current capacity for each point by which the roll was missed. A Mechanic (Lifesystems) roll can be attempted once per day; if it succeeds, it will restore 10% of full capacity. But note that once the lifesystem begins to fail, the effect snowballs. If the ship remains overloaded, the lifesystem will reach 0% of capacity and fail. All the oxygen in the air will be used up within a few hours, and everyone will die. Note: those in cold sleep require no life support and are unaffected if the lifesystem crashes — as long as the power stays on.

Weapons

The GM should pick the weapon tech level available. Each weapon has cost, mass, and volume, just like other ship components. Costs are given in *thousands* of credits. Weaponry of the previous tech level will also be available at about 20% stated cost, but will be comparatively less effective — see Chapter 9, *Space Combat.*

Also given is the weapon's *firepower* (FP), which takes in speed, accuracy, range and destructiveness. The firepower of a ship is determined by adding the firepower of all its weapons — see *Space Combat.*

Power is the amount of MW required to fire the weapon. A dash indicates the power required is trivial. However, no weapon will fire if the ship loses all power!

All weapons are turreted, except those in fighter craft, which will have only one or two weapons, nose-mounted. Weapons may be mounted in groups of up to four identical weapons; such a multibarrel arrangement can be controlled by a single gunner if it fires at the same target, or may be computer-controlled to fire at separate targets. In combat, a hit to one weapon means a 50% chance of equal damage to all other weapons in the mounting. Otherwise, mounting style of weapons does not affect combat.

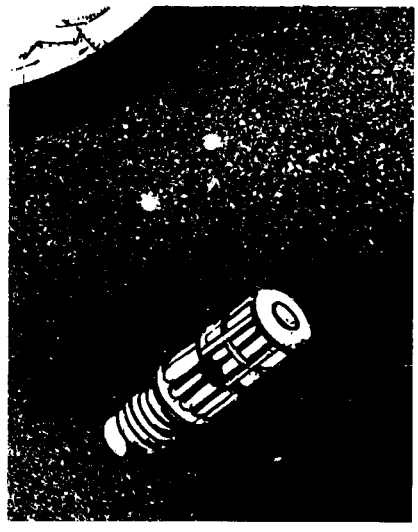
Reaction Mass Requirements for Trips of Different Lengths

The maneuver drive descriptions give the amount of reaction mass required for 10-week and 1-week trips. To compute the reaction mass required when the length of a trip is changed, refer to the following table, where "1" represents the original trip which required 18% of the ship's original mass to be used as reaction mass.

.1	2%
.2	4%
.3	6%
.4	8%
.5	9%
.6	11%
.7	13%
.8	15%
.9	16%
1	18%
2	33%
3	45%
4	55%
5	63%
6	70%
7	75%
8	80%
9	83%
10	86%
15	95%
20	98%
25	99%

For example, a Fast reaction drive requires 18% of its ship for reaction mass to accelerate at .01 G for a week. The same mass would last 2 weeks if the ship only accelerated at .005 G. To accelerate for 2 weeks at .01 G, however, would require 33% of the ship as reaction mass, as would accelerating at .005 G for a month.

Use this information when designing your ship; work out the longest STL trip you expect it to take without refueling, and plan for an appropriate amount of reaction mass.



STL Colony Ships

At Tech Level 8, space travel is possible but star travel — FTL — is not. However, man can still reach the stars in slower-than-light colony ships.

These vessels are massive, designed to carry hundreds or thousands of colonists. Since it will be years before they reach their destination, STL colony ships are designed in one of two ways:

Sleeper ships. Colonists are frozen in suspended animation. This is the most economical method, as more colonists and their supplies can be contained in a ship. Such ships might be computer-controlled, with hundreds or thousands of freeze tubes, holds full of the equipment the colonists will need, and shuttlecraft to get them down to their new home.

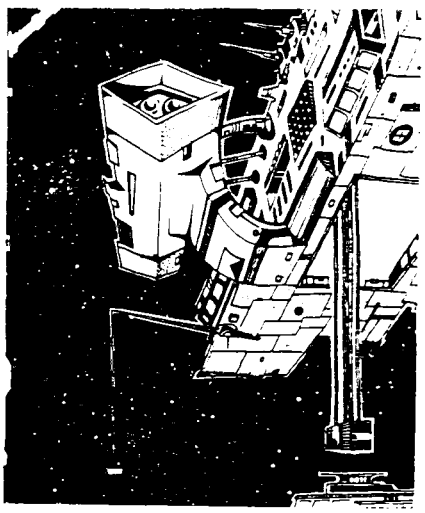
Generation ships. The original "colonists" will raise children and die aboard their ship as it slowly makes its way across the void. It will be a later generation that actually colonizes the new world. Hence the name "generation ship."

Either type of ship might reduce the *shipboard* time that elapses if it could travel near the speed of light (see p. 28). But even so, trips would take many years.

Ethnic, religious or cultural minorities might choose to leave the solar system as colonists. And some colonists will leave earth involuntarily. Colony worlds might also be the Botany Bays of the future, where criminals or social undesirables are sent. Either way, the colonists on a generation ship can never go home.

An adventure could involve a party that discovers a lost generation ship drifting in space. Boarding it, they might encounter an entire self-contained world which the descendants of the original colonists believe to be their planet.

The invention of practical FTL starships makes slow colony ships obsolete. However, if many such missions were sent out, there may be hundreds of scattered human worlds in the galaxy — or the remains of those that failed.



Tech Level 7

	Cost	*Mass*	*Vol.*	*FP*	*Power*
Chain Gun	**10**	**1**	**2**	**1**	—
Light Msl Launcher	**5**	**0.5**	**2**	—	—
Medium Msl Launcher	10	1	3	—	—
Heavy Msl Launcher	20	2	5	—	—
Light Explosive Msl	**2**	**0.1**	**0.5**	**1**	—
Med. Explosive Msl	**4**	**0.4**	**2**	**3**	—
Heavy Explosive Msl	8	2	8	10	—
Light Atomic Msl	30	0.1	0.5	20	—
Med. Atomic Msl	**50**	**0.4**	**2**	**50**	—
Heavy Atomic Msl	**70**	**2**	**8**	**100**	—

The chain gun fires a mix of depleted-uranium and explosive shells. Each round of fire uses up ammunition. A combat round's worth of ammo costs $1,000, masses .05 ton, and takes up .01 cy of space.

Missile launchers have no FP of their own, but fire any number of missiles of the appropriate size per round (the only reason to have extra launch tubes is in case of damage to one). In addition to the listed damage, atomic missiles do radiation damage (see sidebar, p. 93). Atomic missiles are far more powerful than explosive ones, but there may be campaign reasons not to use them!

Tech Level 8

	Cost	*Mass*	*Vol.*	*FP*	*Power*
Railgun	**10**	**1**	**2**	**3**	**2**
Light Laser	**10**	**3**	**2**	**5**	**5**
Medium Laser	25	8	6	20	20
Particle Beam	40	20	10	50	50

TL8 equivalents of all TL7 missiles are available at half the cost, mass and volume given for TL7. Railguns use chain gun ammo. Launchers and chain guns are unchanged.

If a grounded ship were attacked, even a light laser or particle beam would annihilate anything but a heavily armored tank or similar vehicle.

Tech Level 9

	Cost	*Mass*	*Vol.*	*FP*	*Power*
Light Laser	**10**	**2**	**2**	**5**	**5**
Medium Laser	**25**	**5**	**5**	**20**	**20**
Heavy Laser	40	10	8	40	40
Particle Beam	40	15	10	50	50
Heavy Particle Beam	**90**	**25**	**15**	**150**	**150**

TL9 missiles are the same mass and volume as at TL8 — that is, half that for TL7 — at 25% of the TL7 price. Chain guns are obsolete.

Tech Level 10

	Cost	*Mass*	*Vol.*	*FP*	*Power*
Light Railgun	**5**	**.5**	**1**	**1**	**1**
Railgun	**10**	**1**	**2**	**3**	**2**
Disruption Beam	100	40	25	200	200

TL10 lasers and particle beams are the same cost and firepower as TL9, but at half the mass and volume. TL10 missiles are ¼ the mass and volume given for TL7, at 10% of the price.

Tech Level 11

	Cost	*Mass*	*Vol.*	*FP*	*Power*
Light Antimatter Msl	**40**	**0.05**	**.25**	**200**	—
Med. Antimatter Msl	**80**	**0.2**	**1**	**500**	—
Hvy. Antimatter Msl	150	1	4	1,000	—

At TL11, antimatter missiles become practical, replacing nuclear missiles; they also do radiation damage. At this and later tech levels, ordinary explosive missiles are still built for special purposes, but they are still effectively TL10.

TL11 beams and railguns have half the cost listed for TL10.

Tech Level 12

At TL12, cost of antimatter missiles is halved, but all other stats remain the same.

TL12 beams and railguns have the same cost, mass and volume listed for TL11, but Firepower is doubled.

Tech Level 13+

At higher tech levels, weapons continue to improve. Depending on the campaign, new and deadlier weapons (nova guns, antiparticle beams, black-hole projectors . . .) may be introduced.

Sensors and Communications

Sensor Suite

A standard sensor suite is $50,000, 5 cy, 5 tons. The GM defines the range and performance of a "standard" suite, as per p. 29. Compact sensors, or more powerful apparatus, may be available; this will cost more. Inferior sensors may also be available for those who don't need anything better.

Allow 1 MW power for each sensor suite to be operated. If this power is needed for something else, the ship is blind.

Stealth Suite

This is a collection of devices that make it harder to detect the ship that carries them. A stealth suite is described as "-1" if it subtracts 1 from sensor rolls, and so on.

A stealth suite is 3 levels *more* effective for each TL by which it exceeds the TL of the sensors, and not effective at all against sensors of a superior TL!

Cost, mass and size of a stealth suite don't depend on TL, because the sensors to be defeated are constantly improving, too. But they *do* depend on the size of the vessel to be concealed. For each 100 tons of ship mass, a -1 suite costs $10,000, takes 3 cy, masses 1 ton, and uses 1 MW. A miniaturized -1 suite (per 100 tons of ship mass) costs $50,000, takes .5 cy, masses .2 tons and requires .5 MW. Each additional -1 of either suite's effectiveness doubles cost, mass, size and power usage, up to a maximum -6.

Since anything that is harder to detect is also harder to hit, each unit of stealth protection is treated as armor when determining damage to a ship in combat.

FTL Radio

Availability and stats of this item are *entirely* up to the GM, depending on what has been decided for communications in the campaign. See p. 27. If FTL radio is available, small *distress beacons*, self-powered, will also be available.

Gravity and Contragrav Technology

Artificial Gravity (TL10+)

The GM determines whether artificial gravity ("grav") units exist in the campaign. Each unit serves up to 1,000 cy of volume (many cargo ships have no gravity in the hold). If multiple units are required, they must be located in the appropriate areas — so one hit won't take out all of a big ship's gravity. At TL10, each unit costs $100,000, masses 8 tons, takes up 5 cy, and draws 1 MW of power. A unit can provide anything from microgravity to 3 Gs; "stacking" two units would produce up to 6 G, and so on.

At TL11+, a unit costs $20,000, masses 1 ton, takes 1 cy, and draws 1 MW.

Tractor Beams (TL11+)

These beams pull their target to the beam generator, or vice versa. They are normally for cargo handling; ingenious spacers find other uses for them. Use of even one tractor beam gives a +1 bonus to Piloting skill for a microgravity or zero-G rendezvous, but a critical failure on any tractor beam use tears the beam generator out of the mounting and requires a Hull Integrity roll (see sidebar, p. 94).

Beams come in all sizes from 1 MW up. A 1-MW beam gives the equivalent of 10 tons of thrust — e.g., it can pick up a 10-ton object (close by) under 1 gravity. However, the beams are not long-range — effective strength is approximately halved every 100 yards. Double this distance at each TL above 11. At any TL, a tractor beam requires 2 cy and 1 ton per MW. Cost is $5,000, plus $2,000 per MW.

Tractor beam operation is a professional skill (Physical/Easy), defaulting to Gunner (any beam weapon)-2 or DX-4.

Auxiliary Craft

An auxiliary is any craft that is carried aboard a larger one. This can include escape pods, lifeboats, shuttles, the captain's gig, and a variety of special-purpose craft, with or without FTL capability.

Lifeboat (TL10, 30 cy)

Carried to allow the mother ship to be abandoned in case of catastrophe. Most are not capable of interstellar travel — they will merely allow the passengers to survive until help arrives.

A typical lifeboat is the Tri-Tachyon Long-Haul. It is 20 feet long, weighs 13 tons fully loaded, and requires a 33-cy boat bay. It has full life support for one pilot and four passengers, and carries 3.1 tons of assorted emergency gear. Its computer has only one function — Piloting (skill 16). The Long-Haul does not have interstellar capability, but its 1-ton thruster gives it .08 G acceleration. It is winged and can easily lift off from any planet with at least Thin atmosphere; its fusion plant requires no fuel. The Long-Haul is intended for scouts, merchants, prospectors, and other ships where a small crew may be far from help. It can also be used as a small shuttle, since it has a 1-man airlock.

Standard price for a new Long-Haul is $341,000.

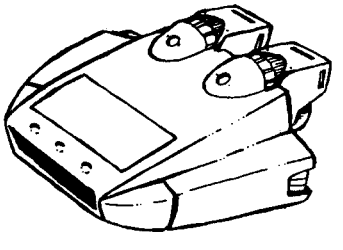
Shuttlecraft (TL10, 200 cy)

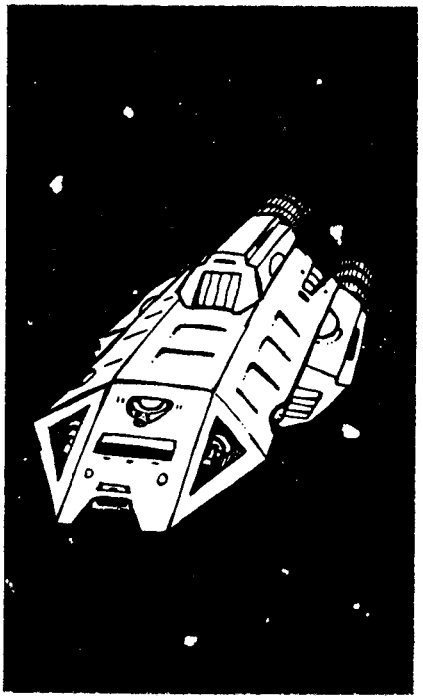
Many spaceships are not equipped for making planetary landings. They carry shuttlecraft to transfer passengers and cargo to and from orbit. And any starport will have a variety of shuttles on hand. Shuttles come in all sizes; a large shuttle will dwarf some starships.

A commonly seen shuttle is the K Star Lancer. This workhorse has a loaded mass of 300 tons. 63 feet long, it carries two pilots and 40 passengers, plus almost 260 tons of cargo. The cargo bay is just under 110 cy.

The Lancer has 15 tons of thrust and a light mass of 40 tons, so it has .05-G acceleration fully loaded, or better than .35 G empty. Winged, it can lift itself from any world with Thin or better atmosphere. It has 42 man-days of life support, artificial gravity and a single standard airlock. Small cargo may be unloaded through the airlock after passengers exit. Large cargo is handled either by moving the shuttle into a hangar, or by depressurizing the ship and opening the cargo bay doors into space.

A standard Lancer costs $1,119,500 new.





Boat Bays and Hangar Decks

Boat Bay

A boat bay holds a single *specific* auxiliary craft very snugly. To enter the small craft, one steps through an airlock door directly into the craft. The craft then leaves through a set of small hangar doors. Volume of the bay is equal to that of the boat, plus 5%. Cost and mass are only that added by the hangar doors: $3,000 and ½ ton. It requires at least one airlock (not included in the price).

Hangar Deck

A hangar deck is a large area that holds one or more auxiliary craft. It includes hangar doors that open to space to let the auxiliaries leave. It requires at least one airlock (not included in the price).

Unlike a boat bay, a hangar can hold a variety of craft. It also lets people walk around the auxiliaries for inspection, repair, and so on. The volume of a hangar must be equal to the tonnage (size) of the auxiliary or auxiliaries it is to hold, plus at least 50%. However, the extra volume can be used for emergency cargo storage. The only cost for the hangar bay is $5,000 for the doors; the only mass added is 1 ton for door machinery.

Pressor Beams (TL12+)

Pressor beams are exactly like TL12 tractor beams, except that they work in reverse, pushing instead of pulling. They improve at higher TLs, always having the same cost and weight as a tractor. They are less versatile, but have their uses. A beam that can act as either tractor or pressor requires 2.5 cy and 1 ton per MW, and costs $8,000, plus $3,000 per MW. Some starports use such beams to assist with landings.

Contragravity (TL12+)

A contragrav-equipped ship can "screen" itself from some or all of the gravitational pull of a planet. In practice, this usually means that its weight is reduced to zero for takeoff or landing, so that a very small amount of thrust will suffice to move it.

A ship-sized contragravity (CG) unit costs $50,000, masses 1 ton, takes up 4 cubic yards, and draws 2 MW of power. Such a unit will neutralize gravity for a mass of up to 1,000 tons. Multiple units will be required for large ships.

At TL13+, a CG unit rated for 1,000 tons will still draw 2 MW, but will cost only $10,000, take up 1 cy, and mass .5 ton.

Grav Compensators (TL12+)

These units are only available if contragravity technology exists. They are strong contragrav generators that activate instantly if the ship undergoes rapid acceleration. This lowers hull stress by reducing the weight placed on the hull.

Each compensator unit costs $20,000, masses 1 ton, takes 1 cy, and draws 1 MW of power for each 1,000 tons of mass it protects (including cargo mass!) At TL12, compensators can cancel up to 2G of acceleration. Double this maximum at each higher TL.

Ship Accessories

Computers

While a computer is not absolutely required in every campaign, ships should not be built without them. Computers are described on p. 51. Power requirement is negligible.

Airlocks

An airlock is a room with a heavy door on each side. One door leads to space; the other leads to the ship. An airlock allows people to enter or leave the ship in space without decompressing the whole ship. Airlocks are designed so that both doors can't be opened at once. Typically, they have the same PD as the ship's hull, and DR of 2 less. Controls are automatic, and can be operated either at the lock or from the bridge; there is a manual lever for emergencies.

Standard airlock doors are also designed so that a ship can mate airlocks directly with a station, or an auxiliary can mate directly with the outside of a larger ship. This docking maneuver requires a Piloting roll to be made by the pilot of the smaller craft.

Airlocks may also be located between compartments of a ship, for extra safety or to separate compartments with different atmospheres. Very small ships don't have airlocks. The occupant(s) must depressurize the ship when they leave.

Large airlock: holds 12 adults at once. Volume 24 cubic yards. $20,000; 2 tons.
Standard airlock: holds 4 adults at once. Volume 8 cy. $10,000; 1 ton.
One-man airlock: holds 1 adult. 2 cy; $3,000; ½ ton.

Passage Tube

A flexible tube that connects airlocks of two ships in space. It holds pressure, allowing occupants to travel between the ships without a vacc suit. Usually 100 feet long and about 8 feet in diameter; hooks to standard fittings around exterior airlocks. Normally takes about an hour to unstow and rig in free fall (30 minutes with two or more working). Requires a Mechanic (Starships) roll. PD 3, DR 12; $1,000; ½ ton. Military/prospector version (PD 3, DR 20): $3,000; 1 ton.

Landing Gear

Useful if the ship is ever to set down. Mass is 1% of ship's loaded mass; cost is $100 per ton of landing gear, with a minimum $500. Landing gear is normally mounted outside the ship and adds no volume. Retractable gear requires 1 cy per ton of mass and costs ten times as much.

Auxiliary Bridge

A secondary ship control center. All ships have a main bridge of appropriate size; this is one place the space allowance for crew goes. To have an auxiliary bridge, a ship must have at least one backup computer (each computer can be accessed from each bridge, but one must be physically located on the auxiliary bridge). Allow 1 cy, .1 ton, and $100 per crewman on the ship (minimum 10 cy, 2 tons, $2,000) for an auxiliary bridge appropriate to the ship. It may be assumed that the main bridge is at least twice this big.

Cargo Capacity

Any remaining volume may be used for storage of cargo. Note that if the drive has a limit it can carry, in terms of mass, the cargo cannot cause the ship to exceed that limit.

Sample Ship Construction System

Following is an example of a technological background and ship construction system that can be derived from the rules above. We'll use this technology to build a sample ship. (You'll also see this specific technological background in some upcoming ***GURPS Space*** material — we like it.)

In general, this universe is Tech Level 10. All hulls, armor, and weaponry are exactly as described for TL10. Slow FTL radio exists, but FTL comm gear is far too massive to take aboard ship, and messages travel at only .1 parsec per day (100 times lightspeed). Ships use normal radio, which has no significant mass, volume or cost.

Modern ship power plants are TL10 fusion plants (p. 82). Many TL9 fusion plants are still in service, and may be bought for only *5%* of their original cost (as per p. 81). Their only real disadvantage is size and mass, and on many ships that does not matter at all. Groundside power plants use antimatter, but it's not suitable for ship propulsion yet.

FTL travel is via *hyperdrive.* Drives are exactly as per p. 83, and require capacitors for energy, as per p. 81. Travel through hyperspace is at .2 parsecs per day.

Astrogation is "modified straight-line" (p. 26), with a -1 to the Astrogation roll for each full parsec traveled. Thus, most ships come out and look around every few parsecs! An hour is required for full observation and recalculation of positions. Hurried skips give a penalty to the roll: -1 for 30 minutes, -2 for 10 minutes, -3 for 1 minute, -4 for a skip without preparation. Ships *have* been known to misskip dramatically (sometimes far beyond the distance they had planned to travel), but it rarely happens. More often the ship is a few parsecs off course, but can easily locate itself.

Hyperdrive has the following limitations: Ships can enter hyperspace anywhere, as long as they are in vacuum (the field cannot form in atmosphere). Ships cannot *leave* hyperspace within (approximately) .5 AU of a stellar mass, or .1 AU of a planetary mass. General accuracy is within 100 AU per parsec skipped, so a ship skips to somewhere within the system, sights on its target planet, and skips again. An Astrogation roll is required to get "just close enough, but not too close" to the target world. An astrogator who tries to cut it fine, and fails, will be "bounced" and will appear in a random location, 3d AU away from the target. If he has the energy, he may skip again. Otherwise, he'll need maneuver drives. And in any case, maneuver drives are necessary for final approach to a planet.

For maneuver drive, ships use TL10 thrusters, as described on p. 83.

Artificial gravity exists, but tractor beams and contragravity are still in the future.

Range of sensors is as described for TL10 on p. 29. Normal sensors are *Difficult* to operate. A standard sensor suite is $50,000, 5 cy, 5 tons. 1 MW. *Compact* standard sensors are available at $200,000, 1 cy, 1 ton, .5 MW. *Reliable* sensors are available at $500,000, 20 cy, 10 tons, 2 MW. Many merchant ships have *Primitive* sensors: $10,000, 2 cy, 2 tons, 1 MW. Shuttles, lifeboats, etc., use a "shuttle suite" which is just enough to make an orbital or planetary approach: $2,000, ½ cy, ½ ton, negligible power requirement.

Ship Construction Example

We're building a small tramp freighter: 1,000 cy. Our PCs can't afford anything fancy. They have the plans for a sturdy vessel, the *Aguila* class — 30 years out of date, but designed for an obsolete power plant that is available cheap. The 1,000-cy hull is also built with the cheapest, heaviest material available. This masses .01 ton per cy of hull, and costs $200/cy. So its total cost is $200,000, and it masses 10 tons.

The PCs want a little armor. The cheapest armor at TL10 (p. 78-79) is $250 and .2 ton per cy of ship armored. This comes to $250,000 and 200 tons. It is reduced to 50%

Pressure Doors

Any spaceship of any size has some internal pressure doors, so that a single hole won't empty the ship to vacuum. The designer of a ship may specify a reasonable number of pressure doors at strategic places.

Standard pressure doors slide open and closed at the touch of a button, but have a manual lock (or "dog") and lever in case of power loss. Spaceships don't have swinging doors, because a 1-atmosphere pressure differential would quite effectively seal such a door shut.

If there is air on the inside of a pressure door, and vacuum on the outside, it can easily be opened. The one who opened it must roll DX-4 or Free Fall-6, depending on gravity, to keep from being sucked through. Others nearby may also have to roll. The fate of those sucked through depends entirely on the circumstances. Maybe they can get back through the door; maybe not. It takes only about 20 seconds for a large room to empty to vacuum.

It requires a (ST+2) roll, and 10 seconds, to push a pressure door *closed* and dog it tight while air is escaping outward. Two people may combine ST for this. If the door won't close, fleeing to a further room will make the job easier, if it is done quickly; the air will flow less quickly out of each room in series, giving a +2 to your door-closing attempt for each extra room in the way. Closing any door from the vacuum side is suicide unless you have your own air supply!

Doors normally open or close in one second. It takes 5 seconds to undog and open a closed pressure door manually, or to close and dog an open one, if there is air on both sides. It takes 10 seconds to undog it partially and listen for escaping air. All pressure doors have an indicator that tells whether there is vacuum on the other side, but these indicators have been known to malfunction. A sign of the true spacer is the cautious way he opens any pressure door at any time.

Sample Computer System

To set up the computer systems for our sample ship, we'll need to refer back to pp. 51-52. This whole system is TL10.

We have five crew positions, so we'll need a multi-user system: a microframe. At TL10, that is complexity 6, more than adequate! We configure it for five users. To play it very safe, our main system will be an optical one: $62,500. We will install a regular microframe (only $12,500) as backup. Their combined weight and space requirements are negligible!

Since our computers have complexity 6, we *could* have one or both of them be sentient. But it's expensive . . . and illegal in some places . . . so we won't.

Now we need to buy software. Fortunately for our budget, in this world background you are allowed to make extra copies of programs that will be used as backups on the same ship. That means we can buy just one of each program we need. That eliminates both the moral and practical considerations of software piracy!

The programs we want are:

Piloting. $80,000. Its effective skill is 16 — or it gives a human pilot a +2. Modifications to the ship will be required for the program to work; see below.

Astrogation. In this campaign, an astrogation program is necessary. A standard program is $20,000.

Targeting and *Gunner.* Just in case . . . The Targeting program is very simple, costing only $1,000, and gives +1 to a human gunner's skill, but requires modifications to the ship (see below). At TL10, a Gunner program has a skill of 14, or gives a human gunner an additional +2. This program costs $45,000.

Damage Control. A bargain: only $2,000. Since we are buying this ship new, the technical database is included free.

Medical. $40,000. At TL10, it gives a +4 to Surgery and Diagnosis rolls, +2 to First Aid.

General Information Database. 1,000 megs of information about systems we're likely to visit. $1,000.

We'll pass, for now, on Translation and on Environmental Analysis — those are for unknown planets, and we don't plan to go anywhere totally unknown. Not just yet.

Ship Modifications

For our Piloting and Targeting/Gunner programs to work, we'll have to make certain modifications to the ship (see p. 52). This must be done only once, regardless of the number of backup computer systems. Piloting modifications cost us the minimum $1,000. Targeting modifications cost 10% of the weapons' cost, or another $2,000.

of this because the ship is 1,000 cy, so the final bill is $125,000 and 100 tons for one point of armor. Our PCs specify 2 points of armor, which doubles this cost and mass.

The *Aguila* class is winged (actually, a lifting body) so it can land and take off easily. This adds cost equal to base hull cost, and adds mass equal to 25% of base hull mass.

With a size of 1,000 cy, the ship automatically has a stress limit of 1,000 tons. We want a loaded mass of 1,000 tons and a significant margin of safety. We'll go with a stress rating of 1,500 tons. This is a 50% addition, so it adds 25% of base hull cost and mass. The *Aguila* design has total compartmentalization, which adds 100% of base hull cost and mass.

We are using an obsolete, used TL9 fusion plant — as per p. 81, but 5% of the original price! We install a 67-MW plant. It takes a base $50,000, 10 tons, and 5 cy, *plus* $5,000, ½ ton, and and ½ cy per 1 MW capacity.

Next we specify maneuver drives. Because our ship is winged, we need thrust equal to only 5% of her mass to let her take off from (worst case) thin-atmosphere worlds. If we assume that the ship's *loaded mass* — the most mass it is expected ever to carry — will be 1,000 tons, then we need a thrust of 50 tons, which would also give an acceleration of .05 G in space.

Now we install the hyperdrive. That's simple: 1,000 tons maximum mass would require 10 generators. We add one more for a backup. Power requirement for 1,000 tons ship mass is 10 MW, which won't be needed except in hyperspace.

However, we also need capacitors to provide the initial energy to enter hyperspace. To push our loaded mass of 1,000 tons into hyperspace, we need 100 MW-h worth of capacitors.

Our PCs make up a crew of five: a captain/pilot/astrogator, an engineer, a trade specialist, a gunner and survival expert, and a medic/engineer trainee. We will allow only enough crew space for five, plus cabins for two passengers. We will specify a full lifesystem for 10, to have plenty of room for error.

We don't have the power for much weaponry, but we can install two light lasers (10 MW total). Since they will never be needed in hyperspace, they can use the power that would otherwise go to the hyperdrive.

The computer system is discussed in the sidebar. We will also install artificial gravity; a standard sensor suite; one standard airlock; and landing gear.

The mass of the empty ship is now 396.5 tons, out of the 1,000 we allowed for, so we can carry just over 600 tons of cargo. Our remaining volume is 607.5 cubic yards.

The cost of the ship is $4,111,000, since she was built from standard plans. She will take about six months to build, as we see on p. 80.

Her hull integrity number (see sidebar, p. 94) is 14: TL10, plus 2 for DF 2 armor, plus 2 for her total compartmentalization.

Space Ship "Van Rijn" — 1,000-Ton "Aguila" Class Merchant — TL9/10

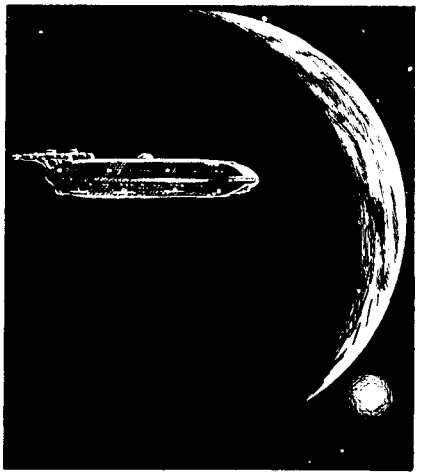
Component	*Mass*	*Volume*	*Cost*	*Power*	*Notes*
Hull	10	1,000	200,000		The cheapest possible material
Armor	200	—	250,000		2 points of protection
Streamlining	2.5	—	200,000		Winged lifting body
Stress rating	2.5	—	50,000		Stress rating 1,500 tons
Compartment.	10	—	200,000		Total compartmentalization
Fusion plant	43.5	-38.5	385,000	67	Obsolete (TL9) but needs no fuel — produces 67 MW.
Thrusters	25	-100	1,000,000	-50	
Hyperdrive	11	-33	440,000	-10	Draws power *only in hyperspace.*
Capacitors	50	-10	1,000,000		Hold 100 MW-h of energy.
Crew	5	-125	20,000		Space for 5 crew
Passengers	2	-40	6,000		Space for 2 passengers
Life support	7	-24	10,000	-5	Full lifesystem, cap. 10 people
2 light lasers	4	-4	20,000	-10	Use 10 MW *only in combat*
Grav unit	8	-5	100,000	-1	
Sensors	5	-5	50,000	-1	
Airlock	1	-8	10,000		Holds 4 humans
Computer gear	—	—	267,000		See sidebar.
Landing gear	10	—	1,000		Non-retracting.
TOTALS	*396.5*	*607.5*	*4,209,000*		

SPACE COMBAT 9

Only warpdrive ships are likely to meet and fight in deep space. But ships of any kind, moving on maneuver drive, can contest the strategic area around a planet or jump point.

The combat system presented here is intended to maximize the involvement of individual PCs (and, of course, significant NPCs). It gives many different skills the chance to be decisive in a battle.

Two types of damage are represented here: personal injury to important characters, and specific damage to the PCs' ship or ships.



Combat Rounds

Battle is conducted in combat rounds. The length of time represented by each round is up to the GM. The "default" value is one hour; space battles can be drawn-out affairs. But in a close-orbital engagement, a round might be ten minutes — and in a long-range running battle between STL craft at the edge of a system, a round might be a day!

The GM also decides how many combat rounds make up a "battle." In general, a battle has ended when the forces have an opportunity to regroup and plan their next moves. When a battle ends, characters make Survival rolls (p. 96).

Some engagements may consist of several combat rounds, one right after the other. Others may consist of several *battles*, with the characters having an opportunity to try more damage control, and make new battle plans, before each.

Detection and Engagement

Before any combat between spacecraft can occur, the opposing forces must detect each other. To do this, the sensor operator on each ship rolls against his Electronics (Sensors) skill (see p. 36). If one or both forces detects the other, they then decide whether they will engage in combat. If neither detects the other, no combat will occur, unless they are closing unwittingly. In this case, each makes another Sensor roll hourly, or oftener if quality of sensors (p. 30) allows it. Two forces may pass in space and never detect each other.

If detection occurs, the next step is to determine whether combat can happen. Speed is the most important factor in this; a fast ship can easily close with a slower one. But a slow ship with missiles may still get some shots at a fleeing opponent.

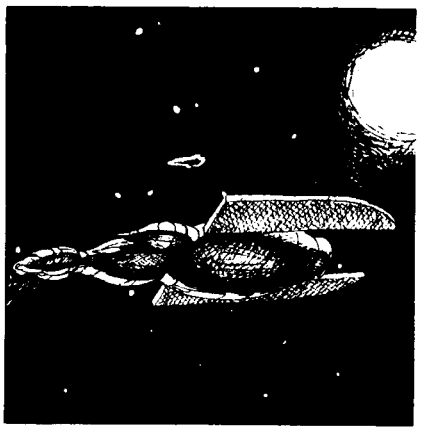
Thus, the decision to fight usually lies with the commander of the faster force. If only one side wishes to fight, but is not appreciably faster than the foe, the question of engagement is resolved by a Quick Contest of Piloting skill between the worst pilot in the fleeing force and each pilot in the pursuing force. Any pursuer who wins the contest may engage the fleeing force.

Should only one side detect the other, and the detecting side prefers *not* to fight, it can simply alter course to avoid closing before the other force detects it. If the detecting side wishes to engage, it can close the gap. As it closes, the opposing force will get additional sensor rolls to detect its approach; once each side has detected the other, the final decision to engage once again falls to the commander of the faster force.

Shadowing

If one force detects another without itself being detected, the detecting force may attempt to *shadow* the other, following its movements and staying on the very edge of sensor range. To do so, the shadowing sensor operator must make an Electronics (Sensors) roll every fifteen minutes, including all appropriate modifiers, to keep a fix on the shadowed craft. Failing this roll means that sensor contact with the shadowed craft has been lost. If the roll is successful, the shadowing pilot must then roll a Quick Contest of skills against the shadowed sensor operator, Pilot vs. Electronics (Sensors), to avoid being detected.

If the shadowing craft has superior sensor range or superior Stealth, it can move in closer, and the sensor operator needs to roll only once per hour.



The Battle

If there is a battle, whether one-on-one or fleet against fleet, the following system resolves the action.

Phase 1: Contest of Tactics

The two ship captains (or force commanders) roll a Quick Contest of Tactics. If there are more than 10 vessels in the battle, use Strategy skill instead. Special circumstances and the PCs' actions can modify the rolls, as detailed below.

If one commander wins the contest by more than 3 points, he may choose either to do more damage to the foe (by shifting all his attacking results by one column to the left on the Combat Results Table) *or* to suffer less damage to his own forces (by shifting all his defending results by one column to the right). A commander who scores a critical success gets two column shifts: one in each direction, or both in the same direction! The commander must make his choice now; he must tell the GM, but not the opponent.

Special Circumstances

The GM assigns bonuses in the Quick Contest of Tactics, or subtracts penalties, for any circumstances which affect the battle. A few examples:

Attack totally by surprise: +5 first round, +2 second round.

Partial surprise — less than 3 minutes warning: +2 (first round only).

Familiar space: +1 to +3 (e.g., fighting in a known asteroid field is worth +2).

Defending your home system: +2, plus "familiar space" if applicable.

Battle Plans

If PCs are force commanders, or important in the planning the battle, the GM should require the *players* to give him a battle plan (or plans, if there are PCs on both sides) before making the Tactics roll. If the GM feels these plans are especially good or bad, he may apply from +3 to -3 in the Contest of Tactics.

Phase 2: Assign Firepower

Each PC who is a *ship captain* (including fighter pilots) now declares how aggressively he will press his own attack, as follows:

Extremely aggressive: +50% to effective Firepower of all ship weapons; -2 to ship's effective DF.

Aggressive: +25% to effective Firepower of all ship's weapons; -1 to ship's effective DF.

Per doctrine: No modifiers.

Defensive: -25% to effective Firepower of all ship's weapons; +1 to ship's effective DF.

Extremely defensive: Halve the ship's effective Firepower of all ship's weapons; +2 to ship's effective DF.

The GM or Adversary decides how aggressively NPC captains will perform. The ship's crew has no say in the captain's decision, unless they want to stage a mutiny.

Each side in the battle (players, GM, and/or Adversary) now lists the weapons that each ship will fire during the first combat round, and the target for each weapon. Some weapons may be assigned to point defense (antimissile) fire. Other weapons should be assigned to specific enemy ships.

If PCs are ship captains, each captain assigns his own weaponry. If the force commander gives specific orders about weapon assignment, it is up to the captain how closely to follow them. NPC captains are controlled by the GM or (for enemy ships) the Adversary, and may or may not follow orders exactly.

Phase 3: Point Defense Gunnery

Any weapon except explosive missiles may be assigned to point defense (anti-missile) fire, targeting one attacking missile. The character controlling the point defense weapon attempts his Gunner roll, plus or minus 3 times the difference in the TLs of his weapon and the enemy missile. On a successful roll, the missile is destroyed, and does not contribute its firepower to that combat. On a failure, the missile is unaffected, and that point-defense weapon may not fire at it a second time.

Point-defense weapons do not contribute their firepower to the combat, regardless of whether they destroy their target missiles — or even if no missiles are fired at the ship. Point-defense gunnery is not affected by the aggressiveness of the captain's attack.

If more than one missile is fired at the ship during a given combat round, a point defense weapon may attack a second one at -2, a third one at -4, and so on. No attack may be made at a modified skill of less than 3! These modifiers are not affected by the length of the round; in a quick, close battle, the missiles will be fired at short range and can be engaged (hit or miss) quickly, while in a long-range battle, it will take longer to deal with each missile. The time to hit a missile is as soon as it comes in range — they accelerate constantly and will be moving very fast if they have come in from a long distance!

Any number of gunners may attack the same incoming missile, but it counts as one shot for each of them.

If atomic or antimatter missiles are used for point defense, at least one missile tube must be committed to point defense, and each attack on an enemy missile expends one of the ship's own missiles. Each subsequent missile fired by the same gunner is fired at a cumulative -2 penalty, as above.

Ship commanders can use NPC gunners for point defense. Unless the NPC gunner's skill is already known, roll 1d+10 to generate skill for an experienced gunner, or 1d+6

for a non-gunner pressed into service. Gunnery computers can be used, at their effective skill. Characters who serve on point defense cannot attempt damage control, etc., on that same round.

PCs with ESP ability can use their Precog skill. Add (Precog-10) to Gunner skill, spending one Fatigue point, to guess where the incoming missile is . . .

Phase 4: Computing Attacks

Each PC who is serving as a gunner (including fighter pilots, but not including point defense gunners) may now make a Gunnery roll. Fighter pilots who are both flying and shooting may substitute a Piloting roll if they choose.

For PCs only, each point by which the roll was made increases that weapon's effective Firepower by 10%. A critical success doubles Firepower. (Missing the roll reduces that weapon's Firepower by 10% for each point by which the roll was missed, and a critical failure reduces Firepower to zero for that round.) For one-man fighters, Firepower of the whole ship is affected.

Each ship in the battle now undergoes a single *attack,* based on the total effective Firepower of all weapons aimed at it (except for destroyed missiles). The attacking Firepower is compared with the ship's Defense Factor to yield a ratio, rounding in the defender's favor. The Combat Results Table then gives the outcome of the attack.

A ship's basic Defense Factor is given by its armor and force fields (p. 78), plus its Stealth Suite if any. If a hull is unarmored, its Defense Factor (DF) starts at 0. If a ship's *final* DF, after modifications for stealth and hull size, is 0 or less, treat it as having a DF of .25. An aggressive attack lowers effective defense, and vice versa. However, a ship can get bonuses or penalties to Defense Factor for other things:

10 or fewer cy: +2
100 or fewer cy: +1
1,000 or fewer cy: 0
10,000 or fewer cy: -1
100,000 or fewer cy: -2
1,000,000 or fewer cy: -3
Over a million cy: -4
Ship has warpdrive: +2
Ship can make short, aimed hyperspace skips at intervals of 5 minutes or less: +1

Combat Results

To determine damage, the attacker rolls one die on the table below, on the line appropriate to the final odds ratio. Treat any result of less than 5 to 1 as having no effect. Divide any result of greater than 1,000 to 1 into separate attacks — one or more at 1,000 to 1, plus a remainder.

Odds	*Die roll, as modified*						
	1	*2*	*3*	*4*	*5*	*6*	*7+*
5-1	1/0/0	—	—	—	—	—	—
10-1	1/1/0	1/0/0	—	—	—	—	—
20-1	2/1/0	1/1/0	1/0/0	—	—	—	—
50-1	2/2/0	2/1/0	1/1/0	1/0/0	1/0/0	—	—
100-1	3/2/0	2/2/0	2/1/0	1/1/0	1/0/0	1/0/0	—
200-1	3/2/1	2/2/1	2/2/0	2/1/0	1/1/0	1/1/0	1/0/0
500-1	3/2/2	3/2/1	2/2/1	2/2/1	2/1/1	1/1/1	1/1/0
1,000-1	3/3/3	3/3/2	3/2/2	2/2/2	2/2/1	2/1/1	1/1/1

Special Radiation Effects of Missiles

Nuclear and antimatter missiles produce radiation and EMP effects which can injure both ship crew and computers. Missiles intercepted by antimissile fire do not produce radiation.

The rad dose delivered by each unintercepted missile is equal to (Firepower × TL × 10). Add all the missiles together to make one radiation dose. See p. 77 for protection against radiation, and for radiation effects. If the ship has armor or a force field of DF 1, (p. 78), it has a radiation Protection Factor of 10. DF 2 gives a PF of 100, DF 3 gives a PF of 1,000, and so on.

If a ship crew takes enough rads to incapacitate them immediately (5,000 rads or more), that ship is out of the battle. A crew that takes 1,600 rads may fight out that battle but will be incapacitated within a day.

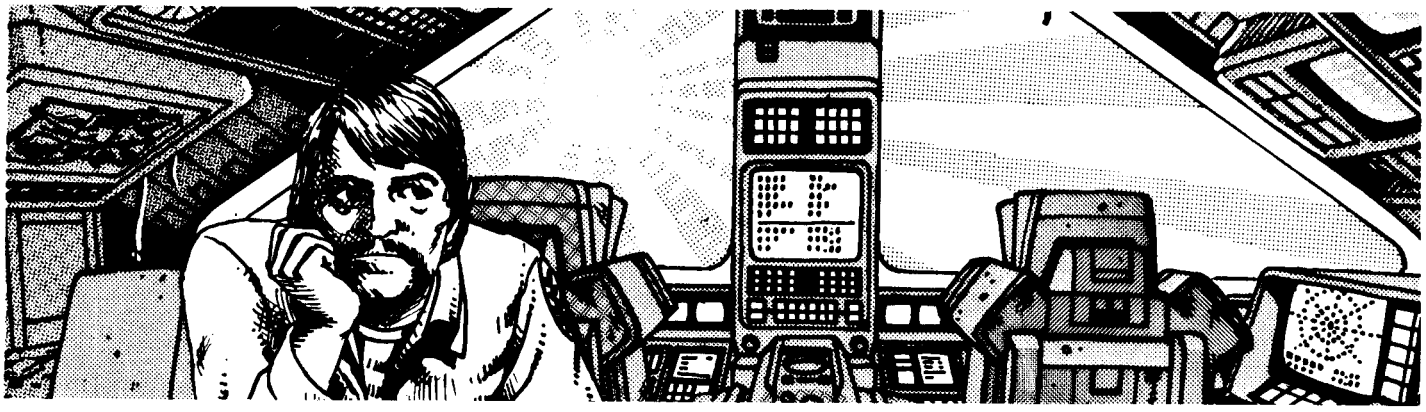
Radiation Effects on Computers

The EMP (electromagnetic pulse) from a nuclear weapon can permanently scramble computers and other delicate electronic equipment. Any electronic gear (sensors, automedics, and so on) is just as vulnerable as a computer. The only exception is an *optical* computer, specifically designed to resist EMP.

Assume that the EMP is proportional to the rads produced by a missile, as described above. But EMP from each missile is figured separately. Thus, while a combined rad dose from several missiles could kill the crew, it is quite possible that no single EMP pulse could penetrate the ship's force field to kill the computers.

The higher the TL, the more resistant electronic gear becomes. Rad levels equivalent to an EMP kill, by TL, are as follows:

TL7	100 rads
TL8	200 rads
TL9	500 rads
TL10	2,000 rads
TL11+	10,000 rads



Hull Integrity

A Hull Integrity roll must accompany each Medium or Heavy damage result; the Hull Integrity roll is made first. The basic Hull Integrity number is equal to the TL plus the hull DF, rounded down; roll this number or less to avoid damage. High compartmentalization adds 1 to Hull Integrity. Total compartmentalization adds 2. If the damage was Heavy, roll at a -2 penalty.

Treat any critical failures as ordinary failures.

Any failed Hull Integrity roll will cause problems. Each individual failure can be repaired in one hour by an Engineering, Mechanic (Starship), or Vacc Suit roll, as appropriate, unless indicated otherwise:

Roll failed by 1-2: Some compartments lose pressure. Make a separate HI roll for each compartment that matters — e.g., bridge, Engineering, control rooms for each weapon. A failed roll puts that compartment in vacuum. Everyone in the compartment must roleplay their attempt to escape and/or get into a vacc suit! Compartments in vacuum cannot be used except by vacc-suited crew.

Roll failed by 3-4: As above, but all rolls at -2.

Roll failed by 5-6: As above. Also, roll separately for each major ship system (each drive, power plant, important weapons, life support, and so on), again at -2, to see if it lost power. It will cost 10% of the hull cost to permanently repair this in a shipyard.

Roll failed by 7-8: As above, but all rolls at -4. It will cost 25% of the hull cost to permanently repair this in a shipyard.

Roll failed by 9: Hull loses pressure entirely. All power conduits are broken. All ship systems are wrecked. No damage control possible; if the ship cannot be towed to a shipyard for salvage, it is lost. All crew make Vacc Suit rolls at -5.

Roll failed by 10+: Hull breaks open entirely. If the ship is landed, it collapses and is wrecked. If it is in atmosphere, it crashes! Otherwise, the ship simply splits open, spilling its contents into space. No damage control is possible. All systems are shut down; every man for himself. All crew must make Vacc Suit rolls at -6.

Landings and Takeoffs

If a ship is not streamlined (see p. 78), a Hull Integrity roll, at -6, is necessary each time it enters atmosphere. This includes landings, takeoffs, attempts to scoop gas from a gas giant, and so on.

If the ship is equipped with contragravity, it rolls at -2 instead of -6.

If a ship is strongly enough built, it can bull right through the atmosphere without falling apart!

Phase 5: Computing Ship Damage

The Combat Result roll indicates which Ship Damage Tables (below) are checked, and how many times. A result of 3/2/1 would indicate three Light Damage rolls, two Medium Damage rolls, and one Heavy Damage roll.

When rolling on the Ship Damage Tables, roll 1 die for ships of hull size under 1,000 cy, 2 dice for ships of 1,000 to 10,000 cy, and 3 dice for ships over 10,000 cy.

Lighter damage rolls are made before heavier ones. Weapon and computer damage, and "shaken up" results, are cumulative but must be repaired separately. Ignore — and do *not* reroll — results which damage a component that has already been destroyed.

Light Damage

1 — Ship shaken up — *all* subsequent rolls involving ship operations at -1. Requires 3 damage-control rolls to fix.
2 — Drive damaged — ship at -10% drive power.
3 — One main weapon damaged — an Armourer+3 roll (or equivalent) repairs it.
4 — Life support damaged — loses 10% of original capacity. See p. 85.*
5 — Sensor suite damaged — all sensor rolls with that suite at -3. Halve Firepower of non-missile weapons.
6 — Power plant or capacitor bank damaged, losing 1/4 its base capacity or 10 MW, whichever is greater. This result may be rolled more than once.
7 — One weapon in six (but at least one) damaged — each at -1 to hit on point defense.*
8 — One accessory damaged — roll randomly, or GM assigns.
9 — One main auxiliary craft damaged — apply one meaningful Medium damage result.*
10 — One area (not otherwise mentioned on this table) damaged.
11 — Fuel storage holed. Lose 10% of remaining fuel or reaction mass.
12 — Landing gear destroyed; ship must be repaired in space or make a belly landing (Hull Integrity roll at -4 penalty).
13 — Cargo area (hangar deck or passenger area) shaken up. Contents may be damaged.*
14 — Passenger area (cargo area or hangar deck) shaken up. Passengers take 1d damage each.*
15, 16 — Hangar deck (passenger area or cargo area) shaken up. Each auxiliary craft takes one Light Damage roll.*
17, 18 — Drive damaged — as #2 above.

Medium Damage

Roll once for Hull Integrity (see sidebar) for each Medium Damage result taken.

1 — Ship shaken up — *all* subsequent rolls involving ship operations at -2. A damage-control roll at -4 reduces penalty to -1. A second roll at -6 removes the penalty.
2 — Drive damaged — ship at -50% drive power.
3 — One main weapon damaged — halve its firepower. Requires 2 damage-control rolls to repair.*
4 — Life support damaged — loses 30% of original capacity. See p. 85.*
5 — Ship's computer damaged — all rolls using computer assist are at -3, unless a backup is available.
6 — Power plant or capacitor bank damaged, losing half its base capacity or 20 MW, whichever is greater. This result may be rolled more than once.*
7 — One weapon in six (but at least one) wholly destroyed.*
8 — Artificial gravity (if it exists) knocked out; all crew now need Free Fall skill (p. 73) on any rolls they try. Reduce effective Firepower by 10%. If there is no artificial gravity, one area not mentioned on this table is damaged.*
9 — Main bridge damaged — all rolls by this ship's personnel, except Survival rolls, at -1. Damage control at -3.*
10 — One area (not otherwise mentioned on this table) damaged.*
11 — Fuel storage holed. Lose 25% of remaining fuel or reaction mass.*
12 — Intership communication ability lost; will require four damage-control rolls to recover. Until then, ship cannot communicate or coordinate with other ships in the battle.
13 — Cargo area damaged (lacking that, hangar deck, or passenger area). Cargo takes approximately 10% damage, as determined by GM.*
14 — Passenger area damaged (lacking that, cargo area, or hangar deck). Each passenger takes 2d damage.*
15, 16 — Hangar deck or boat bay damaged (lacking that, passenger area, or cargo area). Each auxiliary craft takes one Light and one Medium damage roll.*
17, 18 — Drive damaged — as #2 above.

Heavy Damage

Roll once for Hull Integrity (see sidebar), at a -2 penalty, for each Heavy Damage result taken.

1 — Power plant or capacitor bank destroyed. Ships with antimatter engines blow up.**/**

2 — Drive destroyed (no repair possible).**/**

3 — One main weapon destroyed.**

4 — Force field projector destroyed — if there are no force fields, sensor suite lost.

5 — Ship's computer destroyed; halve Firepower unless a backup is available.

6 — Ship's frame sprung. Reduce Hull Integrity by 1d. Cost to repair will be 1d×10% of base hull cost.

7 — Roll 1 die for each weapon; a 6 destroys it. At least one weapon must be destroyed.**

8 — Artificial gravity (if it exists) destroyed; all crew now need Free Fall skill (p. 73) on any rolls they try. Reduce Firepower by 10%. If there is no artificial gravity, one area not mentioned on this table is destroyed.*

9 — One bridge destroyed — ship is dead in space, unless there is another bridge.**

10 — One area (not otherwise mentioned on this table) destroyed.**

11 — Fuel or reaction mass storage opened to space. All fuel or reaction mass (roll if ship has both) is lost.**

12 — Force field projector destroyed. If ship has no projector, one sensor suite destroyed.

13 — Cargo area destroyed (lacking that, hangar deck, or passenger area). Contents take 50% to 100% damage, depending on their nature — GM's ruling.**

14 — Passenger area opened to vacuum (lacking that, cargo area, or hangar deck).**

15, 16 — Hangar deck or boat bay destroyed (lacking that, passenger area, or cargo area). All auxiliary craft take 1/1/1 damage. 1d damage-control rolls will be needed to open a passage to launch auxiliaries.**

17 — Drive destroyed.**/**/**

18 — Power plant or capacitor bank destroyed.**/**/**

Damage Table Notes

Any time the damage result could describe more than one ship system (e.g., "drive" when the ship has two different drives), roll randomly to see which one is affected.

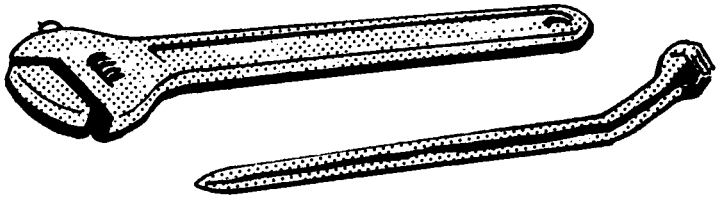
With some FTL drives, it will be impossible to enter FTL until the drive is fully operational. With other drives, the ship is simply slowed.

Damage to the sensor suite halves Firepower of all weapons except missiles, until it is repaired. Loss of the sensor suite means that no weapons except missiles can be used!

Possible PC Injury

When a damage result shows a *, any PC in that area of the ship must *immediately* make a Survival roll (see p. 96). When a ** is shown, any PC in that area must make a Survival roll at -5. If two ** are shown, two survival rolls are required, and so on.

Note that for a ship of 100 cy or less, anyone on board is effectively "in" any area hit. If no specific plan of the ship is available, the GM decides who is affected by each hit.



Phase 6: Damage Control

After damage is assessed and PC injury checked, all PCs may attempt damage control (see sidebar). Damage control is considered to start as soon as the round starts, even though it is computed after damage. PCs who are at half their HT or less may attempt damage control at -2 to their rolls, but those at HT 3 or less may not attempt damage control at all. If rounds are an hour long, the first two PCs treated by each medic may attempt damage control based on their HT *after* treatment.

Damage Control

At the end of each combat round, PCs not involved in controlling the ship or firing the guns may attempt damage control, using skills appropriate to the damage. Engineering, Shipbuilding (Starship), Mechanic, and Armoury (ship's weapons) are always appropriate; the GM may rule that others are appropriate for specific sorts of damage. Vacc Suit is appropriate for hull or other exterior damage.

Each PC may make one damage-control roll per hour. The GM may allow PC commanders to use the services of NPC damage control crews, as well. In general, not more than 10% of the crew should be considered capable of attempting these rolls, at skills of 1d+10.

A successful roll against a given piece of damage repairs it temporarily (a shipyard will still be needed, and real repairs will cost an average of 50% of original cost). Failure has no effect. A critical failure breaks the equipment, and may have worse effects. For instance, a critical failure to repair a fission plant will irradiate the whole engine room, and a critical failure on an antimatter plant will blow the ship up!

Damage control on computers and sensors requires an Electronics roll with the appropriate specialty. This is a matter of quick troubleshooting and replacing modules. If the first roll fails, the damage cannot be repaired until after the battle.

Some types of damage will give penalties to the roll, or require more than one roll, as noted on the Damage Tables. Note that when a component is listed as destroyed, rather than damaged, it cannot be repaired unless the ship has a spare available!

If a component is repaired, and then damaged again in the same battle, subsequent damage-control rolls are at -2 for each time the component has been damaged. This does not apply to welding the hull or splicing power lines after a Hull Integrity failure.

Emergency Medical Aid

The ship's medic, and anybody else with First Aid skill, will be busy during a battle. Anyone who is injured during a round of battle may be the subject of a First Aid roll during the damage-control phase. First aid takes 10 minutes per victim (see p. 64). A medic can get a skill bonus for heroism by taking a penalty on his next Survival roll (or vice versa), as described in the sidebar on p. 96.

The medical team's ability to get key crew back into action can make the difference between victory and defeat, especially on a small ship.

Heroism and Caution

At any time during the combat, a PC who makes a skill roll (for any reason) may elect to behave either heroically or cautiously. Heroic behavior gives a +1 or +2 bonus on the skill roll; cautious behavior gives a -1 or -2. And either choice gives the *opposite* modifier on the PC's next Survival roll.

For instance, suppose a PC is attempting damage control. He may get up to a +2 bonus on the roll by declaring that he is behaving heroically; perhaps he is entering a potentially radioactive area in order to make a repair quickly. Likewise, he may declare that he is behaving cautiously, taking up to a -2 penalty. Either way, the opposite modifier applies on that PC's next Survival roll, whenever it is.

These modifiers are cumulative. An engineer who is heroic three times before a Survival roll, for a +2 each time, will take a -6 when that roll is made. But each bonus or penalty applies only to one roll . . . the next one made.

The GM may also declare that certain damage-control tasks are hazardous and require the crewman to take a penalty on his next Survival roll if he tries those tasks at all!

The effect of bravery or caution can extend beyond the battlefield. If your daring helps carry the day (and you are lucky enough to be noticed by the Right People), you might receive a decoration, a promotion, or even a patron. Cowardice in the face of the enemy will have obvious negative effects.

Ending the Round

In an abstract system, ending an engagement must be at the discretion of the GM. As a rule, any ship faster (or with better acceleration) than its foes can break away. In some situations, slower ships may still escape by scattering, hiding, landing on a planet, and so on. GMs should be sympathetic to clever PC ploys to escape a hopeless battle!

If the engagement is at slower-than-light speeds, fight one last round of combat using missile weapons only.

Starting a New Round

If both sides still want to fight, or if one side cannot (yet) escape, another round of combat begins. Recalculate the firepower of both sides to account for lost or damaged ships, dead or unconscious crew, and any reinforcements that may have appeared.

Battle plans do not affect the Tactics rolls made for the second and subsequent rounds of a battle.

Starting a New Battle

The GM may also rule that the forces will have time to regroup, repair and make new plans, even though both want to continue fighting. This might be the case if, for instance, the forces met at high speed and passed through each other while firing!

In this case, determine survival as described below. Allow one damage-control roll per PC for each hour that passes until the next battle. If FTL radio exists, forces can communicate with their bases.

Player Character Survival

At the conclusion of the entire battle, each PC and important NPC must make a Survival roll, based on his HT. This is modified by the size (in cubic yards) of the PCs' ship, and the intensity of the heaviest damage it suffered. PCs with Combat Reflexes get an extra +2 to effective HT for this roll, because they can react quickly to emergencies.

Those who have the bad luck to be in a portion of the ship that takes damage must also make one or more Survival rolls (using all the modifiers listed below) *during* the battle.

It is assumed that a vacc suit is available; those without access to a vacc suit have -2 on any Survival roll. Actual, airtight body armor gives a +1 or better — GM's option.

Degree of Damage	*Survival Roll Modifier*
Light	0
Medium	-1
Heavy	-2
More than one Heavy	-3

Ship Size	*Survival Roll Modifier*
100,000+	+2
50,000+	+1
10,000+	—
5,000+	—
1,000+	-1
Under 1,000	-2
Any non-military ship	-2

Having determined the appropriate Survival roll for each PC, roll to determine the injuries incurred during action:

Survival Roll Result	*Injury*
made by 5+ or a Critical Success	unhurt
made by 1 to 4	1 hit
made exactly	2 hits
missed by 1 or 2	1d+1 hits
missed by 3 or 4	two 1d wounds
missed by 5 or 6	two 2d wounds
missed by 7+ or a Critical Failure	three 2d wounds

Crew Losses

In a situation where there are a great many NPCs on the PCs' ship, a "group survival roll" may be made to see how many "generic crew" have been killed or incapacitated. Assign the crew a generic HT of 10, unless they are of a race with a different average HT. Roll, using all the above modifiers. The ship loses 10% of its current crew for each point by which the roll was failed. Check once at the end of each battle, and again *during* the battle for all crew in a compartment affected by a damage result marked with a *.

STARS AND WORLDS 10

When the GM knows what type of campaign he wants to run, and what his interstellar civilization is like in general, it's time to draw a star map and start creating worlds.

This chapter describes a step-by-step method for the GM to follow in building stars and worlds logically. Also included, mostly in the sidebars, are probability tables for the GM who wants to create many worlds quickly (or perhaps write a computer program to do the job).

Fill in a Planetary Record sheet (example on p. 116, blank form on p. 128) as you develop each system and its worlds.

Star Mapping

The type of map to draw depends on the scope of the campaign, and, even more, on the type of FTL travel used in your universe.

If starships move by "jumplines" or a similar system, space can be mapped just by drawing the jumplines. Any star (or anything else) not on a jumpline may be ignored; it can't be reached except by a generation ship! If travel is instantaneous, only the connections are important. If travel along jumplines takes time, the length of each line must be shown.

If ships move through hyperspace, the distance between stars is important, but intervening features may be ignored.

If FTL ships use a "warpdrive" to move through "normal" space, possible hazards like nebulae should be mapped. In general, any area that could harbor foes or slow travel should be shown on a map.

Map Scale

Map scale will depend entirely on the frequency of important worlds (not just habitable ones). If useful worlds average 3 to 5 parsecs apart, for instance, a ¼" square grid, with each square representing a parsec, will be convenient. If worlds are closer together, as in a cluster, use a smaller scale.

The Third Dimension

Maps (at least, the convenient kind) are flat . . . but space is not. You may simply ignore this and place all your star systems in the same plane. But it is more realistic to use a three-dimensional grid system. The map surface itself represents a "height" of 0. If you are mapping a whole galaxy, zero height indicates the "galactic plane."

A star above the galactic plane should be mapped with a "+" sign, followed by its distance above the plane in parsecs. If it lies below the plane, note it with a "-" sign and the distance. Stars on the galactic plane need no designation. Thus, if Lestrade's Star lies 4 pc below the galactic plane, this should be noted on your map with (-4).

To find distances between stars on a 3-D map, use the formula $x^2 + y^2 + z^2 = d^2$. That is: square the distance, on each of the three axes, between the two stars. The square root of the total is the straight-line distance between them.

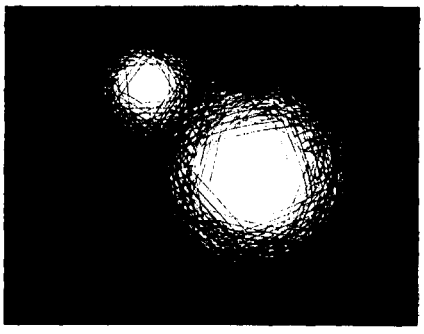
Astronomical Measurement

Three measures of distance are used on the stellar and interstellar scale.

The *astronomical unit*, or AU, is approximately 93 million miles. This is the distance from the Earth to the Sun. Orbital distances from a star are expressed in AU in this book. In our own solar system, Earth lies 1 AU from the sun, Mercury is .4 AU from the sun, and Uranus lies 19.2 AU out.

The *light year*, or ly, is some 5.9×10^{12} miles — the distance light travels in one year. This is a common measure of distance in science and science fiction. One ly equals 63,271 AU.

The *parsec* (*par*allax of one *sec*ond, or 206,265 AU), abbreviated pc, is approximately 3.26 ly. This is roughly the distance from Sol to the nearest star, Alpha Centauri. The parsec is the standard unit of interstellar measurement in this book.



Random Star Location

Assuming 3-dimensional grid points one parsec apart, and a general separation between stars of about 4 parsecs, the GM may roll 2 dice to determine what lies at each grid point. Add 1 to the roll in a cluster or core area.

2-9 — Empty space.
10 — Possible unusual item; roll one die. If the result is a 6, go to the Unusual Stellar Objects table on p. 100. Otherwise, there is nothing here.
11+ — Star system.

Note that this is a very time-consuming method of building a star map, unless you program a computer to do it for you. See p. 99 for an alternate method of placing worlds.

Generating Star Systems

Single or Multiple?

As many as one in three star systems may be a multiple star. Roll 2 dice to determine how many stars there are in the system, adding 2 to the roll if the area is in a cluster or galactic core:

2-9 — Single star
10 — Double star
11 — Triple star
12+ — Four or more stars — a double rotating around a double or triple, for instance — GM's decision!

Star Class (Size)

Most stars fall into four size classes. These are *main sequence* stars, average-sized stars like our own sun and the most common; smaller *dwarfs* and *subdwarfs*; larger *giants*; and huge *supergiants*. Roll 3 dice:

3-5 — White dwarf (Class D)
6 — Subdwarf star (Class VI)
7-17 — Main sequence star (Class V)
18 — Giant star; roll 3 dice again:
  3 — Class I supergiant. ⅓ chance of Class Ia (the largest); ⅔ chance of Class Ib.
  4 — Class II large giant
  5-12 — Class III giant
  13-18 — Class IV subgiant

Main Sequence Star Types

To determine type of a main-sequence star (Class V), roll 3 dice:

3 — O (Blue)
4 — B (Blue-white)
5 — A (White)
6 — F (Yellow-white)
7 — G (Yellow)
8 — K (Orange)
9-18 — M (Red)

Clearly, the small M-class red stars are by far the most common.

Giant Star Types

To determine the type of a giant, subgiant or supergiant star, roll 2 dice.

2 — O (Blue)
3 — M (Red)
4, 5 — B (Blue-white)
6-9 — K (Orange)
10-12 — A (White)

Certain giant stars do not seem to exist. Ignore and reroll the following results: O-II, O-III, O-IV and M-IV.

Also ignore any Blue or Blue-White result if you are mapping an area of space other than a spiral arm or young cluster.

Giant stars of types F and G are very unusual — they exist, but they are much too rare to show on a random table.

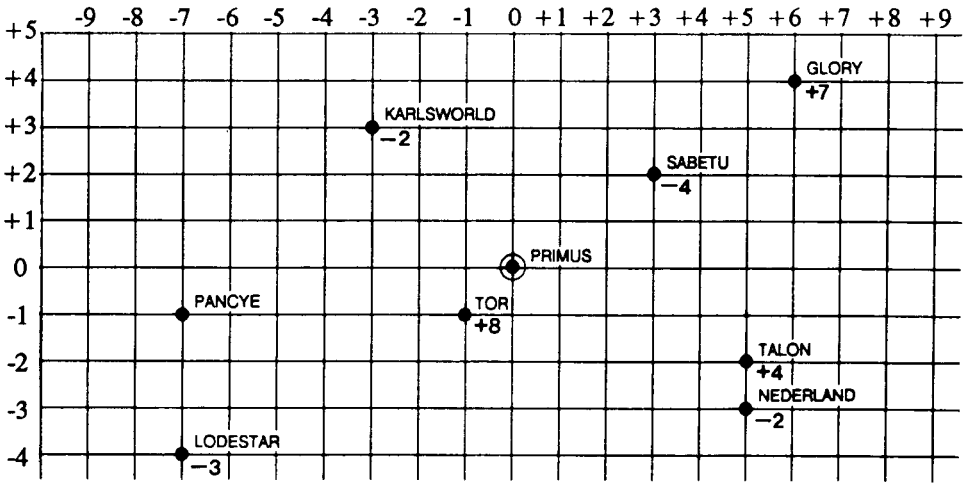
Subdwarf Star Types

Roll 1 die for a subdwarf's color:

1 — Yellow (G)
2 — Orange (K)
3-6 — Red (M)

3-D Terminology

A spaceman uses standard directions to describe star locations. When he says "north," he means *galactic* north, unless he is groundside, and even then he will specify *planetary* north if that's what he means. Galactic North always goes at the top of a star map; the direction from Sol to the Core is defined as Galactic North. Galactic Up is arbitrarily defined; if an observer is "above" the Milky Way, the arms go counterclockwise as they spiral outward from the core.



Astrographic Features

Map features (depending on the scale chosen) may include:

Galactic clusters. Galaxies congregate into structures known as *clusters* — groups of 10-100 galaxies within 1.5 million parsecs of one another. Clusters are distributed through the universe as though space contained invisible bubbles, with clusters on the surface of the bubbles. There are great voids, surrounded by expanding fringes of galactic clusters. The "bubbles" seem to be distributed evenly — scientists differ over whether the universe has or *can have* a center.

Galaxies. Our galaxy is 30,000 parsecs across, with most of the galaxy being a thin "disk" of spiraling arms. The central core is roughly spherical, around 5,000 pc across.

Galactic arms. Our galaxy, like many, has spiral "arms." The arms contain more gas and hot, young stars — this is what makes them visible. Stars are born in the arms, but as they age their orbits take them elsewhere. The spiral pattern will continue, with new stars born as others age and wander. Galactic arms are often broken or irregular. An average arm is 1,800 pc wide and 300 pc high. Some galaxies are not spiral, but *elliptical,* with no particular internal structure.

Globular clusters, 6-60 pc in diameter, form when a galaxy is young, and contain some 100,000 tightly-packed stars. In our galaxy, these clusters and their stars are very old. Many of the stars are red giants, and a large black hole may reside at a cluster's core. Star systems may be mere light-weeks apart in the center; thus, few worlds have stable orbits or life. Clusters do not concentrate in the galactic disk, but orbit the core, crashing through the disk twice per orbit.

Nebulae are gas clouds, 1-60 pc across. They may contain stars in process of formation. A nebula may be dark, or may glow if it is excited by radiation from a nearby star or its own protostars. Nebulae can be important in a campaign if they conceal stars or block (or just slow) interstellar travel.

Open clusters. When a nebula is disturbed by an outside influence, concentrations of gas occur, which then suck in more gas . . . and stars are formed. Originally the stars are close together, but outside influences gradually scatter them, especially in smaller clusters. Binary (two-star) systems are common in

open clusters; trinary and larger systems are possible. Stars, and therefore worlds, are close together in clusters, making them strategic locations and logical centers of trade.

Young open clusters are tight-packed groupings of stars, 3-15 pc across; many are hot and bright. Their radiation may ionize any remaining interstellar gas in the cluster, making it glow. Or a dense cloud may shield the stars within from outside view; on the inside, the cloud will be lit by the stars' light.

Middle-aged open clusters are less tightly packed — 6-25 pc across. The hot, bright stars have destroyed themselves in supernovae. Any remaining gas in the cluster is dark. These clusters are likeliest to have life-bearing worlds.

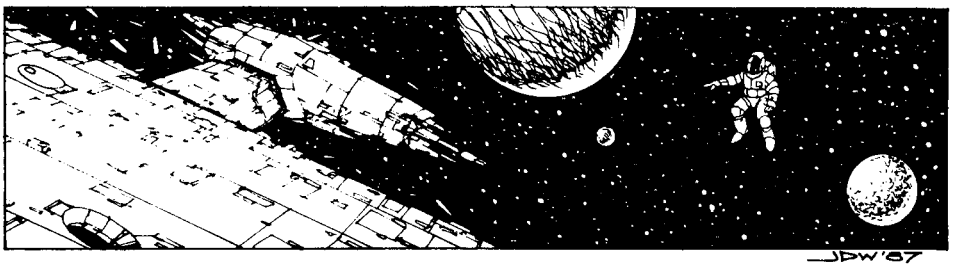
Old clusters are rare, since a cluster is usually scattered before it reaches this age. They include many red giants and dwarf stars.

Placing Worlds

There are some 4×10^{11} stars in our galaxy. 1.3×10^{11} — 33% — are thought to have planets. How many of these are suitable for life? *Insufficient data. It's anyone's guess.* Any number of scholarly calculations can be made, and they're all based on assumptions.

This means that the GM is free to make habitable worlds as common as he likes. It is possible that Terra-type worlds are a natural feature of G-type stars. It's also possible that the right combination of temperature, gravity and composition is so rare that explorers will have to search thousands of stars to find one marginally habitable world.

Unless habitable worlds are incredibly rare, we will find many planets that just aren't worth bothering with. These will include some we might not care to colonize (though there will usually be at least two life-candidates per system) — hot or cold, thick or thin atmospheres, or tide-locked worlds on which one side permanently faces the sun. There will be worlds with nothing more than amoebas in an organic soup, or lichen on eroding rock. There will be worlds with intelligent life that has not developed star travel, or that has destroyed itself or been destroyed. There will also be high-TL races which have no star travel due to lack of metals, odd technological development, or unsuitable physiology or temperament (aerial or oceanic creatures, perhaps).



The point is: if the campaign covers more than a few cubic parsecs, the GM should not try to map every star, or even every habitable system, and probably not even every world with intelligent life. There are just too many. The GM can concentrate on locating the major star systems in his campaign, just as the publisher of a road atlas selects the most important cities for a national map.

There are two ways to locate worlds. The easiest is to close your eyes and mark the map twenty or so times — each mark will be an important world.

The harder method is to study the map, and add systems at selected spots for economic, military and campaign reasons. For instance, clusters will logically contain more stars, and more chances for a useful world.

For realism, GMs should combine both methods. Systems in vital locations will be colonized, even if they aren't ideal. And some of the best worlds for settlement may be remote. Random location reflects this.

Multiple-Star Systems

Most multiple-star systems are made up of stars which evolved together. The companions may be of very different types, but they will have the same age. But since stars evolve at different rates, a pairing like red giant/blue giant is possible. Another likely combination is a red giant and a white dwarf; if they are close binaries, they may be a nova system (see p. 100). If close companions are very different in energy output, their worlds will experience "seasons" depending upon which star is closest to them. These seasons may be as short as days or as long as months.

However, the dynamics of multiple systems make planets rarer than in single star systems; add 2 to each die roll when checking for planets of stars in a multiple system.

Binary systems

These contain two stars, revolving around one another. Binary systems are common, especially within open clusters (see sidebar). Binary systems with planets fall into one of two types:

Close companions: The two stars are very close, revolving rapidly around one another. Worlds orbit around the center of mass of the stars. The minimum orbital distance equals three times the separation between the two stars. Habitable close binaries are rare — it is difficult to have worlds close enough to be habitable, unless the stars are so close that they will soon destroy one another. In a *contact binary*, the stars' gaseous envelopes are in contact.

Distant companions: The two stars are distant, so that each star can have its own set of worlds. Neither star has much effect on the other's planetary system. Distant binaries are less common than close binaries. When determining worlds for a system with a distant companion, use the normal rules for each of the two stars. The maximum orbit for any world is ⅓ the distance between the stars.

Trinary systems

These systems have three stars in close association. Commonly, two form a close binary pair; the third star is a distant companion of the close binary.

Quaternary systems

These four-star systems typically consist of two binary pairs, each pair being a distant companion of the other. Larger systems are possible, but rare; they are usually found in open clusters.

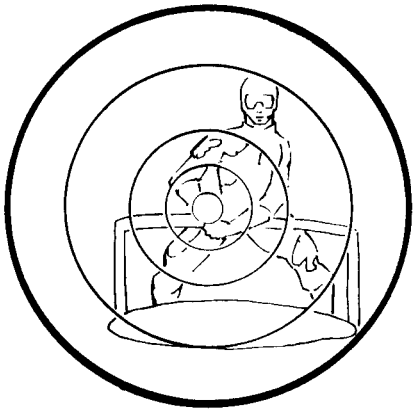
Unusual Stellar Objects

To generate a random "unusual object" in interstellar space, roll 3 dice. Singularities, supernovae, huge black holes, zones of improbability (p. 115) and white holes are too uncommon to appear randomly on a 3-die table; the GM must place these unique objects intentionally if he wants them to exist.

3 — Neutron star
4 — Black dwarf (no planets)
5 — X-ray star
6, 7 — Gray dwarf
8, 9 — Lost planet (gas giant)
10-13 — Lost planet (terrestrial)
14 — Flare star (red M-type)
15 — SS Cygni catastrophic variable; roll 2 dice for number of months between bursts
16 — Center of nova shell
17 — Center of small nebula; roll 1 die for diameter in parsecs
18 — Roll on table below

Very Unusual Stellar Objects

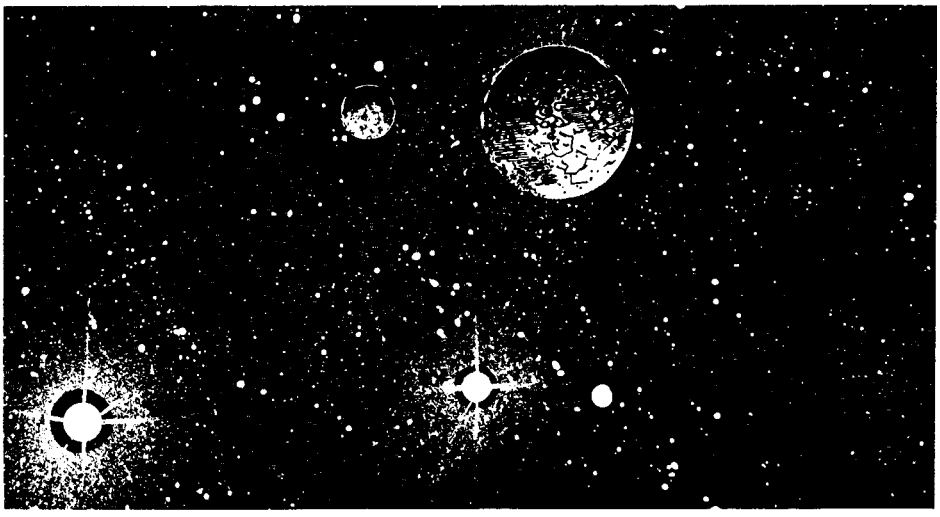
3 — Pulsar
4 — Planetary nebula: diameter 1d × .1 pc
5 — Antimatter system
6 — Center of nebula with T Tauri protostars condensing; roll 1 die for diameter of nebula in parsecs, 1 die for number of protostars.
7 — Black dwarf, with planets
8 — Center of large nebula; roll 3 dice for diameter in parsecs
9, 10 — Black hole of average stellar mass
11 — Nova
12 — Black hole of 10 times average stellar mass
13 — X-ray *burster*
14, 15 — Natural stargate to *somewhere*
16 — Star enclosed by Dyson sphere (see p. 115). Star will be type F through M.
17 — Center of huge nebula; roll 6 dice for diameter in parsecs
18 — Neutron star surrounded by supernova shell



Unusual Stellar Objects

Many of the following interstellar objects are rare once-in-a-campaign encounters. They may be posted Prohibited or Hazardous by interstellar authorities, *if they are known.* However, even in known space many of the smaller or dimmer objects may be uncharted.

Protostars. A star is created by the collapse, due to gravity, of a cloud of dust and gas. A small cloud — a "globule" — can give birth to one to three stars; larger nebulae create a cluster of stars of many different types. The condensing cloud spins and begins to glow as it collapses. These objects are also called T Tauri variables.



Lost planets. Worlds can become separated from their parent star when another star passes, becoming frozen wanderers of interstellar space. Such planets may be fairly common, but they are extremely unlikely to be discovered due to their size and darkness in the vastness of space. However, they might contain relics of former life, or even surviving life that has somehow adapted. Wandering gas giants, or even "gray dwarfs" (huge gas giants that did not quite become stars) are also possible.

Planetary nebulae. In the last stages of a red giant's life, it throws out much of its mass to form a spherical shell, .1 to .5 pc across, called a planetary nebula. The star's ultraviolet light makes the nebula glow brightly. A giant may throw off several nebulae, one after the other.

White dwarfs. After a red giant throws off its last planetary nebula, the core that remains is a white dwarf star — a ball of degenerate matter at a uniform temperature. This is small but extremely dense, rarely larger than a medium-sized planet. If any worlds survive, they are usually long-dead, outer-orbit cinders (the inner worlds were destroyed when the star became a red giant).

Black dwarfs. White dwarf stars eventually cool and become dark and dead. Any remaining worlds are perpetually frozen. Formerly-inhabited worlds of such suns will be eerie museums, full of relics of their vanished people.

Novae. When two stars of unequal mass form a close binary pair, the larger star will use its fuel faster — going to red giant and then white dwarf stage before its companion. When a red giant is a close companion with a white dwarf star, the white dwarf will collect hydrogen from the red giant's stellar atmosphere. The hydrogen compresses under the dwarf's gravity until it flares into a brief thermonuclear reaction — a nova. Such a binary pair may "go nova" several times in its lifetime. Each time, ejected material forms a spherical shell of gas, or "nova shell," around the system, up to 12 pc across. (It is probable that there are other mechanisms — for instance, collision with a large planet or even a dense nebula — that could create a nova or nova-like effect.)

Supernovae. Unlike novae, supernovae are formed by single stars, and are the result of fusion of heavier elements than hydrogen. The great blue giant stars blow themselves apart spectacularly, shining for several months more brightly than all the other stars in the galaxy combined. The explosion causes a shock-wave effect, which may help form gas clouds and also trigger the formation of new stars. A star only goes supernova once, leaving behind a huge gas shell up to 60 pc across, and often a neutron star or black hole (see below). Supernovae are believed to occur once per century in our galaxy.

Variable stars increase and decrease their output of energy at regular or irregular periods. These include pulsational variables such as the F and G supergiant *Cepheid variables* and type A blue giant *RR Lyrae* stars (limited to the galactic core and globular clusters) that have regular intervals between their pulses of energy; *explosive or catastrophic variables* such as the binary *SS Cygni* that exhibit nova-like bursts, but of smaller amplitudes, every few months to a year apart; and other variables, such as red *UV Ceti* flare stars, which display intense solar flares on irregular occasions.

Neutron stars. The ultimate fate of a star depends on its mass. A star with enough mass (at least four times that of our Sun) will go supernova, while the remaining core will collapse until the pressure of the neutrons equals the pressure exerted by gravity — creating a neutron star. A typical neutron star is a hot, dim object only 20 miles across, with very powerful gravity. There is evidence that neutron stars may retain planets, although any such will be airless and ocean-free, charred by the supernova blast. The matter of a neutron star (sometimes called "neutronium") is *dense* — a teaspoonful weighs billions of tons.

Pulsars. Neutron stars with a powerful magnetic field and a rapid rotation emit pulses of high energy — visible light and hard radiation — at regular intervals, making them "pulsars." The pulse of such a star is visible only in the plane of rotation — viewing the star from the directions of its poles, it would not seem to pulse. The pulse is extremely hazardous to all but the most heavily-shielded ships. Pulsars may retain planets.

Black holes. The largest giant stars eventually collapse to become black holes. A star with twenty times the mass of our Sun will shrink incredibly (e.g., to the size of Greater Los Angeles), spin faster, redden and then — while the gravity increases to 10^{10} G — the star will *go out.* A black hole has been formed. Black holes are found within supernova shells, and are suspected within the cores of galaxies and globular clusters.

The high gravity of black holes means that even light cannot escape from them. The sphere from within which light cannot escape is known as the Schwarzschild region, and the boundary is called the "event horizon." Starships at FTL speeds can theoretically escape from within the event horizon. This may create problems if the black hole is a singularity (see below).

Not all black holes have the same mass. If our Sun were squeezed to black-hole density, its event horizon would be one mile from its center. A black hole with mass equal to that of our galaxy would have an event horizon of .01 pc. Black holes shrink gradually, and will eventually vanish. Lifetimes vary: a black hole of stellar mass may outlast the universe, while a 2,000-ton black hole endures for only a second. Therefore, conveniently-small black holes have inconveniently-short lifespans.

Black holes passing through a cloud or accompanying another star may be surrounded by an *accretion disk,* a disk-shaped collection of dust and molecules just outside the event horizon. Gravity waves are produced as objects fall into the hole; these are so intense that ships near the event horizon can be torn apart by them. Even the normal gravitational "tide" of a black hole is dangerous.

Even distant approaches to a black hole are hazardous; the intense gravitational field produces a relativistic effect that will effectively send an intruding

Population I and II

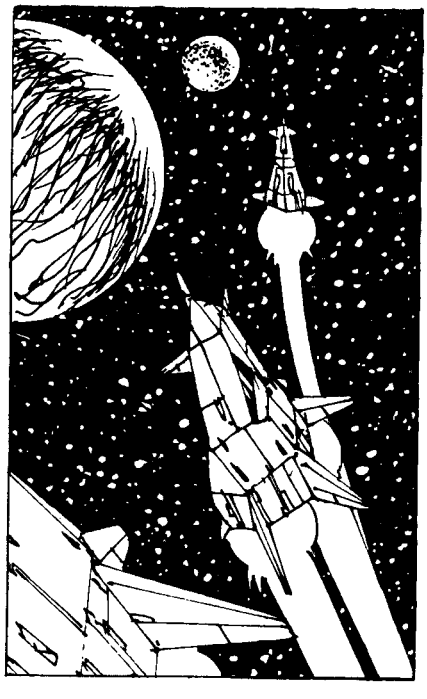
There are two distinct types of stars in our galaxy: Population I and Population II. Only Population I stars are likely to have useful planets.

Population II stars are very old. These stars are left over from the original formation of the galaxy, from the primordial hydrogen and helium. They contain almost nothing *except* hydrogen and helium. Therefore, they will have no planets except hydrogen/helium gas giants and a very rare captured world.

Population I stars are of the second (or later) generation. They formed from interstellar material enriched by the byproducts of earlier stars. Heavy elements are formed only by stellar processes, and are spread when an old star goes nova or supernova. Since planets are formed from the same material that goes to make up their star, Population I stars can have planets with heavy elements. The younger the star, the more likely it is to have high-density planets.

Population I stars are found only in the disk of spiral galaxies; Population II make up perhaps 1% of the stars in the disk, but are almost the only type in the core and the "halo" around the galaxy.

It is easy to distinguish the two populations of stars at a great distance. If a star can be seen, its spectrum can be studied, and the presence of heavy elements determined. When examining a star in the galactic halo or core, start by rolling 3 dice; only on a 3 will the star be Population I. Others are Population II. Such stars have a normal chance of having planets, but any such planets will be hydrogen-helium gas giants. There will be no asteroid belt, comets, or Oort Cloud.



System Names

Stars and worlds are traditionally named by the discoverer, though they may be renamed by colonists or conquerors. Military and scientific personnel often refer to planets by their star name and orbit number (Cephallo III would be the third planet of the star Cephallo).

There is usually a connection among the names of the worlds in a system, though the connection may be obvious only to the namer.

Types of names include:

Native names. Likely to be unpronounceable by humans. Example: Brqqsh.

Astronomical names. The classic method of naming stars is by their visibility within a constellation; thus Alpha Draconis is the brightest star in the constellation Draco. This will continue, and stars will be named after the constellations of new skies.

Researchers' names. Many worlds and stars are named by scientists or other researchers. These tend to be poetic, often based on archaic languages, legends, or names of deities. Examples: Siva, Cantrip, Acheron, Nubia. Or they may honor scientific or literary greats of the past (Einstein's Star, Asimov, Tesla, etc.).

Descriptive names. Classical or plain-language references to the world's most obvious feature. Examples: Oceania, Verdant, Sunrise.

Derogatory names. A description may be offered by an irreverent scout or disgruntled colonist — and stick. This is likeliest on a marginal world. Examples: Dustball, Hell's Kitchen, No Hope.

Random names. Scouts may name a star *anything*, especially if they've been out a while and are getting bored. It isn't uncommon to find stars and planets named after a scout's pet cat, his favorite holovid star or even his lunch. Examples: Sombrero, Kudzu, Charlie Brown.

Nostalgic names. Many worlds are named after someone's mate, home town, or friends. Examples: Cynthia, Wolverton, New Sweden, New New England.

Societal names. Worlds often receive new names when colonized or conquered by a new society. These names reflect the principles or personalities of the conquerors. Example: Prosperia, King Willem's World, New Beginnings.

Real star names. Unless the campaign involves only very local stars, GMs should not worry about using "real" star names. Many stars were named because they were bright enough to be seen by the naked eye — and such stars seldom have habitable worlds. Other "named" stars have cryptic or coded names (L115-21, for instance). Meanwhile, many stars with habitable worlds have never been seen by astronomers because they are too dim.

starship on a one-way trip to the future. Mathematics and Astrogation rolls, both at -5, would be required to predict this effect enough to use it constructively. Otherwise, the ship might find it has "lost" anything from a few minutes to a billion years or so.

X-ray stars. These are binaries where one component is a normal star and the other is either a black hole or a neutron star. Matter from the normal star flows to its companion, producing radiation. If a black hole is involved, the radiation is continuous, and includes radiation all across the spectrum, including visible light and gamma rays. If the companion is a neutron star, the effect is more nova-like, and very energetic, producing frequent bursts of hard X-rays. These objects are called *X-ray bursters.* Starships within 100 AU will take "light" damage (see *Space Combat*) and 10 or more rads, hourly; those within 10 AU will take "medium" damage, and 1,000 or more rads, hourly.

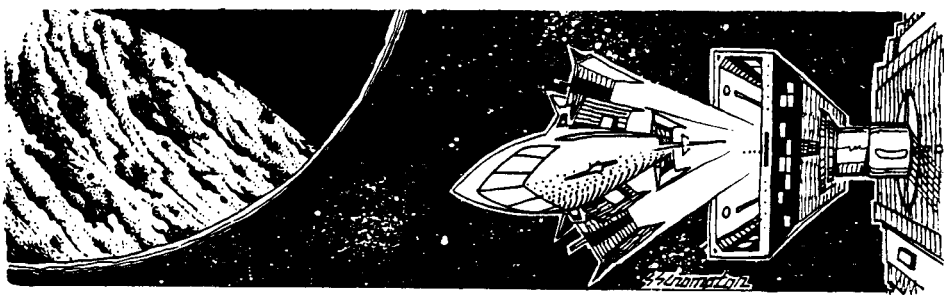
Singularities. Large black holes continue to collapse until they become infinitely dense, at which point their matter ceases to exist in this universe. The black hole now contains a singularity. The laws of relativity suggest that physics as we know it does not apply at — or within observation range — of a singularity: time might reverse, or cause-and-effect disappear, or *anything* could happen. For this reason, physicists are grateful that singularities are invisible within their event horizons . . . but what happens to someone who penetrates the event horizon and sees a singularity is unknown, *except* that gravitation should rip his molecules into disassociated atoms first (singularities have *enormous* gravitational effects) *and* he will exit into a universe eons older than when he left it (time is slowed within the event horizon). Singularities might be donut-shaped; the singularity caused by the collapse of a galaxy would have a large enough donut-hole for a starship to pass through without being destroyed by gravitation.

White holes. Speculation has it that an object which is sucked into a black hole will reenter normal space at a point called a "white hole." There is no evidence for their existence. Such an object is probably rare, and of value for research — wars may be fought over its possession.

Antimatter systems. Theoretically possible, though none are known. Such a system would appear quite normal, except that, since it would have to originate outside the galaxy, its orbit might be unusual. It would also generate a high level of gamma radiation, through interaction with cosmic gas and dust. Generate such a system normally (planets and all), but all objects in the system will be antimatter. Contact with any of them will be explosive!

An antimatter system, if already charted, will definitely be off limits. If uncharted, explorers will have a chance to realize its nature; antiparticle radiation from the star will cause random instrument errors, and then actual failures, as the star is approached. Contact with even the fringes of a planet's atmosphere will produce explosions as the antiparticles annihilate the particles of the ship, boat or probe.

Natural stargates. A ship making a proper approach to such an "object" comes out . . . somewhere else. Even if a return trip is possible, an Astrogation roll is necessary to do it right. A failed roll can mean the ship is lost forever, and space-crew and passengers have suddenly become colonists.



Creating the Star System

When the stars have been mapped, the GM can detail the systems in which the campaign will take place. The most important systems will have at least one habitable world. A world is "habitable" if an intelligent race can establish a viable colony there. Uninhabitable worlds can still hold docking facilities, mines or research stations.

Star Types

To design a world in detail, start by choosing the type of star the world orbits. Stars are classified by spectral class. From brightest (and hottest) to dimmest, the "main sequence" star types are O (blue), B (blue-white), A (white), F (yellow-white), G (yellow), K (orange) and M (red). Astronomers remember the classes and their order with a mnemonic: "**Oh, Be A Fine Girl, Kiss Me.**" Each class is further divided into sub-classes of 0 through 9, 0 being brighter than 9. A Roman-numeral suffix indicates the star's size; supergiants are Ia and Ib, giants are II and III, subgiants IV, main-sequence stars V, dwarfs VI. Our sun is classified G2 V — a fairly bright, yellow, main-sequence star.

Outside the regular classification system are the white dwarves (class D), the last stage in the life of a main sequence star. They are unlikely to have usable worlds.

The brightest stars are the blue, blue-white and white ones: O, B and A class. They are massive, but they also burn their hydrogen quickly, which means they are short-lived stars. Observation of the rotation rate of these stars argues that they are unlikely to have planets — and if one did; the system would be so young that life would have had little time to evolve.

F (yellow-white) stars are brighter than our Sun, so Earthlike planets will orbit at a greater distance. These stars also emit more harmful radiation, which can be counteracted if a world has a high magnetic field (due to a high density) or a thick atmosphere.

K (orange) stars are dimmer than our sun; M or red stars are smaller and dimmer still. K and M stars produce much less radiation than G stars, so habitable worlds require little radiation protection. The dimmer the star, the longer-lived it will be, and the more highly-developed its life might be.

On the whole, the GM may choose any star type from F to M for a habitable world. O, B and A stars will have habitable planets only rarely. White dwarf stars will often have planets, but they will have been badly scorched during the star's red-giant phase.

Creating Star Systems

If systems are being randomly generated, it is easiest to start by creating the star, as described above. Roll to see if the star has planets; if it does, generate them as described below. If a possibly-habitable world appears, the details can then be determined.

Number of Orbits

Roll for the number of orbits in the system, as per the table on p. 104; big stars have more orbits. Most of these orbits will have planets, but some may turn out to be empty. The next step is to determine where those orbits lie. This is done according to Bode's Law.

Bode's Law

Bode's Law (or, more formally, the Titius-Bode Formula) is a method of describing the orbital locations in the Solar System. It works very well for the planets up to Uranus, if you count the Asteroid Belt as a planet. It fails totally for Neptune and Pluto, but works for Pluto if you pretend that Neptune isn't there. (Some astronomers have suggested that Neptune occupied Pluto's orbit, with Pluto as a moon, until a wandering planet threw Neptune into a closer orbit. This would make the observed facts fit the theory exactly, and explain Pluto's eccentric orbit too.)

To find an orbital placement according to Bode's Law, start by taking the series 0, 3, 6, 12, 24 . . . After 0 and 3, each of these is twice the preceding number. Now add 4 to each number, and divide the result by 10. This yields a value, in AU, for orbital radius.

In the following table, the first column gives the orbital radius predicted by Bode's Law; the second column gives the actual orbit.

Mercury	0.4	0.39	
Venus	0.7	0.72	
Earth	1.0	1.00	
Mars	1.6	1.52	
Asteroids	2.8	2.77	(Ceres)
Jupiter	5.2	5.20	
Saturn	10.0	9.54	
Uranus	19.6	19.18	
Neptune	—	30.60	
Pluto	38.8	39.44	
Next planet	77.2	???	

Since we have only one solar system to observe, we cannot know whether Bode's Law is pure coincidence, universal law, or something in between. It does not seem to hold, in any form, for the moons of Jupiter or Saturn.

The sidebar on the next page describes how to use Bode's Law to generate the orbits for your solar system.

Orbit Locations

This rule assumes that Bode's Law is a special case of a universal rule of geometric progression in orbit spacing. Details will vary from system to system in a predictable way. Generate the orbital spacing for each system follows:

Roll 1 die and multiply the result by .1 AU. This gives the distance (D) from the sun of the first, or *innermost* planetary orbit. If the star is very large, this distance may be within the star's inner radius; in this case, that orbit will be empty.

Next, set the distance from the first to the *second* orbit. This is .2 AU for a red subdwarf (class M VI). For any other star, it is either .3, .35, or .4 AU (determine randomly). This is the *Bode constant*, or B, for that system. So the radius of the second orbit is (D+B).

The third orbit is the same distance from the second orbit that the second orbit is from the first, so its orbital radius is (D+2B). Thus, if the first orbit is at .2 AU, and the second another .4 AU out at .6, then the third orbit will be at 1 AU.

The radius of the fourth orbit is (D+4B); the fifth, (D+8B), the sixth, (D+16B), and so on, doubling the B component each time.

Our own solar system has a D value (inner orbit) of .4, and a B value (Bode constant) of .3.

According to this formula, the equations for the first 13 orbits of a star system are:

Orbit 1: D
Orbit 2: D + B
Orbit 3: D + 2B
Orbit 4: D + 4B
Orbit 5: D + 8B
Orbit 6: D + 16B
Orbit 7: D + 32B
Orbit 8: D + 64B
Orbit 9: D + 128B
Orbit 10: D + 256B
Orbit 11: D + 512B
Orbit 12: D + 1,024B
Orbit 13: D + 2,048B

The Habitable Zone

Each star has a "habitable zone" or *biozone*, defined as the distance from the star in which water can exist in liquid form on a planet's surface. Human-habitable worlds must lie within this zone. The larger and hotter the star, the larger the biozone is, and the farther from the star it is, as shown by the chart below. The chart assumes all planets have Earthlike albedo and "greenhouse effect," which is not always the case; see below.

Star Types and Planetary System Data (distances in AU)

Type	*Size*	*Stellar Mass*	*Biozone*	*Inner Limit*	*Stellar Radius*	*Planets On*	*Number of Orbits*	*Life Roll Modifier*
O	**Ia**	**70**	**790-1190**	**16**	**0.2**	**-**	**-**	**-12**
	Ib	**60**	**630-950**	**13**	**0.1**	**-**	**-**	**-12**
	V	**50**	**500-750**	**10**	**0.0**	**-**	**-**	**-9**
B	Ia	50	500-750	10	0.2	-	-	-10
	Ib	40	320-480	6.3	0.1	-	-	-10
	II	35	250-375	5.0	0.1	3	3d+1	-10
	III	**30**	**200-300**	**4.0**	**0.0**	**3**	**3d+1**	**-10**
	IV	**20**	**180-270**	**3.8**	**0.0**	**3**	**3d+1**	**-10**
	V	**10**	**30-45**	**0.6**	**0.0**	**4-**	**3d**	**-9**
A	Ia	30	200-300	4.0	0.6	3	3d+3	-10
	Ib	16	50-75	1.0	0.2	3	3d+2	-10
	II	10	20-30	0.4	0.0	3	3d+2	-10
	III	**6.0**	**5.0-7.5**	**0.0**	**0.0**	**3**	**3d+1**	**-10**
	IV	**4.0**	**4.0-6.0**	**0.0**	**0.0**	**4-**	**3d**	**-10**
	V	**3.0**	**3.1-4.7**	**0.0**	**0.0**	**5-**	**3d-1**	**-9**
F	Ia	15	200-300	4.0	0.8	4-	3d+3	-10
	Ib	13	50-75	1.0	0.2	4-	3d+2	-10
	II	8.0	13-19	0.3	0.0	4-	3d+1	-9
	III	**2.5**	**2.5-3.7**	**0.1**	**0.0**	**4-**	**3d**	**-9**
	IV	**2.2**	**2.0-3.0**	**0.0**	**0.0**	**6-**	**3d**	**-9**
	V	**1.9**	**1.6-2.4**	**0.0**	**0.0**	**13-**	**3d-1**	**-8**
G	Ia	12	160-240	3.1	1.4	6-	3d+3	-10
	Ib	10	50-75	1.0	0.4	6-	3d+2	-10
	II	6.0	13-19	0.3	0.1	6-	3d+1	-9
	III	**2.7**	**3.1-4.7**	**0.1**	**0.0**	**6-**	**3d**	**-8**
	IV	**1.8**	**1.0-1.5**	**0.0**	**0.0**	**7-**	**3d-1**	**-6**
	V	**1.1**	**0.8-1.2**	**0.0**	**0.0**	**16-**	**3d-2**	**0**
	VI	0.8	0.5-0.8	0.0	0.0	16-	2d+1	+1
K	**Ia**	**15**	**125-190**	**2.5**	**3.0**	**10-**	**3d+2**	**-10**
	Ib	**12**	**50-75**	**1.0**	**1.0**	**16-**	**3d+2**	**-10**
	II	**6.0**	**13-19**	**0.3**	**0.2**	**16-**	**3d+1**	**-9**
	III	3.0	4.0-5.9	0.1	0.0	16-	3d	-7
	IV	2.3	1.0-1.5	0.0	0.0	16-	3d-1	-5
	V	0.9	0.5-0.6	0.0	0.0	16-	3d-2	0
	VI	**0.5**	**0.2-0.3**	**0.0**	**0.0**	**16-**	**2d+1**	**+1**
M	Ia	20	100-150	2.0	7.0	16-	3d	-10
	Ib	16	50-76	1.0	4.2	16-	3d	-10
	II	8.0	16-24	0.3	1.1	16-	3d	-9
	III	**4.0**	**5.0-7.5**	**0.1**	**0.3**	**16-**	**3d**	**-6**
	V	**0.3**	**0.1-0.2**	**0.0**	**0.0**	**16-**	**3d-2**	**+1**
	VI	**0.2**	**0.1-0.1**	**0.0**	**0.0**	**16-**	**2d+2**	**+2**
D		0.8	0.03-0.03	0.0	0.0	*	*	-10

* Class D (white dwarf) stars have been through a great deal. When a main-sequence star burns all its hydrogen, it expands into a red giant, scorching its inner planets in the process. Then it collapses into a white dwarf. See p. 100.

To generate a white dwarf's planetary system, start by creating a system for a normal main-sequence star of any color. Change any gas giant inside 80 AU to a terrestrial planet (this is the core of the former gas giant). Turn any planet inside 40 AU into a rockball, with no atmosphere or trace atmosphere. Remove all planets within 1 AU; they evaporated while the star was a red giant.

Type refers to a star's color and temperature, and *size* to its classification (giant through dwarf), as described on p. 103. A few types (e.g., M-IV) are omitted from the table because such stars don't seem to exist!

Stellar Mass is the mass of an average star of the type, relative to our sun. Thus, a K-V star, with a stellar mass of .82, is about 4/5 as massive as the sun.

Biozone is the range of distances (in AU) at which a planet of the star can have liquid water.

Inner limit is the distance from the star, in AU, at which rock vaporizes; any orbit at or within this limit will be empty.

Radius is the star's own size, in AU. This is effectively zero for all but giant and subgiant stars. Note that an inner planet of a class M giant can be *within* the star's glowing envelope of gas, without melting!

Planets On indicates the roll, on 3 dice, on which the star has planets. For instance, if this entry reads 12-, then the star has planets on a roll of 12 or less.

Number of Planets indicates how many dice are rolled to determine the number of planets the star has, if it has planets at all.

Life Roll Modifier is used when randomly determining the highest life form on the star's planets (p. 112). Very young stars are unlikely to have life, and if they do, it will be primitive. Older stars are much likelier to have life, and it may be advanced.

World Types

Now generate the system's worlds. There are two basic types of worlds, each with subdivisions, described below. For some campaigns, it will be enough to describe a world as a "small gas giant" or a "cold desert world" and leave it at that. Other campaigns will need the detailed rules in the rest of this chapter.

Terrestrial Worlds

Terrestrial worlds are usually small to medium-sized planets, of Silicate, Iron-Silicate, or occasionally Metallic composition (see p. 106). If located within a star's biozone, they may eventually develop breathable atmospheres and life as we know it. Terrestrial worlds come in five main types:

Earthlike: A terrestrial world rated as earthlike will be very much like our own planet — or at least like parts of it, depending on its overall climate, the amount of water it has and its atmosphere. The climate may be temperate, tropical, or arctic, but is liveable by definition. Of course, there may still be obvious flaws or hidden deathtraps, making the world useless.

Greenhouse: Greenhouse worlds have thick, dense atmospheres that magnify the greenhouse effect, producing worlds that are very hot — sometimes too hot for life to develop. Atmospheres may have high concentrations of carbon dioxide and sometimes sulfur compounds. Venus as we now know it is a greenhouse world taken to the extreme. Venus as it was once thought to be would be a habitable greenhouse world.

Desert: Desert worlds are usually smaller worlds with thin atmospheres and little, if any, free water. Their water may lie frozen in ice caps, melting only at certain times of the year to nurture what life exists. Depending on their climate, they may be classified as *Desert/Cold* or *Desert/Hot*. Mars is an extreme example of a Desert/Cold world. Mars as it was once thought to be — with canals and seasonal vegetation — is a mild example of a Desert/Cold world. Some desert worlds are very old; they once had more water but lost it to space.

Rockball: Rockball worlds are usually small worlds made totally of rock, from core to surface. Their surfaces are rock plains, mountains and crevices, and perhaps craters and dust plains. If there is atmosphere, it is thin; if there is water, it is usually underground. Icy rockballs are only found in a star's outer orbits.

Generating Worlds

Generate worlds for each orbit in the system, depending on the location of the orbit relative to the star's biozone:

Orbits Inside The Biozone

For orbits closer to the star than the biozone, roll 2 dice.

2-4 — Empty orbit
5, 6 — Hostile Greenhouse world
7-9 — Hot Rockball world
10, 11 — Asteroid belt
12 — Huge gas giant (if this is orbit position 1, treat orbit as empty instead).

Orbits Within The Biozone

For orbits within the biozone, where liquid water is possible, roll 2 dice. If a terrestrial world results, see the later part of this chapter for details of type, atmosphere and life.

2, 3 — Empty orbit
4-8 — Terrestrial-type world
9, 10 — Asteroid belt
11 — Large gas giant
12 — Huge gas giant

Orbits Outside The Biozone

For orbits outside the biozone, roll 1 die, adding 1 to the result if the orbit is more than 10 times the outer radius of the biozone. Determine details of terrestrial worlds as above.

1 — Terrestrial-type world
2 — Asteroid belt
3 — Empty orbit
4-6 — Gas giant (see sidebar, p. 113)
7 — Terrestrial-type world: trace or no atmosphere

Binary/Trinary Orbits and Biozones

Determining orbits and habitable zones in binary and trinary systems is much trickier than with single stars. If companion stars are in *distant* orbits (over 5 AU), calculate orbits and biozones normally unless the distant star is a giant. In that case, you may need to figure distances from the giant companion to determine if it will interfere with planets in the primary's biozone. As a rule, if the biozones overlap, no planet in the system will have a habitable temperature all the time.

If the stars are in a medium orbit (.1 to 5 AU), worlds will have orbits of less than 2 AU, or else very distant orbits that circle both stars. Liveable planets are unlikely.

If companion stars are in *close* orbits (less than .1 AU), any planets will orbit *both* stars. Determine orbits and biozones normally for the largest of the two stars, but increase the biozone orbital ranges by 1 *spectral type* hotter if the companion is larger than a dwarf. Habitable planets will orbit the center of mass of the two stars.

Type of Terrestrial Planets

When it is determined that a planet is terrestrial, the GM may use this table to get a quick description of its type, and fill in any desired details from other tables, ignoring any results that contradict the basic type. Alternatively, this table may be skipped, and the general description assigned after the details are rolled up.

To use this table, roll 2 dice:

2-4 — Rockball

5 — Hostile Greenhouse (planet must not be farther from the star than the biozone; gravity must be more than .8 G).

6 — Earthlike Greenhouse (planet must be within the biozone; gravity must be more than .8 G; temperature must be Tropical or hotter). Atmosphere is Oxygen-Nitrogen, but may still be Polluted; surface water is at least 10%.

7 — Earthlike (planet must be in the biozone). Atmosphere is Oxygen-Nitrogen (but may still be Polluted). Surface water is at least 10%.

8, 9 — Desert (planet must be in the biozone). No surface water. Roll for climate (p. 111) to determine temperature.

10 — Hostile. Ignore any Oxygen-Nitrogen result from Atmosphere Composition table (sidebar, p. 109).

11 — Icy Rockball (planet must be beyond biozone)

12 — Iceball (planet must be beyond biozone)

Size of Terrestrial Planets

To determine the rough diameter, in miles, of a randomly-generated Terrestrial planet, roll 2 dice and multiply by 1,000 miles. If you want more precision, use any method you find convenient.

Density and Composition of Terrestrial Planets

To determine the density of a Terrestrial planet, roll 3 dice and divide the result by 10 (giving a number from .3 to 1.8). Then roll one die and add this result. This yields a number from 1.3 to 7.8, averaging 4.55.

This density then gives the planet's composition, as per the main text.

Stellar Ages and Planetary Density

An optional complication, for those very interested in realism and willing to assign ages to stars: For every billion years younger than Sol that a star is, add .2 to all density rolls. For every billion years older, subtract .2. This means that younger stars have higher-density planets, which is to be expected (see sidebar, p. 101). Limiting factors: The galaxy is some 10 billion years old; Sol is perhaps half that age.

They are usually coated with ice — their water, and often the atmosphere as well, is completely frozen. *Iceball* worlds consist entirely of frozen liquid and gas, with no rocky core at all. Mercury is a Rockball world and Pluto an Icy Rockball or possibly just an Iceball.

Hostile: A "hostile" terrestrial planet has an atmosphere poisonous to humans. Often, its climate is far too cold and its free-standing liquid is liquid methane or ammonia rather than water. Nevertheless, such planets may have native life. Hostile terrestrial planets usually occur beyond a star's biozone and may be moons of gas giants. Saturn's moon Titan is a hostile terrestrial world.

Gas Giants

Gas giants are huge planets with thick atmospheres consisting primarily of hydrogen, methane and ammonia, occasionally with helium as well. Some may have a solid core of ice or rock, while others may be nothing but gas all the way through.

Gas giants come in four general sizes: Small (30,000-mile diameter, the size of Neptune and Uranus); Medium (50,000-mile diameter); Large (80,000 miles, the size of Saturn and Jupiter); and Huge — (perhaps 200,000 miles, such as that believed to orbit Barnard's Star). Large gas giants actually produce heat; their infrared radiation may help bring their moons to habitable temperature. Huge gas giants are also called "gray dwarfs" — they produce even more heat, possibly through hydrogen fusion, and may be actual stars in process of formation.

Small and medium gas giants are found only outside the biozone; closer to their sun, their gases would boil away. Larger gas giants may be found as close to the star as halfway in from the inner limit of the biozone.

Creating Habitable Worlds

Having established the general nature of the planets in a system, the next step is to detail its important world or worlds — which usually means the habitable ones. Of course, not all habitable worlds will be very earthlike; an asteroid belt or a planet without atmosphere would be considered "habitable" if it were worthwhile to establish a colony there.

Size, Gravity and Density

A planet's size, gravity and density are interrelated. By choosing any two of these, you define the third one. Earth has a diameter of 7,915 miles, a density of 5.5, and a gravity of 1 G.

If you have any two of these factors for another planet, you can find the third one, using the following formula: (Planet diameter/Earth's diameter) times (Planet density/Earth's density) = gravity in Gs. This simplifies to (Diameter × Density × .0000229). Example: Stefan's World has a diameter of 6,644 miles and a density of 6.1. Its gravity is .93 G: 6,644 times 6.1 times .0000229.

Size of Planets

There is no lower limit to the size of a world. Gas giants over about 25-30 times Earth's diameter are likely to collapse and become stars. Huge bodies of rock and metal, many times Earth's size, may be possible, but none are known.

Gravity

This is measured in relation to Earth — 1 G is Earth's gravity. Humans may exist at any gravity up to 3 G, and can survive more for short periods, but long-term settlement is possible only between .75 and 1.25 G. Outside this range, humans and humanoid aliens will have health and reproduction problems, unless they have been genetically modified for a different G tolerance.

Density and Composition

A planet's density is governed by its composition — the material of which it is made. A large world may have a relatively low gravity if it is made up of light substances; a small world may have a higher-than-expected gravity if its density is high. The composition types, from heaviest (densest) to lightest, are:

Metallic (Density 7.1 and up): Mostly silicates (rock), but metals and rare elements are plentiful — a great place for mining. But there's high background radiation, frequent volcanoes and earthquakes, and extra heat (due to internal radioactivity). There's not likely to be much atmosphere, but the strong magnetic field helps to retain any atmosphere captured (perhaps from comets), diverts solar radiation, and provides a colorful aurora. Example: none in the Solar System. There are reasons to believe that planet-sized bodies this dense are *very* rare; a world of solid iron would have a density of 8.

High-Iron (Density 6.1 to 7): As above, but less so: a breathable atmosphere is likelier. Composition is essentially Earthlike, but with more metal. Example: none in the Solar System.

Medium-Iron (Density 4.6 to 6): Even more rock and less iron. Examples: Earth (5.5), Venus (5.2).

Low-Iron (Density 3.1 to 4.5): Density significantly lower than Earth's. Metals are rare — high-tech civilization based on abundance of metals cannot develop. With less interior heat, the climate will be cooler than might otherwise be expected. Volcanoes are rare. The magnetic field is weaker, so the world is less protected from outside radiation. Examples: Mars (4.0), Luna (3.3).

Silicate (Density 1.3 to 3): A very low-density world. Metals are very rare — any civilization will have to use low-density ores (such as aluminum), a major obstacle to development of a high-tech native culture. Volcanoes are rare, as are earthquakes. There is almost no interior heat, and the weak magnetic field lets harmful radiation reach the surface. Examples: Pluto (1.5?), the Jovian and Saturnian moons.

Gas Giant (Density .6 to 2.5): An accumulation of frozen gases, uninhabitable by humanoid races. Some gas giants have a central "rockball" core, which will never be seen unless the planet is boiled away by a nova. Others may have a core of solid (metallic) hydrogen. Examples: Saturn (.7), Neptune (2.3).

Rotation and Axial Tilt (Seasons)

Larger worlds rotate faster and have shorter days, though many other factors affect this. Mars and Earth days are nearly the same, but a Venus day lasts 243 Earth days — *and* Venus rotates in the wrong direction. Fast rotation causes Coriolis effect, which encourages hurricane-type weather. Moons, especially large ones, slow rotation. Old worlds tend to rotate more slowly.

In the final analysis, so many factors affect planetary rotation that the GM may make the day any length he likes, down to a minimum of about ten hours for an Earth-sized planet.

Tide locking. Worlds in the biozone of dimmer stars — class K-V and below — will be tide-locked, unless they are recent captures. On such a world, the same side always faces the sun, so there is no "day" or "night," but a permanently-hot and a permanently-cold side. Only a small band of twilight territory will have the climate shown on the table.

Axial tilt. Many worlds are *tilted* — instead of spinning upright in their orbit, they lean one way or another. This gives *seasons;* for half the year, the northern hemisphere is warmer than the southern one, and vice versa. Earth has a 23° tilt; thus, we have summer and winter. GMs may specify any tilt; the normal range is from 30° (Neptune and Saturn) to nearly none (Venus and Jupiter). Worlds with a tilt near 90° (Uranus) will show very strong seasonal effects!

Gravity of Terrestrial Planets

Determine this from size and density, using the formula on p. 106.

Determining Axial Tilt

For a random determination of axial tilt, and therefore seasonal effects, roll 2 dice:

2, 3 — No appreciable tilt, and no seasons.
4-7 — Minor seasonal effects (less than Earth's). Roll 1 die and multiply by 3 to get degrees of tilt.
8-10 — Earthlike seasonal effects. Roll 2 dice and add to 20 to get degrees of tilt.
11 — Major seasonal effects (much more than Earth's). Roll 3 dice and add to 30 to get degrees of tilt.
12 — Gross seasonal effects. Roll 1 die, multiply by 10, and add to 40 to get degrees of tilt (but treat anything over 90 as 90).

Length of Day

For a random determination of the length of a planet's day (in hours), roll 2 dice:

2 or less — 2d×10 days
3 — 1d×12 days
4 — 1d×5 days
5 — 2d×10 hours
6 — 1d×10 hours
7 — 7d hours
8 — 6d hours
9 — 5d hours
10 — 4d hours
11+ — 3d hours

Subtract 4 from the roll for orbital position 1, and 2 for position 2. Subtract 1 if the world has a large moon or binary companion. Subtract 1 for a diameter less than half Earth's. Add 1 for a diameter more than 3 times Earth's, 2 for a diameter more than 6 times Earth's, 3 for a diameter more than 9 times Earth's.

Terrestrial Atmospheres

To determine a Terrestrial world's atmosphere, roll 2 dice for *pressure*. If atmosphere exists, then roll 2 dice for *composition*, as described below.

Pressure

3 or less — None
4 — Trace
5 — Very Thin
6 — Thin
7-9 — Standard
10 — Dense
11 — Very Dense
12+ — Superdense

Subtract 1 for each full 20% decrease in planet's diameter relative to Earth; add 1 for each 20% increase in diameter.

Subtract 3 if the planet is beyond the star's biozone, or 6 if the planet orbits at a distance more than 10 times the maximum biozone radius.

Subtract 2 for a world of an M-class star, or 1 for a world of a K-class star.

Composition

5 or less — "Reducing" atmosphere: hydrogen, CO_2, methane)
6 — Exotic — see below
7-9 — Oxygen-Nitrogen
10 — Polluted
11+ — Corrosive

Exotic Atmospheric Gases

To find the exact composition of exotic, corrosive and superdense atmospheres, roll 1d-2 for the number of gases that make up the atmosphere (minimum 1). Then roll on the appropriate table below; add 1 for a planet within the biozone, 2 for a planet *closer* than the biozone. If only one gas is present in an exotic atmosphere, it will not be a corrosive.

The first gas rolled will make up 1d×10% of the atmosphere; the second will make up the remainder, with trace amounts (under 1%) of any other gases present.

Exotic or Superdense Atmospheres

1 — Hydrogen; methane also present
2 — Methane; hydrogen also present
3 — Carbon oxides
4 — Corrosive — roll on next table, using the same modifiers
5+ — Nitrogen

Corrosive Atmospheres

1, 2 — Ammonia
3 — Chlorine
4 — Fluorine
5 — High-Oxygen
6 — Nitrides
7 — Sulfur Compounds
8 — Water Vapor

Continued on next page . . .

Atmosphere

Although oxygen is a very common element, it is not likely to occur in an atmosphere unless the world has life. Plant life breaks down CO_2 and other compounds, giving a breathable atmosphere. But even if oxygen is present, a world may have atmospheric trace elements harmful to some or all races. These are most common on Metallic worlds . . . but *could* occur anywhere.

An atmosphere is a world's best friend. A thick atmosphere shields against solar radiation (this can make up for the effects of a weak magnetic field). High air pressure increases average temperature by retaining heat, and moderates temperatures — leading to more weather, but less difference between day and night temperatures. Worlds with low-pressure atmospheres are colder (retaining less heat), with less weather but greater extremes in day/night temperatures.

In theory, atmospheric pressure and Gs are directly related — 1-G worlds have Earth air pressure, .75-G worlds have 75% of Earth air pressure, and so on, *if* the world has an atmosphere. If air pressure is less than 20%, humans cannot breathe without artificial assistance. Pressure drops as height increases, depending on gravity — on a high-G world, pressure falls off swiftly, and even a low mountain may require breathing gear for mountaineers. In the real universe, however, other things affect air pressure — neither Venus nor Mars fit this pattern. Venus has very high pressure, simply because it has a huge mass of atmospheric gas; Mars is missing atmosphere, which is thought to be locked in subsurface minerals and frozen in the ice caps.

In the end, the GM is perfectly free to set the atmosphere he finds most interesting, within the guidelines below. Gas Giants will always have extremely dense hydrogen or hydrogen/methane atmospheres. Only the largest asteroids will have any sort of atmosphere.

Atmospheric Pressures

None: No atmosphere at all; vacc suits and pressurized habitats with artificial air supplies are necessary here.

Trace: There are mere traces of gas at some levels of the world's surface, deep in caves or crevices, etc. Artificial life support is necessary here. Oxygen, nitrogen and other "atmospheric" gases will be frozen into "snow" or "ice" on very cold planets.

Very Thin: Atmospheres are extremely tenuous: below .5 Earth air pressure. Explorers will need life support: oxygen, and usually pressure suits as well.

Thin: Atmospheric pressure is lower than Earth's: .51 to .8 Earth normal. If enough oxygen is present, humans will find the air completely breathable with the aid of a respirator and can even breathe it for short periods unaided. Early theories on Mars pictured this kind of atmosphere.

Standard: .81 to 1.2 Earth normal. Breathable without any artificial aids by humans, if enough oxygen is present. These are the most Earthlike atmospheres.

Dense: Pressures greater than Earth's: 1.21 to 1.5 Earth normal. They are still breathable, with some difficulty, if O_2 is present. Dense atmospheres may seem "soupy" to regular humans, and asthma sufferers will find breathing very difficult.

Very Dense: Pressures much greater than Earth's: over 1.5 Earth normal. A reducing respirator is required to breathe, even if O_2 is present.

Superdense: Superdense atmospheres can have pressures up to several hundred times that of Earth. Only the sturdiest structures can maintain Earthlike internal pressures and survive. In the outer zone, frozen or near-liquid atmospheres may qualify as superdense. Nothing less than an EAVS or battlesuit — if that — will make it possible to get around on the surface of these worlds. Venus has a superdense atmosphere.

Atmosphere Types

Reducing: Methane, CO_2 and/or hydrogen. Unbreathable to humans, but not necessarily poisonous. This type of atmosphere is typical of Terrestrial planets before our type of life develops. But anaerobic life or "nitrolife" is quite possible here.

Oxygen-Nitrogen: Generally Earthlike atmosphere; almost impossible to find except as a result of life similar to Earth's. Earth's atmosphere is 77% nitrogen, 21% oxygen, and 1% argon, with traces of water, CO_2, and so on. Nitrogen and argon are inert; the oxygen percentage is vital. Earth's biological and geological processes hold it at 21%. Too little oxygen is inconvenient, but too much is deadly — see sidebar.

Polluted: Polluted atmospheres are basically oxygen-nitrogen, but contain contaminants. This can be organic matter such as pollen; volcanic ash; industrial pollutants; or naturally occurring noxious chemicals, such as sulfur compounds. Pollutants range from merely irritating to deadly. Filter masks (or combination filter/respirators) are normally sufficient to allow these atmospheres to be breathed. The GM should determine the exact pollutant; on a newly-discovered world, Planetology rolls (sometimes at a hefty penalty) may be necessary to discover the pollutant's existence before it is too late.

Exotic: Exotic atmospheres (see sidebar) consist of assorted non-breathable or poisonous gases; some may contain corrosive elements. Self-contained oxygen supplies, and often protective or pressure suits, are necessary to survive in these atmospheres. (Alien races may thrive in exotic atmospheres.)

Corrosive: These very deadly atmospheres (see sidebar) require well-protected artificial life support for survival. Unprotected humans will die quickly and painfully. Vacc suits or protective suits with self-contained air supplies are necessary. Most metals will quickly be destroyed by such atmospheres, especially those with even a trace of chlorine or fluorine.

Climate

Next, the world-builder should choose the world's climate. This is the average temperature of all points on the 30th parallel, night and day — tropics will be warmer, mountains and poles will be colder. This table describes ten typical climate ranges, in degrees Fahrenheit.

Climate type	*Low*	*Avg.*	*High*	*Comparisons*
Very Hot	100°	120°	140°	Record high for U.S.: 134° in Death Valley
Hot	90°	110°	130°	Death Valley, CA in July
Tropical	80°	100°	120°	African desert in July
Warm	70°	90°	110°	Phoenix, AZ in July
Earth-normal	60°	80°	100°	New Orleans, LA in June
Cool	40°	60°	80°	Knoxville, TN in April
Chilly	20°	40°	60°	New York City, NY in March
Cold	0°	20°	40°	Huron, SD in December
Very Cold	-20°	0°	20°	Fairbanks, AK in February
Frozen	-40°	-20°	0°	Whitehorse, Yukon in January

Orbital distance, naturally, affects climate. A world at the inner edge of the biozone will be hot, and one at the outer edge will be cold. But a world in the middle can have any climate the GM chooses, because of other factors. For instance, Earth would be much colder if not for the heat still being released from its molten core. Internal radioactives and the "greenhouse effect" can also warm up a world. Interstellar gas can block sunlight; cloud or ice surface can increase *albedo* and reflect heat, cooling a planet. Planets in a multiple system can receive extra heat from other suns. Thus, it is quite possible for a world to remain habitable even though it is slightly outside the nominal biozone.

Exotic Atmospheric Gases (Continued)

Determine relative percentages as above, except that High-Oxygen always means at least 30% oxygen. Other gases may be present in trace amounts, including inert gases such as helium, neon, argon, krypton and xenon, or more deadly ones such as carbon monoxide.

Hydrogen: H_2 is abundant in the atmospheres of gas giants and frequently found in smaller quantities in other types. It is extremely flammable. Its atoms are so small they can penetrate protective suits, and when in contact with the oxygen inside can be set off explosively by a spark. Exotic atmospheres high in hydrogen are extremely dangerous.

Methane is always found with hydrogen, and vice versa, though concentrations differ widely; it is highly flammable.

Carbon oxides: CO and CO_2. This is an expected atmosphere for an "earthlike" world with no life. Plant life, when it develops, breaks the carbon compounds down to free oxygen.

Nitrogen: Inert and unbreathable; poisonous (causes "the bends") in very high partial pressures. But this is relative; Earth has 77% nitrogen.

Ammonia: NH_3 is highly poisonous and water-soluble; if there is liquid water, the ammonia will be dissolved in the seas, not free in the atmosphere.

Chlorine and Fluorine: Both deadly poisons to terrestrial life, either could nurture completely alien beings. These gases are so reactive that they aren't likely to be present in noticeable quantities unless a life process is replenishing them. Even then, HCl and HF are far likelier than the pure gases. Chlorine in an atmosphere may result in strange visual distortions.

High-Oxygen: Atmosphere at least 30% oxygen, possibly with ozone. This would be very flammable, very corrosive, and quite unbreathable; it would send human beings into a laughing jag even as it killed them by drying out their eyes and lungs. Some sort of life must be present to release this much oxygen. Oxygen reacts with hydrogen, methane and CO, so it won't be found in the same atmosphere.

Nitrides: These are nitrogen-oxygen compounds that are always corrosive. Nitric acid vapor may be present in the atmosphere as well.

Sulfur Compounds: These might include hydrogen sulfide (flammable, rotten-egg smelling), sulfur trioxide (a corrosive irritant) or sulfur dioxide (suffocating).

Water Vapor: May be plentiful on a world inside the biozone, where temperatures rarely or never drop below 212 degrees. Corrodes metals.

Random Climate Choice

When creating a habitable world randomly, roll 3 dice to set its climate, as per the Climate Table. Subtract 1 from the roll if the world is part of a multiple star system. Add 3 if the world is actually a moon of a gas giant; add 2 if it is a planet of a Class M, or 1 if it is a planet of a Class K.

2-5 — Very Hot
6, 7 — Hot
8 — Tropical
9 — Warm
10 — Earth-normal
11 — Cool
12 — Chilly
13 — Cold
14, 15 — Very Cold
16+ — Frozen

It is quite possible for a world in the biozone to be hotter than "Very Hot." A world with an average temperature of 160°, for instance, could have liquid water and even native Earthlike life, but Earth humans couldn't survive there unaided (except perhaps at the cooler poles). Earthlings, being warm-blooded, can adapt to cold more easily than they can to heat.

Water Surface

For a terrestrial world in the biozone, the surface covered by water will be (2d-2)×10%. This gives a result of 0% to 100%. However, no liquid water will be present if there is no atmosphere or Very Thin atmosphere; it will escape to space.

By definition, worlds outside the biozone are unlikely to have liquid water; it will escape to space on inner worlds, freeze or escape on outer ones. The likeliest possible exception is a large moon of a gas giant, which may get enough heat from its primary to have liquid water; roll as for any other terrestrial world.

Terrain

Roll 2 dice to determine the primary terrain type for any Terrestrial world. A second roll may be made to determine a secondary terrain type.

2-4 – Barren; Desert if world is Cool or warmer (roll again if surface water is over 30%), otherwise Icy.
5, 6 – Hilly/Rough. Roll again if surface water is over 70%.
7 – Mountainous/Volcanic. Roll again if surface water is over 30%.
8 – Plains/Steppes. Roll again if surface water is over 80%.
9, 10 – Forest/Jungle. Roll again if there is no plant life, or if surface water is under 40%.
11, 12 – Marsh/Swamp. If surface water is under 70%, increase it to 70%.

It is important to note that climate is an *average!* Earth, as shown on the table above, has "Earth-normal" climate, but local temperatures span the whole table. A world with Hot climate overall might have some Earth-normal areas at the poles, and large areas at the equator so hot they are unusable. If the world has axial tilt, seasons will affect the temperature at a given time and place, without changing overall climate.

Surface Water

Most planets start with water; it is a common compound. On inner planets, it evaporates and is lost; on outer planets, it freezes solid. Terrestrial worlds with under 10% surface water are desert worlds. Those with 10-40% water will be dry and arid except near ocean areas. Those with 40% to 80% ocean area can be relatively Earthlike, depending on the climate. Surfaces of over 80% water will be humid unless the climate is Cool or colder; then they will be icy.

Primary Terrain Types

Almost every type of terrain can be found *somewhere* on any planet, if the appropriate plant life has evolved. But the prevailing terrain on a world is governed by its climate and the amount of water present. The following types of terrain may be found on Earthlike and Hostile Terrestrial worlds; most can be found on Greenhouse and Desert worlds as well. Rockball worlds almost always look Hilly/Rough.

Desert/Barren: Low, flat, barren plains, perhaps covered with sand and/or dust in low dunes. Prevalent on older planets with less than 30% surface water, or any world with under 10%. Can occur even on worlds with more water if the land areas are cut off in some way from the seas.

Icy/Barren: As above, but drifted with snow and ice. Prevalent on Chilly to Frozen worlds with more than 30% water; also common on Cool worlds with under 50% water.

Hilly/Rough: Mostly bare, rocky terrain, with small hills, boulders and debris, crevices and ravines and so on. Prevalent on younger planets with less than 30% surface water. Can include cratered terrain and rough glaciers.

Mountainous/Volcanic: High rocky mountains, jagged peaks, cliffs and/or active or dead volcanoes. Most likely on geologically very young worlds with less than 30% surface water.

Plains/Steppe: Low, flat expanses. Not as dry as desert/barren. May have abundant rivers and lakes, moist soil, etc. Common on worlds with 30% to 60% water surface; also found in the center of large continents, or behind mountain ranges, on wetter worlds. Plant life, if any, is characterized by grasses, low shrubs and bushes, and tough weeds.

Forest/Jungle: These only exist if vegetable life does. Can range from lightly wooded areas to densely packed forests and jungles. Usually abundant near rivers, lakes and other bodies of water. Common on Cool or warmer worlds with more than 40% water surface. (Hostile Terrestrial forests might be some other form of immobile alien life, or even forests of crystal, minerals, etc.)

Marsh/Swamp: Low, wet areas, often near large bodies of water and almost always including areas of surface water themselves. Mud, quicksand and very moist ground are abundant. If vegetation exists, lush water plants and other life forms are common. Likely if surface water is over 90% and the world is Cool or warmer; very likely if the world is Tropical or warmer.

Mineral Resources

Some planets become important because of their mineral resources; others are crippled for lack of a resource. Roll 2 dice for each of the categories below to determine the abundance of that resource.

This resource roll is modified for the planet type: +4 for Metallic, +2 for High-Iron, -1 for Low-Iron, -3 for Silicate, -1 if surface water is at least 90%, +1 if surface water is 30% or less. Exception: None of these modifiers affects the roll for organics.

6 or less — Almost entirely absent.

7, 8 — Scarce even for local use; imports will be required if industry requires the material.

9 — Ample for local use, but no real surplus.

10, 11 — Plentiful; worth export if there is great demand.

12+ — Extremely plentiful! Certainly worth export if there is any demand.

Categories include:

Gemstones/Industrial Crystals: Diamonds, emeralds, rubies, sapphires, industrial silicon and so on. -3 to Abundance roll.

Rare/Special Minerals: These can include rare earths, or unusual elements or compounds not normally found on other worlds. -2 to Abundance roll.

Radioactives: Uranium, radium, thorium and so on. -2 to Abundance roll.

Heavy Metals: Gold, silver, platinum, cobalt and so on. -1 to Abundance roll.

Industrial Metals: Iron, tin, copper, zinc, and so on. +1 to Abundance roll.

Light Metals: Sodium, aluminum, lithium and so on. +3 to Abundance roll.

Organics: Carbon, fossil fuels and so on. Organic deposits often indicate that life once existed on this world, even if it no longer does. However, lifeless worlds may have "organic" compounds; some scientists believe that Saturn's moon Titan has hydrocarbon oceans!

Moons

Many worlds have one or more moons; the bigger the planet, the more moons are likely. Gas giants may have giant (Earth-sized) moons. Large moons are 25-45% Earth size (Titan and Merçury). Medium moons are 10-25% Earth size (Luna and Iapetus). Small moons are 5-10% Earth size, and may be unrounded chunks of rock (Tethys and Ceres). Moonlets are orbiting boulders, less than 5% Earth size (Phobos and Vesta). Size, density and gravity of moons are related just as for planets.

Rotation. Moons create tides on their mother planet. Multiple moons create complicated ocean currents. Everything else being equal, the tidal effects of a moon will slow the world's rotation. The details depend on the masses, distance, and the age of the planet-moon system — GMs have plenty of room to fudge most desired results. Many moons will be tide-locked — the same side always faces the mother world.

Separation. For habitable worlds, the distance between centers of moon and planet must be at least 2.5 times the planet's radius (Roche's Limit). As the separation between moon and planet increases, so does the chance of the moon retaining its own atmosphere.

Composition. Large and medium moons will be less dense than their mother world, unless they are *captured* moons; small moons and moonlets vary widely. Exception: Moons of gas giants are usually denser than the mother world.

Orbital plane. Most moons orbit in the plane of the mother world's equator. Wildly-canted orbits are rare and less stable.

Length of Year

To determine the length of a planet's year, you need to know the mass of the star (from the table on p. 104) and the radius of the planet's orbit. Use the formula:

$$P = \sqrt{D^3/M}, \text{ where}$$

P = the length of the planet's year, in Earth years
M = the mass of the star, in Solar masses, and
D = the radius of the planet's orbit, in AU.

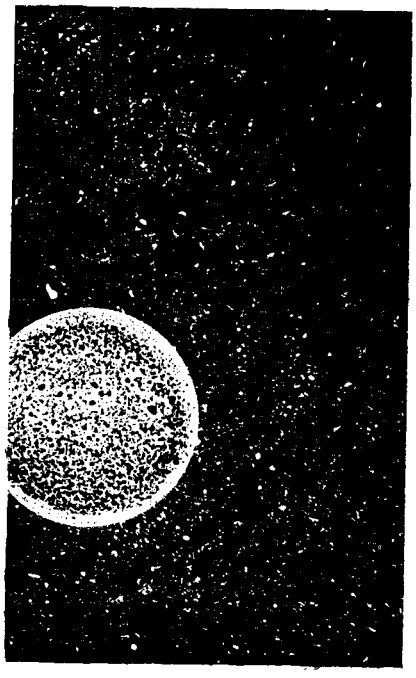
In a campaign, you may want to know the number of local days in the local year. To find this, simply multiply the length of the local year by 8,766 hours (the number of hours in an Earth year). This gives the number of hours in the local year. Divide by the number of hours in the local day. The result is the number of local days in the local year.

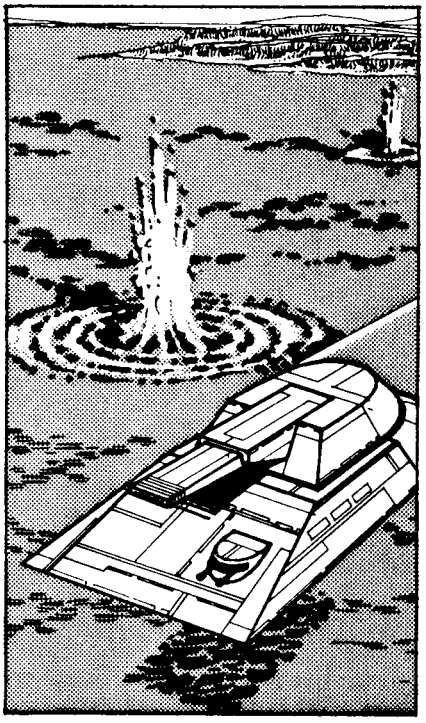
Moons for Terrestrial Worlds

To determine what moons orbit a terrestrial world, roll as shown for each type of *moon.* The result gives the number of that type of moon.

Moonlets: 1d-4
Small Moons: 1d-4
Medium Moons: 1d-5
Large Moons: 1d-5

Modify each roll by -1 for a world of less than Earth's diameter (8,000 miles or less), or +1 for a world of over 1.5 Earth diameters (12,000 miles or more).





Humidity

Humidity — the amount of water vapor in the air — is important to most species. Earth averages 50% humidity. Anything below 30% is uncomfortably dry; anything above 70% is muggy. At 100%, it rains.

The presence of liquid water makes higher humidity likely, but there are many other factors involved. To assign humidity randomly, roll 2d-2, multiply by 10%, and add 10% of the world's water surface. Thus, a roll of 6 on a world with 50% water would give 45% average humidity. Average humidity over 100% is impossible — 100% means it rains all the time.

Water and Other Liquids on Uninhabitable Worlds

Metallic, iron or silicate worlds in outer orbits will be almost totally covered with "ice," which may include many compounds other than water. Oxygen, nitrogen and other "atmospheric" gases will be frozen out on very cold planets. Asteroids may have ice, though it will not be on the surface.

If Hostile Terrestrial worlds and Greenhouse worlds with Superdense atmospheres have any liquid at all, it will likely be methane, ammonia or sulfuric acid. Worlds with Exotic or Corrosive atmospheres will have a liquid appropriate to their atmospheric composition and orbital positions.

Gas giants have no liquid water; there will be solid H_2O on the surface and possibly traces of water in the atmosphere.

The Biosphere

A planet's biosphere is its envelope of life — its flora, fauna, and microorganisms. The exact nature of each world's life should be decided by the GM, often in connection with a specific adventure. However, the table below will allow a broad determination of what types of life exist.

This table is primarily for Terrestrial worlds within the habitable zone. It may be used with other types of worlds, but life will be truly alien there, if it exists at all. The information given is about what could be learned by observation from orbit; details are up to the GM.

To determine the dominant native life form on the planet, roll 3 dice. The *Life Roll Modifier* for the star's type and class, from the table on p. 105, gives the final result for life on the world.

7 or less — No life, and therefore no oxygen atmosphere.

8, 9 — Protoorganisms: single- or multi-celled microorganisms, including algae, protozoa, amoebas and so on.

10 — Lower plants: equivalents of lichens, mosses and fungi.

11 — Higher plants: equivalents of ferns and flowering plants.

12, 13 — Lower animals (IQ 2-3): equivalents of insects, fish, amphibians.

14-16 — Higher animals (IQ 4-6): equivalents of reptiles, mammals, birds.

17 — Near-intelligence (IQ 7): no civilization.

18+ — Intelligence (IQ 8+): civilization or the potential for civilization. Tools, fire, and language.

Lower forms than the dominant one will usually still exist. The GM may roll again from the choices given under dominant type — e.g., to determine whether insects, fish or amphibians are the dominant type, if "lower animals" is rolled.

If intelligence exists, the GM should define its type, tech level, society, and so on — see the next chapter.

Completing the System: Other Worlds

Most solar systems will have a number of worlds. We will assume that Bode's Law (see sidebars, p. 103-104) will prove to be more or less universal, but that different systems will have different types of orbital spacing.

To determine system orbits, use the system described in the sidebar on p. 104, unless the campaign background requires that this particular system *not* follow Bode's Law for some reason. Make sure that you have at least one orbit in the biozone, if the system is to contain a habitable world. Note that some orbits may be empty.

Details About Uninhabitable Worlds

The GM can add as much detail as he wants about worlds not in the biozone. In general, close-in worlds are dense and airless. Worlds outside the biozone are usually less dense; they are also less likely to have a useful atmosphere. Outer planets are likely to be gas giants; little detail will usually be needed.

Asteroid belts may replace one or more worlds per system. An asteroid belt is an orbit filled with small planetoids, most of which will be a few miles in diameter at most. Asteroid belts may include small Rockball or Ice worlds. Rare are the asteroids with even thin atmospheres, though a few have water in the form of ice. Asteroid belts may be the remnants of a destroyed planet, or just a world that never formed. Individual asteroids are scarce within the belt; except when clusters orbit together, they won't be encountered in masses, despite bad SF movies.

Asteroid Types: Three types of asteroids are common. Most are small, but some are the size of small worlds or moons; Ceres is an example. *C-Type* asteroids are dark, low-reflective, with brittle bodies made of fine opaque material and hydrated (water-rich) minerals. *S-Type* asteroids have stony/iron compositions. *M-Type* asteroids have nickel/iron compositions and are rarer than other types; these are the ones that meteor-miners look for. Any of these may have a usable amount of ice on the surface or within.

Rogue worlds, not fitting the normal orbit pattern, may be added. If they orbit within a few AU of other worlds, they create an unstable situation and are therefore recent — perhaps captured from another system. Such captured worlds may have eccentric orbits, becoming much hotter during the part of the year when they approach the sun most closely. If such a world stays within the biozone the whole year, any life it harbors may be very unusual.

Unusual System Objects

These objects might be found in an otherwise-normal star system.

Unusual shape. Nature creates irregular shapes through impacts and vulcanism, which gravity then works to smooth. The spin of a planet also works to make it bulge at the equator, while flattening at the poles. For this reason, planets are seldom a perfect sphere (if one is, suspect it of having an artificial origin). Large or dense worlds may be conspicuously flattened at the poles. Small worlds maintain more irregularities than larger worlds — at the extremes, moonlets are often square chunks rather than small balls. On an irregular world, portions may extend above the planet's atmosphere.

Dying world. This planet is being destroyed, possibly by a moon in decaying orbit, with tidal forces causing planetwide vulcanism and earthquakes. Death may also come from outside: a wanderer or other foreign object approaching too near, a prolonged meteor storm, or a star threatening to explode. Or the inhabitants might destroy their planet through warfare.

Dead world. This planet once had life, but most or all of the biosphere has been destroyed. The atmosphere is not likely to be breathable.

Gas Giant Types

To randomly determine a gas giant's type, roll 3 dice, subtracting 2 for an M-type star, or 1 for a K-type star. If a "Huge" result is rolled for either of these star types, roll again, and accept this second result, whatever it is.

3 — Huge (gray dwarf). No other planets or moons in system.
4 — Huge (gray dwarf) as part of normal planetary system.
5-8 — Small
9-12 — Medium
13-18 — Large

Moons for Gas Giants

To determine what moons orbit a gas giant, roll dice, as shown, for each type of *moon.* Modify the roll by +1 for a Large gas giant, or by +2 for a Huge one. The result is the number of that type of moon.

Moonlets: 3d
Small Moons: 2d
Medium Moons: 1d+1
Large Moons: 1d-3
Giant Moons: 1d-5
Small Gas Giants: 1d-7

Gas Giant Special Features

Roll 3 dice to see if a gas giant has some special feature. Add 3 to the result if the gas giant is Huge, or 2 if it is Large.

3-9 — No special feature.
10 — One moon has a retrograde or inclined orbit.
11-13 — Faint ring, like Uranus'.
14 — Spectacular ring, like Saturn's.
15 — "Asteroid belt" of small moons and moonlets.
16 — "Oort belt" of cometary slushballs.
17 — Twice as many moons as rolled originally.
18 — Roll twice more.
19-21 — Produces enough heat to warm its moons; has at least one Large or Giant moon of habitable temperature (roll as for terrestrial worlds, disregarding uninhabitable results).

Asteroid Types

To randomly determine an asteroid's type, roll 3 dice:

3, 4 — M-type
5-13 — S-type
14-17 — C-type
18 — Icy — roll again for type.

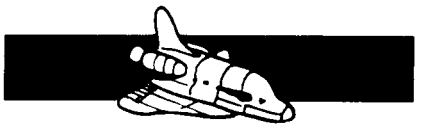
Most asteroids are small — house-sized up to mountain-sized. Very large asteroids, like Ceres and Vesta, are rare in our solar system, but relatively easy to find. An ordinary optical telescope can spot them. The GM can make a given asteroid this big on a roll of 5 on 5 dice, or assign large asteroids to suit the campaign.

Miscellaneous Debris

In addition to planets, asteroids and moons, star systems usually have lots of assorted orbiting trash — meteor swarms, comets and so on. These may be placed by the GM as necessary (usually as a space encounter for some special purpose).

It's probable that most or all systems have a cometary belt similar to the Oort Cloud of our own solar system. This is an area of small ice/methane bodies, orbiting at about 50,000 AU and beyond, from which the system's comets originate. To determine if an Oort Cloud exists at the rim of a star system, roll one die. On a roll of 1 to 4, the system has a definite cometary cloud; on a 5, the cloud is unusually sparse (only half normal density). On a 6, there is no cloud.

The presence of a cometary belt is likely to be important only to spacefarers whose ship uses hydrogen as fuel or reaction mass, and who are stranded on the fringes of a star system. But it's always good to know what's out there . . .



Terraforming

Terraforming is the process of making a world habitable. Its difficulty depends on the current state of the world. Mars, for instance, could probably be made very Earthlike in a few hundred years if we just crashed a few ice asteroids to give it more water, and set up a big solar mirror to raise the temperature. Venus would be a lot harder; it would have to be cooled down, and its entire atmosphere *changed.* And less Earthlike worlds would be harder yet to terraform.

Terraforming is certain to be a very lengthy process . . . measured in tens, if not hundreds, of years. Once the world's temperature and chemistry are right, an appropriate ecology has to be introduced. The higher the tech level, the more worlds can be terraformed, and the faster the process is. TL8 could terraform Mars as described above. TL10 or 11 should be able to use nanotechnology and self-replicating machines to do even a Venus-type job quickly. At TL13, worlds themselves can be moved to the star's biozone — we could terraform Titan!

We may also meet aliens who know how to reshape worlds. And their ideas of "terraforming" are likely to be very different from ours! The more advanced both sides' terraforming technology is, the more worlds will be useful to both races, and the more likely conflict becomes. "Look, Zort! It's oxy-nitrogen right now, but we could G'voontform it in just a few megacycles!"

Captured world. When stars approach closely, planets from one star may be "captured" by the other. Outer worlds are more likely to be captured than inner worlds. Captured worlds have eccentric orbits, often varying from the plane of the new solar system. If an inhabited world is captured by a new star, few higher life forms are likely to survive, but ruins may be found on captured worlds.

Retrograde-revolution world. Normally, all worlds in a system orbit in the same plane and in the same direction. A "retrograde" world, orbiting in the wrong direction, is almost always artificial or captured.

Inclined orbit. A world with an inclined orbit (one set at an angle to the system's normal orbital plane) is likewise probably a captured world. Such worlds may be very hard to find, especially if they are far from the sun and do not approach the orbits of any "normal" worlds.

Elliptical orbit. Most orbits are nearly circular, but a world can take an elliptical orbit due to a near-collision or other accident. Such a world will have very extreme "seasons" affecting the whole planet, and the native life will have some very strange adaptations. In extreme cases, a world spends centuries in frozen darkness, then has a brief spasm of glory as it plunges around the sun, burning off its atmosphere. If an elliptical orbit crosses that of other worlds, a collision will eventually occur unless the elliptical orbit is also inclined.

Binary planet. Two planets in the same orbit, revolving around one another. They do not need to be identical. Tidal forces will be very strong (if the worlds are too close, the tidal pull will tear them apart), and the worlds will be tide-locked unless their relationship is recent. Formation of such a system is improbable (suspect Precursor involvement!), but it is stable once formed. Moons are possible, but will orbit at a distance from the system's center equal to at least three times the worlds' separation. If such a system fails, the worlds may disintegrate or take up elliptical orbits (see above).

Double planet. Two identical-mass planets in the same orbit, but on opposite sides of the sun. If either world has a moon, the moon's mass is added to the world's when matching masses. Inhabitants of one world may not know of the other until sublight space travel is developed. Double planets are extremely rare in nature, but can be engineered at TL13+.

Eccentric star. This seems to be a normal star most of the time, but has storms or seasons, hundreds or thousands of years apart, in which it changes its nature. It might abruptly become warmer or cooler, enough to change a habitable world's climate, and possibly increasing the amount of hard radiation it emits. Flares may erupt from its surface, producing a lethal barrage of radiation that could kill the crew of an unshielded ship, knock out its instruments, or sterilize a world. An eccentric star might also have unstable magnetic fields, snaring unwary spacecraft among its inner worlds. A world of an eccentric star might be colonized before the danger was detected, or the ruins of an extinct culture might be found there.

Rosette. This is a formation of three or more planets of approximately equal mass, in an equidistant orbit around a star or other object. It could be natural, but it is far likelier to have been engineered at TL13+.

Artificial world. A world — probably the size of a small planet or a large moon — built by intelligent life. Artificial worlds may be built at an uninhabitable system, to allow colonization or to build a military post; they might also be built to ease population pressures for a society without FTL drive. Artificial worlds are expensive, and generally built only for compelling reasons. A TL13 artificial world may be constructed like a spacecraft, and might be mobile. A TL14 artificial world is built from planetary debris; it will have odd density and composition readings (and may be geologically unstable).

Ringworld. First envisioned by Larry Niven, this structure is a flat band circling a star within the habitable zone. One surface faces the star. Its rotation

creates centripetal force or "gravity" on this inner surface. Even a small ring has many times the surface area of a planet. Usually a ringworld is alone in a system, as worlds from this and neighboring systems have been used to construct it. Constructing a ringworld is a huge undertaking even for a TL14 society.

Dyson sphere. As proposed by Dr. Freeman Dyson, this is a spherical shell entirely surrounding a star. The star is hidden from sight within the shell, where its total energy is trapped and used by the inhabitants. From the exterior, the sphere is dark and can be detected only by the heat it gives off. If the sphere is rotating, the centripetal force will create "gravity" that is strongest at the equator, falling off to nothing at the poles. Often, it will be the only body in a star system, as the natural planets of this and neighboring systems have been dismantled to create it. The radius of the sphere should be the same as the distance at which a habitable world would orbit. Even the smallest Dyson sphere has a huge habitable area — many billions of times larger than any single planet. Construction of a Dyson sphere is impossible below TL14, and a monumental task even at TL15; unfinished or failed spheres might also be encountered.

Other artificial structures are also possible — for instance, a structure like a huge phonograph record, with the star located in the hole.

Planetary Records

On the next page is an example of a Planetary Record, filled in for the world Saphronia. A blank form is on the last page, to make it easy to photocopy.

The map uses an "equal-area icosahedral" projection. Each hex represents the same amount of space. Size of a hex depends on the size of the planet. Multiply the world's diameter by .07 to determine the distance across one hex.

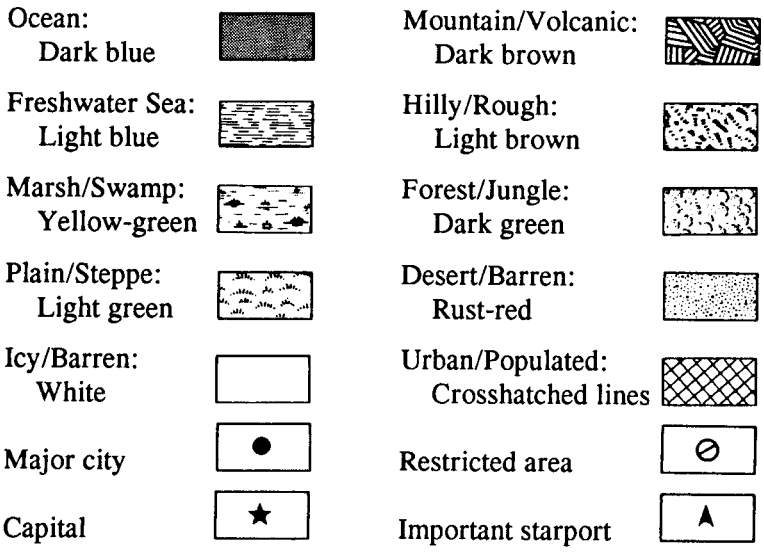
Unless specified otherwise, the north pole is at the top of the map, in the hex formed by the joining of the five points. Because this tends to distort the polar areas, a circular area centered on the North Pole is also shown at the top of the map, and an area centered on the South Pole is shown at the bottom.

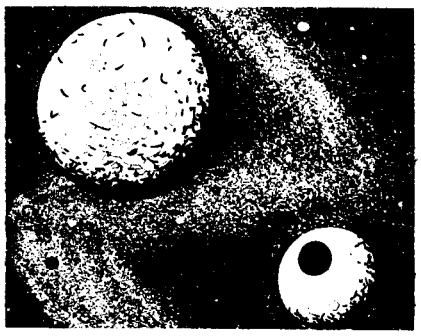
The zero meridian line and the equator are shown as dashed lines. Lighter dashed lines connect hexes that are divided on the map. If this map were cut out and folded up, it would form a 20-sided "globe."

Specific points of interest are shown by a letter, keyed to text.

Map Key

This key shows suggested colors, for those making their own maps, and standard black-and-white symbols.





Unusual System Phenomena

If star systems are being created randomly, a system will contain something unusual only on a roll of 12 on 2 dice. To determine the specific "special effect," roll 3 dice.

Entries marked with an * may be ignored (do not roll again) if the GM does not want super-high-tech or science-fantasy elements in his campaign.

3 — Sentient world*
4 — Artificial world (TL14+)*
5 — Artificial world (TL13)*
6 — Double planet
7 — Elliptical-orbit world
8 — Captured world(s)
9 — Dead world(s)
10 — Unusually shaped world
11 — Eccentric star
12 — Inclined-orbit world
13 — Retrograde-revolution world
14 — Dying world
15 — Binary planet
16 — Ringworld*
17 — Rosette*
18 — Godstar*

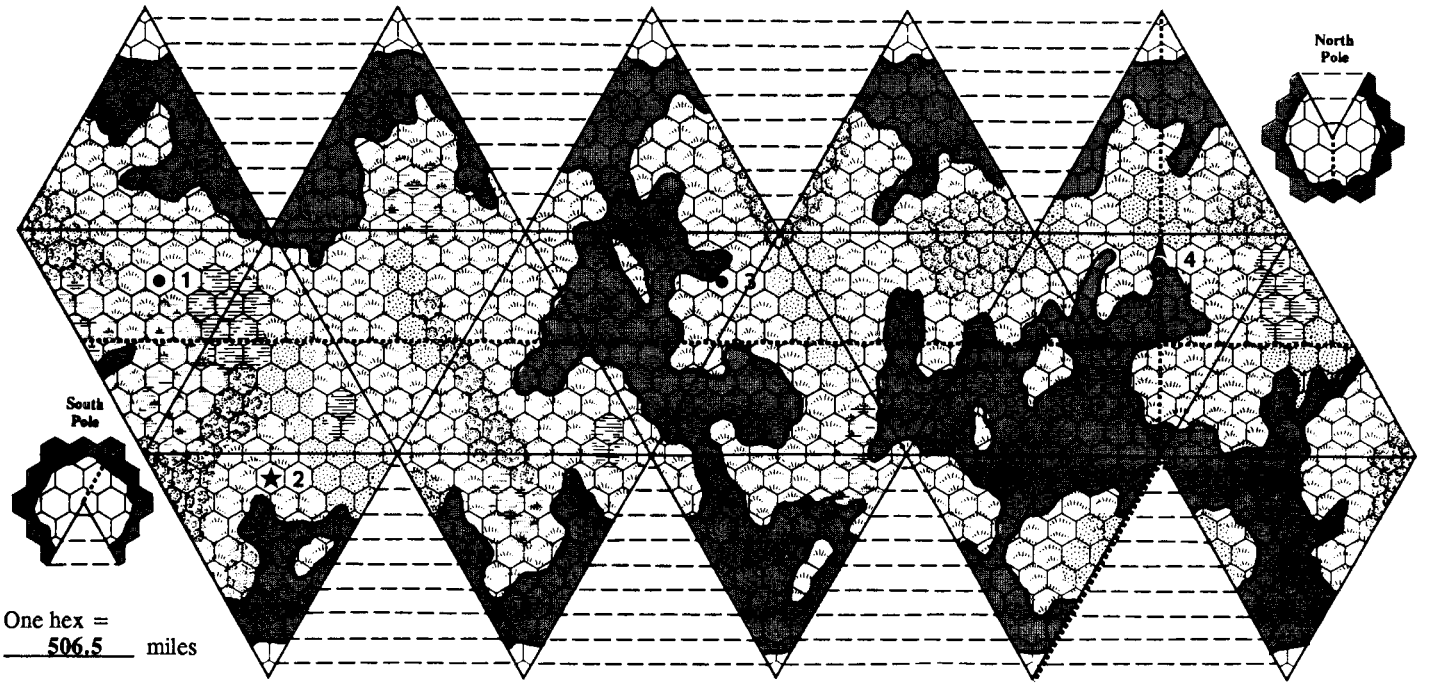
Science-Fantasy Phenomena

Sentient world. On the fringes of science fantasy are worlds which are alive and self-aware. The life might be in the world itself, or a "total consciousness" of the combined life on the world — in the latter case, the world entity might have control of all native life forms. A sentient world might be childlike or very wise, and may be friendly, suspicious or resentful of intruders. It will often be very alien in its thought processes. Its powers are entirely up to the GM; it may or may not be able to communicate, and may or may not have control of its own weather, seismic processes, and so on.

Godstar. A sentient star, essentially similar to a sentient world.

Zone of Improbability. An area in which, for reasons either natural or artificial, some of the normal laws of nature are suspended. Effects can range from amusing but trivial (wavelengths of light are shifted) to potentially catastrophic (entropy is slowed or reversed; intelligence is lowered) to ludicrous (inanimate objects talk).

PLANETARY RECORD: Saphronia



One hex = 506.5 miles

Planet type Earthlike Diameter 7255.4 mi. Gravity .75 G Density 4.2 Composition Low-Iron
Axial Tilt 28° Seasonal Variation Earthlike Length of Day 28 hrs. Length of Year 255 days/ .69 Earth years
Atmosphere: Pressure .69 (Thin) Type and Composition _____ Nitrogen (66%) Oxygen (32%) Other (2%)
Climate Warm Temperatures at 30° latitude: Low 80 ° Average 90 ° High 100 °
Surface Water 50% Humidity 95% Primary Terrain Marsh/Swamp — Little Volcanic Activity, Flat Surface

Mineral Resources: Gems/Crystal Absent Rare Minerals Absent Radioactives Scarce
Heavy Metals Absent Industrial Metals Absent Light Metals Absent Organics Plentiful
Moons **Hyltin — Large Moon (Diam — 2, 176 mi.; Density — 3; .13G; No Atmosphere**

Biosphere: Dominant life form **humans and animals transplanted from other systems**
Other significant life forms **Most advanced native life — insects on land; bony fish in oceans**

Civilization: Population(s) 1,296,000 humans (PR 6) Tech Level(s) 10 Control Rating 3/4
Society **Meritocratic caste system, based on intelligence. IQ 11 or better to vote**
Starports **Essle (Class III); Class II facilities at Deshong, Hamplin and Orzell**
Installations **Pachekki Embassy; Colonial Recruiting Center; Home office of Spataro Industries, Ltd.; advanced plastics research inst. (Gov't.); Morava Gravitech Research Facility (on Hyltin); Radionics Corporation Research Facility.**
Economic/Production **Mixed economy — exports large quantities of petroleum & related products, especially plastics, explosives, bulk foods; also exports some fine timber**

Other notes: **Strict IQ tests must be passed to hold high-ranking positions in gov't or business, encouraging "selective breeding" for IQ, especially among the upper circles.**
Map key: 1. Hamblin, 2. Deshong (planetary capital), 3. Orzell, 4. Essle (Class III starport).

System Information:

Star Name Ashtoreth Type G3V Location
Biozone .8 — 1.2 Inner Limit —— Number of Planets 8

Planet	*Orbit*	*Distance*	*Type*	*Diameter*	*Density*	*Gravity*	*Atmosphere*	*Notes*
Burnout	1	.3	Hot Rockball	9,260	6.1	1.10	Trace	
——	2	.6	——	——	——	——	——	——
Saphronia	3	.9	Earthlike	7255.4	4.2	.75	Oxygen-Nitrogen	detailed above
——	4	1.5	Asteroid belt	——	——	——	——	——
Chill	5	2.7	Icy Rockball	11.064	5.4	1.16	Methane	Naval base (PR 4)
David	6	5.1	Small Gas Giant	27,869	1.9	1.02	Hydrogen	15 moonlets; 9 small moons; 2 med; 8 lg. faint ring
——	7	9.9	Asteroid belt	——	——	——	——	High iridium content
Goliath	8	19.5	Med. Gas Giant	52,574	1.3	1.32	Hydrogen	8 moonlets; 7 small moons; 5 med moons; 1 small moon is captured.
——	9	38.7	Asteroid belt	——	——	——	——	——
	10							

PLANETARY CIVILIZATIONS 11

For each world with intelligent life, native or otherwise, the GM should determine basic facts important to the adventurer: the general structure of the society, tech level, basis of the economy, and existence of important facilities.

Population

The GM may assign population as he chooses, or calculate it based on the world's history and environment. The Population Rating (PR) is the "order of magnitude" of the world's population. Increasing the world's PR by 1 multiplies the actual population by a factor of 10.

There are three good ways to set PR. For a random determination, just roll 2 dice and subtract 2. To assign PR according to campaign needs, base it on the following:

0: less than 10. Research team, shipwreck survivors, etc.
1: 10-99. As above, or a very small startup colony.
2: 100-999. The smallest likely startup colony, or a military base.
3: 1,000-9,999. A fairly small colony (equivalent of a small town).
4: 10,000-99,999. A growing colony or very large military base.
5: 100,000-999,999. Equivalent to the population of a small city.
6: 1 million-9,999,999. Equivalent to a single large city.
7: 10 million-99,999,999. A huge city, like New York; a large colony.
8: 100 million-999,999,999. A very large and successful colony.
9: 1 billion-9,999,999,999. A long-settled world or homeworld.
10: 10 billion-99,999,999,999. A severely overpopulated world.

Calculating Population of Colony Worlds

It is also possible to calculate PR mathematically, based on the history of the world in your campaign. The initial PR might be anywhere from 2 (a very small colony) to 5 (from a huge colony ship or fleet). Growth of the original colony depends on how hospitable the world is. On a wholly Earthlike world, with medical technology of at least TL5, a human population will increase by a factor of 10 every 100 years, up to the maximum population for the planet (see below).

Non-Earthlike environments will reduce this *increase factor,* as shown below. If the increase factor is 0, population on the planet is static; if the increase factor is negative, the world is so hostile that population is in decline.

High Gravity: For gravity over 1 G, subtract the gravity, *cubed,* — e.g., if gravity is 1.2, subtract (1.2 × 1.2 × 1.2.)

Low Gravity: For gravity under 1 G, take (2-G) and subtract the result, *cubed* — e.g., if gravity is .7, subtract (1.3 × 1.3 × 1.3.)

Composition: Subtract 4 if the world is Metallic. Subtract 2 if it is High-Iron or Silicate.

Climate: Subtract 4 if the climate is Very Hot or Frozen. Subtract 2 if it is Hot or Very Cold.

Atmosphere: Subtract 2 if the atmosphere is Thin or less, or if it is Polluted; subtract 3 if it is both, or if it is Exotic or Corrosive.

Other factors: Continual war, savage or toxic native life, disease and so on will also lower the factor of increase. Deliberate attempts to increase the popula-

Native Intelligence

When intelligent life is encountered, th GM may get basic information about it b rolling 3 dice on the table below. Add 3 the planet is Hostile Terrestrial; subtract if it is Earthlike. Assume a native race perfectly adapted to its environment unles it is a colony, or unless the world is a dyin one.

4 or less — Human colony (perhaps lost)
5-8 — Cold-blooded, four limbs
9 — Cold-blooded, six limbs
10 — Warm-blooded, four limbs
11 — Warm-blooded, six limbs
12 — Insect- or crab-like
13 — Boneless or worm-like
14 — Plant-like
15 — Two races living in a symbioti relationship; roll twice more.
16 — Roll two dice on the "Psychologica Oddities" table, and again on this tabl at a +2.
17+ — Physically very unusual; roll 2 dic on the next table.

Physical Oddities

2, 3 — Energy eater
4 — Gaseous
5 — Shapeless
6 — Roll twice more on this table, discard ing contradictions
7 — Roll two dice on the "Psychologica Oddities" table, and again on this table
8 — Possesses a sense humans don't have such as radar
9 — This is an outpost; race is not native t the planet and is not adapted to it.
10 — Artificial or mechanical life.
11, 12 — Silicon-based metabolism

Psychological Oddities

These creatures have cultures very dif ferent from the humanoid patterns described in the rest of this chapter. The GM may add details as he chooses.

2, 3 — Simply incomprehensible t mankind
4 — Hive culture (telepathic)
5 — Hive culture (non-telepathic)
6 — Dislikes other intelligent life
7 — Extremely short life span
8 — *Secretly* xenophobic: dislikes other in telligent life
9 — Ignores attempts to communicate
10 — Secretive; avoids *all* contact!
11, 12 — Moves/thinks *very* slowly

Natural Environments

To determine the natural environment of nonhuman intelligent life, roll two dice, discarding any result that contradicts with facts already known about their world:

4 or less — Underwater
5, 6 — Water
7-10 — Land
11 — Underground
12 — Air

If the natural habitat is on land, use the planetary terrain table (p. 110) to determine what type of land environment the natives prefer. Do the same if they live underground or in the air (unless they are fliers who never land) to find out what type of terrain they live under or above.

Underwater: These beings live their entire lives underwater and may die if they leave it for more than very short periods.

Water: These beings live in the water, but not necessarily under it. They may float on its surface all their lives, or live underwater but not be able to breathe underwater, like whales and dolphins.

Land: These beings live on land, in one (or more) of the various terrain types described earlier. You may roll more than once for their native terrain, if you wish them to be found in more than one type of environment.

Underground: These beings are burrowers who live under the surface all or part of their lives, or are primarily cave dwellers.

Air: These beings spend most or all of their lives in the air. True fliers, floaters and some gliders will fall in this category.

tion will have a significant effect only if a significant portion of the world's resources go toward the effort!

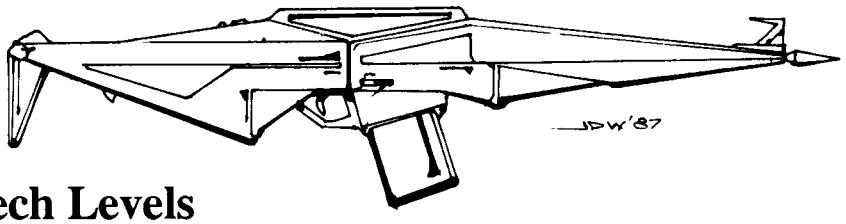
Example: Saphronia has .75 G; subtract (1.25 × 1.25 × 1.25), or 1.95, from the Increase Factor. Its composition is Low-Iron, and its climate is Warm (no effect from either). It has thinner atmosphere, which means a higher background radiation (subtract 2). Therefore, its increase factor is 10, minus (1.95 + 2), or 6.05. Thus, the population is multiplied by 6 every 100 years. If it started with a population of 1,000, and has been colonized 400 years, it will now have a population of 1,000 x 6^4, or 1,296,000. In the same time, an Earthlike planet would have increased its population to 10,000,000!

Maximum Population

Maximum population is determined by TL and usable space. Earth has some 40 million square miles (only about 20% of its surface) of liveable land, and a PR of 9 (currently something over 5 billion). It probably has a maximum PR of 10 (over 10 billion, less than 100 billion). For a world of comparable area, then, maximum PR is 7, plus 1 for every TL above 7, to a maximum of 10.

Alien Populations

Alien races may increase at different rates, and may have different requirements, depending on their homeworlds. Small creatures can build higher populations in a given space. If a world has multiple races with different requirements, figure each race's PR separately. If they live in wholly different environments, one world could support "full" populations of two or even more races — one terrestrial and one aquatic, for instance.



Tech Levels

Each world has a Tech Level from 0 up. Most worlds will have the same TL as the campaign. Possible exceptions include:

Society TLs. A particular interstellar society may have a different TL. For instance, in a TL10 campaign, one empire might be TL9 — its advanced technology must be imported, and cannot even be repaired locally. A society or world may be given a "split TL" to show this: TL10/9 means that TL10 gear is available but not produced locally.

Colonies. A new colony is generally at least one TL lower than the world or society that colonized it. It may have the use of advanced technology, but the devices cannot be repaired or replaced locally.

Backward worlds. A world newly introduced to interstellar society will have a TL between its level when discovered and the society's TL. Cultures resistant to change (such as 17th-century China) may advance slowly, while ambitious cultures (19th-century Japan) might leap several TLs in a century. An interstellar society might enforce "non-interference" or stable-growth regulations, controlling the spread of advanced technology. Again, a split TL is possible: barbarians with stolen blasters might be TL8/4.

Regressed worlds. On these worlds, a high technology is being (or has been) lost. This may be due to philosophy (a religious movement that rejects "mechanical brains," for instance), isolation (a colony cut off from its mother society, unable to replace its aging high-tech devices) or loss of the tech-educated segment of society through war or disease.

Advanced worlds. For game balance, GMs should be cautious about worlds with a higher TL than the campaign. One option is to have a few worlds advanced in a single field, perhaps balanced by retardation in another — the Somisians, for example, have TL10 medical technology, but no starflight. Advanced societies might also restrict the spread of their knowledge.

Worlds with an overall TL above that of the campaign should not be randomly generated; any that exist should be created by the GM for a specific reason!

Planetary Societies

Mankind has lived under dozens of different societies; aliens will no doubt have dozens of their own. And the possible differences in planetary societies are far greater than those of interstellar nations! For adventurers used to the sophisticated spaceways, an unusual society can be a death trap.

Some possibilities are listed below. Note that worldwide societies are likely only at TL8 and above. At TL6 and 7, a world may harbor several different societies; at TL5 and below, there are likely to be hundreds.

Anarchy

There are no laws. Order is maintained by the social conscience, or the strength and weaponry, of the population. An anarchy may be a lawless mob, or a crew of clear-eyed, strong-backed pioneers. Control Rating (see sidebar, p. 122) is usually 0 — but if all your gun-toting neighbors disapprove of what you're doing, it is effectively illegal!

Athenian Democracy

Every citizen (the definition of "citizen," of course, can vary) votes on every action the society takes. In a low-tech society, this works only for groups under 10,000. In a high-tech society, any number can discuss and vote, electronically. Usually CR 2 to 4.

Representative Democracy

Elected representatives form a congress or parliament. If the citizens are vigilant and informed, this is a benevolent government. If the citizens are badly-educated, government policies will be bad but popular (bread and circuses!). If citizens are apathetic, government may be dominated by factions or special interest groups. In all cases, secret conspiracies may operate to control the society. Usually CR 2 to 4.

Clan/Tribal

The society is one large interlocking family, made up of cooperating clans or tribes. Rule is usually by the clan elders. Customs and tradition are very important. Younger clansfolk may feel forced to conform, or may be rebellious about their lack of influence; seniors may channel this energy by encouraging sports, recreational combat or outworld adventuring. Usually CR 3 to 5.

Caste

As for Clan/Tribal, but each clan has a set profession — for instance, if the Arrin family is a warrior clan, then all Arrins are soldiers of some sort. Those who don't follow their clan profession become Clanless (a social stigma) unless there is a system for adoption into a new clan. Clans are often arranged in a social hierarchy — Administrators outrank Warriors, who outrank Street Sweepers, and so on. Individuals are expected to associate only with those of equivalent status. There may also be rivalries among clans of the same type (different Warrior families, for instance). Usually CR 3 to 6.

Random Tech Levels

Tech level is based on the TL determined for the campaign by the GM. To determine relative tech level randomly, roll 3 dice.

3 — *Anomalous.* Roll 1d+1 to determine TL, but they have star travel. Somehow, the barbarians got some starships — now they have advanced weapons, and perhaps a hostage world or two doing manufacture and repair.

4, 5 — *Retarded in a science.* Same TL as the campaign, but retarded in technology in one field — see the Sciences Table.

6, 7 — *Retarded in an art.* As above, but see the Arts Table.

8, 9 — *Primitive.* Roll one die to determine the world's TL.

10 — *Developing.* TL is (one die) lower than the TL of the campaign.

11 — *Slightly retarded.* Same TL as the campaign, though manufactured items tend to be larger, heavier, costlier (+10%) or less user-friendly.

12 — *Modern.* TL of the campaign.

13 — *Slightly advanced.* Campaign's TL, but products are beautifully-styled, compact, inexpensive or easier to use.

14-16 — *Advanced in an art.* Same TL as the campaign, but this society is advanced in one of the arts — see the Arts Table.

17, 18 — *Advanced in a science.* As above, but see the Sciences Table.

Sciences (roll two dice):

2-4 — Biology and medicine
5 — Weaponry
6 — Sublight space travel
7 — Power generation
8 — Communications or sensors
9 — Computers or robotics
10, 11 — Air or surface transportation
12 — FTL travel

Arts (roll two dice):

2, 3 — Games and diversions
4 — Social science and/or history
5 — Mathematics
6 — Visual arts
7 — Finance and commerce
8 — Performing arts
9, 10 — Music
11, 12 — Other arts

An advance might mean:

(1) the society has a *breakthrough* in the field. Its equipment — though still campaign TL — is noticeably improved.

(2) the society can construct a specific device from an advanced TL, though no other items from that TL are available.

(3) the society has advanced an extra TL throughout the field.

In a retarded society, the opposites apply.

Restricted Worlds

A world may be placed on "restricted" status by outside societies. Depending on the interstellar society, the Patrol may intercept ships approaching a Restricted World. The degrees of restriction are:

Hazardous: This may be a navigation hazard within the system, unusually vicious native life, or a poisonous atmosphere or ecosystem. Automatic warning buoys may be posted in systems posted as hazardous.

A world may also be posted as hazardous due to danger to visitors — the political climate may be extreme, or a local religion or culture may be easily offended.

Reserved: Reservation worlds have been prohibited from colonization or development at the current time.

Embargoed: All trade with this world is prohibited. Unless the interstellar society is very weak, the embargo is enforced by Patrol or Navy ships. Visitors are carefully searched to prevent smuggling.

Prohibited: No contact is allowed except by special government permission. Prohibited ratings may be given because a system is very hazardous (or if visitors might help spread the hazardous item) or harbors a technological or military secret (Precursor ruins or a captured enemy base). Developing sentients may be protected by declaring their homeworld prohibited. Or society may protect itself from dangerous cultures by declaring them off-limits. Prohibited worlds are usually patrolled by the Patrol, Navy or Survey. Depending on the danger, trespassers may be forcibly removed, prevented from leaving or destroyed on sight.

Protected: Contact with this world is permitted, but strictly limited, in order to protect local life or native culture. Depending on the danger, visitors may undergo medical quarantine, be prohibited from carrying equipment above a certain TL, and/or required to disguise themselves as natives.

Corporate State

This is similar to the interstellar corporate state — see p. 12. The world is ruled by corporate officers, usually chosen by a board of directors; most citizens are employees of the corporation. Society runs smoothly — it has to, or it won't be profitable. Usually CR 4 to 6.

Dictatorship

All government is in the hands of a single ruler — king, dictator or warlord. Successors may be chosen by inheritance, single combat, election, or any number of other means. If the ruler is a king, this is a *monarchy.* This sort of government can act faster, for good or evil, than most representative governments. Usually CR 3 to 6.

Many dictatorships and other totalitarian states, if they endure long enough, develop a "balance wheel" in the form of custom. Though the ruler's will is law, there will be unwritten laws which even he may not violate with impunity.

Feudal

Similar to Monarchy, but subsidiary lords retain power. The ruler, therefore, must be careful to maintain the support of the lesser lords, or be overthrown. Each lord rules his own territory, so laws and personal freedom vary from dominion to dominion. If the lord's rule is harsh, he will restrict ownership of high-tech items to protect himself! Usually CR 4 to 6 for commoners.

Technocracy

Engineers and computer programmers rule in the name of efficiency. Everything is carefully planned; of course, plans can go wrong. The better the technocrats are at running things, the less oppressive they will be; if they're incompetent, they will also be dictatorial. CR can range from 3 to 6.

Theocracy

A theocracy is ruled by a religious group or leader; freedom of religion is unlikely, and there is no distinction between religious and civil law. Theocracies range from totalitarian religious dictatorships to benign Utopian societies. In either case, the leaders may or may not believe in their own religion; "miracles" may be faked or *genuine.* Usually CR 3 to 6.

Multiple Societies

There is no world government. The worldwide political situation may be:

Diffuse: There are dozens, if not hundreds, of clans, nations and groups; no one can make any claim to world domination.

Factionalized: GMs may roll 3 dice to determine the number of major governments — which may be of wildly varying types. Anyone can flee justice by jumping the nearest border. Mercenaries may be welcome. Everything from scheming to warfare is going on, as factions strive for control — often with off-world assistance.

Coalition: The world is dominated by a few of the larger societies, which may bicker among themselves but usually present a united front to outsiders. GMs may roll one die to determine the number of major governments. A powerful homeworld run by a coalition, whose members each have their own off-world colonial empires, can make an interesting campaign.

Special Variations

These situations may apply to most society types listed above.

Bureaucracy: Government has fallen to a self-perpetuating bureaucracy. The bureaucrats, not elected, are insulated from public pressure. Government seems to run very smoothly — or if there are difficulties, you aren't told about them. But there are high taxes, many laws and lots of red tape. The government is unresponsive to citizens. There may not be a free press. CR 4 or higher.

Colony: A dependent member of a larger society. It is ruled by the mother society, usually through a governor. The colonists may have an elected council (through which they influence the governor) and/or an elected representative to the mother government (with non-voting power), but they have no direct say in their own government as long as their society is a colony. Colonies become *territories,* receiving more self-government, when they reach a set population or development level; territories eventually become full-fledged members of the society. Colonial government will be patterned after that of the mother society.

Colonies tend to be less regimented — rebels and outcasts are welcome if they have useful skills, and laws are loose. There is less government — no welfare bureaucracy, few police outside of major communities, and the TL is lower.

Cybercracy: Administration, and perhaps actual legislation, is controlled by a statewide computer system. Impossible below TL8, and unlikely below TL9. Government may be efficient, or inhuman, or both. CR 3 and up; the system is only as good as its programmers and technicians. Trust the Computer . . .

Meritocracy: No one may enter the government without passing a series of tests. A good meritocracy is likely to have (mostly) competent leaders . . . but this can lead to a rigid caste system. CR 3 and up.

Military Government: All administration is by the military. If led by a single commander-in-chief, the society is totalitarian; if the commander is responsible to a council or *junta* of officers, the society is feudal. Military governments can be strong and honest, but most become dictatorships. CR 4 and up.

Oligarchy: Regardless of the nominal form of government, leadership is in the hands of a small, self-perpetuating clique. CR 3 and up.

Patriarchy: Positions of authority are open only to males. In a *matriarchy,* all the rulers are female. Other than that, any CR is possible.

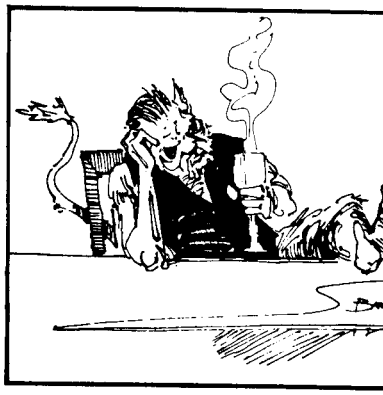
Sanctuary: A sanctuary world does not extradite criminals who may be hunted elsewhere, whether they be criminals, or religious or political fugitives (or there may be a Sanctuary Tribunal to decide each petitioner's fate). Lawmen or bounty hunters from other worlds are outlaws here. A sanctuary risks eventual takeover by the criminal element. CR rarely over 4.

Slave state: Slavery may be economic — if you can't pay your debts, you are sold into slavery. The length of the slavery might be pre-set, or economic slaves may have the chance to earn a wage and eventually buy freedom. Economic slaves are often used as colonists or soldiers. Racial slavery — in which a race or caste is held in slavery — is sometimes practiced by xenophobic races. In some cases, mentally-inferior (or intelligent but passive) aliens are enslaved by a dominant race; some races have a low-IQ slave sub-race. Martial slavery exists when a militant nation raids foes for slaves.

CR can vary; possibly everyone but the slaves is free.

For the GM, this is a way to get impoverished PCs involved in adventure. Characters might also fight a repressive state by fostering a slave revolt.

Socialist: Citizens are very heavily taxed, but government provides free education, entertainment, medical care, utilities and so on. Quality varies . . . Visitors will usually get these same services free, but if they stay more than a month, they will be taxed 1d+3% of their monthly income. If they don't pay, they may find it impossible to get the desired services at all.



Random Societies

World Government

To determine the general nature world government, roll two dice. Subt 4 from the roll if the world's prevailing is 6 or less.

5 or less — No world government; diff
6 — No world government; factionalize
7 — No world government; coalition
8 — World government with a special c dition; roll on the Society Type ta below, and then on the Special Cor tions table.
9 or better — World government with special conditions; roll on the Soci Type table below.

Society Type

To determine a society type, roll 3 d and add the world's TL, treating any over 10 as 10:

3-6 — Anarchy: no government!
7, 8 — Clan/Tribal
9, 10 — Caste
11 — Feudal
12 — Theocracy
13-14 — Dictatorship (details vary wide
15-17 — Representative Democracy
18-20 — Athenian Democracy
21, 22 — Corporate State
23-25 — Technocracy
26 — Caste
27+ — Anarchy: no government!

Special Conditions

Roll 3 dice on this table only if t World Government table indicated that special condition exists.

3, 4 — Subjugated*
5, 6 — Slave State
7 — Sanctuary
8 — Military Government
9 — Socialist*
10 — Bureaucracy*
11 — Colony
12 — Oligarchy*
13 — Restricted World; Hazardous*
14 — Meritocracy*
15 — Restricted World; Embargoed*
16 — Patriarchy/Matriarchy (flip a coin)
17 — Utopia
18 — Cybercracy (roll again if TL is les than 8)

* Roll one die. On a result of 1 to 3, ro for a second special condition.

Control Rating (CR)

The Control Rating is a general measure of the control which a government exercises. The lower the CR, the more freedom exists on the world and the less restrictive the government. Government type does not *absolutely* determine CR; it is possible (and interesting) to have a very free monarchy, or an Athenian Democracy where the voters have saddled themselves with thousands of strict rules. The GM can assign the CR as he pleases, or just roll one die.

CR also affects what weapons can be carried (see p. 54), but especially violent or nonviolent societies will have a separate, modified CR for weapon laws.

If any question of legality arises, or to determine how severe government checks and harassments are to visitors to the planet, roll one die. If the result is lower than the CR, the act is illegal or the PCs are harassed, delayed or even arrested. If it is higher, they escape trouble, either because the act is legal or the authorities overlook it. If the CR is rolled exactly, the situation could go either way; play out an encounter or make a reaction roll.

Control Ratings are as follows:

0. Anarchy. There are no laws or taxes.

1. Very free. Nothing is illegal except (perhaps) use of force or intimidation against other citizens. Ownership of all but military weapons is unrestricted. Taxes are light or voluntary.

2. Free. Some laws exist; most benefit the individual. Hunting weaponry is legal. Taxes are light.

3. Moderate. There are many laws, but most benefit the individual. Hunting weaponry is allowed by registration. Taxes are moderate and fair.

4. Controlled. Many laws exist; most are for the convenience of the state. Only light weaponry may be owned, and licenses are required. Broadcast communications are regulated; private broadcasts (like CB) and printing may be restricted.

5. Repressive. There are many laws and regulations, strictly enforced. Taxation is heavy and often unfair. What civilian weapons are allowed are strictly controlled and licensed and may not be carried in public. There is strict regulation of home computers, photocopiers, broadcasters and other means of information distribution and access.

6. Total control. Laws are numerous and complex. Taxation is crushing, taking most of an ordinary citizen's income. Censorship is common. The individual exists to serve the state. Private ownership of weaponry, broadcasting or duplication equipment is prohibited. The death penalty is common for offenses, and trials — if conducted at all — are a mockery.

Subjugated: This world is under outside control, which may be military (an occupying army or garrison) or economic (perhaps with a "puppet government," subservient to foreign masters). CR always 4 or more.

Utopia: A utopia is a perfect society, in which all citizens are satisfied. CR always seems low . . . but is it? Real utopias are rare. More often, seeming utopias have some dark secret — a hidden technocracy ruling by mind control, for instance. For sophisticated roleplaying, a sinister utopia is a real challenge. Real utopias make excellent "good guy" societies, to be saved from conquest or other threats. But real utopias, unless threatened by destruction, are boring.

Starports

Starports are graded by their ability to handle interstellar trade. A starport may exist on any world which has star travel, or which trades with star travelers; Class II and below may be present on any world which has space travel.

For a random determination of what starport class a world has, roll 3 dice, modifying the result by the world's PR (Population Rating) as described below. If a world has no Class V, check for IV, and so on. A world will usually have several ports of lower class than the main starport, but this rarely affects play.

Class V — Full facilities. Full repair and ship construction facilities, along with associated Patrol, Naval and/or Survey bases. Port has berths for hundreds of vessels, multiple landing fields, and every facility imaginable — from crew union halls to high-tech training facilities. A Class V port is present only on worlds of PR 6 or better, on a roll of less than (PR+3).

Class IV — Standard facilities. Full repair facilities and light ship construction facilities. A Patrol or Survey base is attached. Any world engaged in regular, substantial trade has at least standard facilities. A Class IV port is present only on worlds of PR 6 or better, on a roll of less than (PR+6).

Class III — Local facilities. Repair facilities for common needs; special parts or complex repairs will require off-planet parts, technicians or facilities. Patrol or Survey may have a base; if not, there will be at least an office. Worlds with limited interstellar commerce have local facilities. A Class III port is present on a roll of less than (PR+9). (If a world does not have at least a Class III starport, there must be a reason why it gets no regular star traffic.)

Class II — Sub-C facilities. These are intended for interplanetary or shuttle craft rather than FTL ships. Only emergency repairs are available for starships, but common fuel types are available. A Patrol office may be found here, perhaps accompanied by a Survey office if the world is isolated. A Class II port is present on a roll of less than (PR+8).

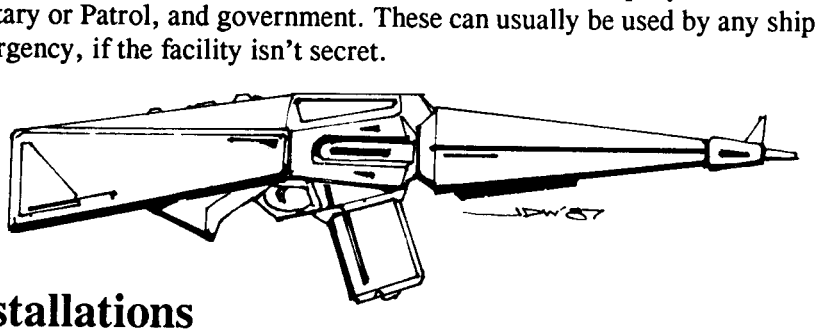
Class I — Emergency facilities. No real starport — only a landing area. Marked by automatic buoys, it might be a cleared-off, flattened space or a small orbital station. If FTL message beacons or drones exist, one should be present. A Class I port may be unmanned, or it may have local customs and security offices. Emergency parts and fuel are stored nearby. If qualified technicians are available, the buoys will have contact information. Class I facilities are present on a roll of 14 or less.

Class 0 — No facilities. There isn't even a designated landing site — ships planning to land must look for suitable terrain. If the world has a high enough tech level, there will be an airport, parking lot or wide roadway.

Orbital vs. ground ports. Depending on the campaign's FTL technology, starports may be in orbit or on the ground. Ground ports service shuttles and landing-capable starships; an orbital port allows non-landing starships to dock, and provides shuttles to the surface. If a world has two ports, the older often has poorer facilities, lower rates and a less-selective clientele.

A well-developed world will have at least one shuttleport or ground starport on every continent.

Special starports. Other starports, not specifically included in a world's rating, include: company ports (servicing only one company and its clients), military or Patrol, and government. These can usually be used by any ship in an emergency, if the facility isn't secret.



Installations

Many worlds have interesting special features. These may be placed by the GM, or rolled randomly. Each facility type lists a number; if a roll on 3 dice yields this number or less, the facility is present. Chance of some installations is increased by PR, TL, CR or other factors. If a particular type of installation doesn't exist in your campaign, or is simply of no interest, don't roll for it!

If a world has a PR of 2 or less, the first installation rolled represents essentially the whole population of the planet; it is a special-purpose colony.

Alien enclave. One or more races alien to the world's major population live in segregated "ghettos" or reservations. This may be by their own choice — to preserve their own culture, or from dislike of the other race. Or the major population may dislike *them.* An entire world may be designated an enclave. Present on a roll of 6 or less.

Black market. The market may have a physical location, or it may simply be that illegal goods are easily found through conventional contacts here. If the black market is commonly known, the Patrol is likely to raid occasionally or restrict trade (unless people in high places have been paid off). Interstellar criminal organizations have agents here. Present on a roll of (9-CR) or less.

Colonial office. An office of the colonial authority, whatever that is. On a heavily-populated planet, this may be a recruiting center; on a colony, it will be a "compliance" office, with the attitude of the chief administrator set by a general reaction roll. Present only at PR 3 or more, on a roll of (PR+4) or less.

Corporate headquarters. The nerve center of a major interstellar corporation is located here. Industrial operations may or may not be present. In extreme cases, the planet is governed by the company. Present only at PR 6 or more, and local TL of 7 or more, on a roll of (PR+3) or less.

Criminal base. "Corporate HQ" for a criminal group. The Patrol will be interested in this world, if it knows about it. Present on a roll of (PR+3) or less.

Espionage facility. This may range from a secret starport to a minor office or spy cell. Civilian espionage organizations may be involved in industrial espionage. Military espionage bases will specifically be involved in spying on enemy capabilities and forces, or (in rear areas) in correlating data. Espionage facilities will be present on a roll under (TL+PR).

If a facility is present, determine its type. Roll one die; it is civilian on a roll of 1 to 4, friendly military on a 5, hostile military on a 6. Roll 1d-2 for the PR of the facility if military, or 1d-4 if civilian. Equipment available will be appropriate to the staff size.

If one espionage facility is present, there may be others (possibly to spy on the first one). Roll again for another facility; if it is present, roll for a third, and continue until a roll fails.

Government research station. Possible research subjects include FTL travel or communications, weapons and power technology, medicine, or Precursor

Production Type

A world's production type indicates its place in interstellar commerce. There are a few general types:

Agricultural worlds raise and export crops and/or animal products. High-tech "agricultural" includes gene-tailored products and harvested microorganisms (algae and yeast). Most such worlds are fairly Earthlike.

Service worlds might be involved in banking and finance, trade, data processing, communications, education, entertainment and tourism (including gambling and business conventions) and mercenary camps.

Government worlds include capitals, administrative centers (with bureaucrats), prison planets, outposts and military bases.

Industrial worlds research, manufacture and sell goods. Types include machinery, consumer goods, refined chemicals, highly-processed foods and so on. Rare raw materials are often imported, as are workers. Industrial worlds are often metallic, so that basic raw materials don't have to be imported; they often become polluted.

Mining worlds export raw or processed minerals. These include both industrial metals (aluminum, steel), rare metals (titanium, gold) and rare non-metals (energy-regulating crystals for FTL drives, perhaps) — most likely asteroids or planets of High-Iron or Metallic density. These worlds may be exploited in a way that leaves them seriously polluted. However, there may be little population other than mining crews. Gas giants, and the comets of Oort clouds, may also be "mined" for their gases.

Mixed worlds have several types of production. Homeworlds often have a mixed economy.

None: This world takes no part in interstellar commerce. It may not be on most star maps, and it receives only irregular passenger service by the starliners. Its society must be self-sufficient, as it has nothing to trade for outside goods.

To determine a world's production type, roll two dice. If the result does not match the information known about that world, roll again.

2-4 — Mining
5 — None
6, 7 — Agricultural
8 — Industrial
9 — Service
10 — Mixed. Roll twice more.
11 — Government
12 — Mixed. Roll three more times.

Interstellar Trade

Star traders purchase goods from one world and sell them at another for a profit. This sidebar does *not* attempt to provide detailed rules for trade; the subject easily warrants a whole book of its own, and if there's enough demand, it will be written. This is nothing more than a very general overview for the GM.

GMs may want to assign a *production score* to each world, reflecting that world's ability to market its product in interstellar commerce. Consumer goods are sold at any inhabited world, with the demand (and prices) related to the size of the population and the remoteness of the world; raw materials will be purchased by industrial worlds. Interstellar trade must be very cheap and efficient before it's worthwhile to move processed raw materials, let alone ore, between star systems.

If interstellar banking functions smoothly, then a planet's ability to buy goods is linked to its production score — if it is selling goods to other systems, it will have more credit with which to purchase new goods. If there is no working bank system, then worlds will use native, marketable goods to purchase goods from a trading ship. This leads to well-planned trade routes: a trade ship goes to Awwad to obtain brof fruit, which it takes to Boozer (where they make brof rum) in return for osmic ovens, which it takes to Cummerbund (where there is a housing boom, and every home needs an osmic oven) in exchange for rifles, which are then sold to the rebels back on Awwad for more brof fruit. These routes are subject to sudden change — if the housing boom on Cummerbund collapses, some trade ship will be left with a hold full of osmic ovens and no market.

Some worlds are trade centers. These are convenient for merchants, as goods and buyers are present in one location. However, trade centers usually charge fees (and high docking charges), and attract government inspectors and pirates. Without a competent Patrol, trade centers cannot survive long.

Startown

Almost every world with significant interstellar trade has a Startown — or several of them. It's most likely to grow up around and in the starport or shuttle landing site.

Startown is the place where aliens don't get a second look . . . where almost anything can be bought and sold . . . where you can need both Streetwise and Savoir-Faire within five minutes.

Typically, the Control Rating of a Startown area is at least 1 below that of the world it's on.

studies. They may be known to the public, garrisoned by security troops and ships; or they may be secret, located in remote areas of an inhabited planet, on remote worlds (sometimes protected by a "Prohibited" rating), or disguised as some other installation. Present on a roll of 12 or less, on any planet; if one is present, a second is also present on a roll of PR or less. There is a 1/3 chance that any station is secret.

Mercenary base. Current home planet for a mercenary company, perhaps with a contract from a local government. Training facilities, depots and support personnel are here, as well as fighting forces. Present on a roll of 7 or less.

Nature preserve. Most or all of this world is set aside in its unexploited, natural state. These preserves may be used for scientific research (off-limits to tourists), light or heavy tourism (safaris, excursions and so on). Present on a roll of (12-PR) or less.

Naval base. Size and complexity can vary from a main base to a refueling point or observation point. Present on a roll of 10 or less. Roll 1d-1 for the PR of the base itself; this gives a clue as to its purpose. Note that some bases will not be on the populated planet of a system.

Patrol base. As above, but for the Patrol. Present on a roll of 9 or less. Roll 1d-2 for its PR.

Pirate base. This planet may house a full-fledged pirate outpost with its own starport and security forces, perhaps allied with the world's population. Or, on a smaller scale, a single pirate corsair may set down secretly from time to time for supplies and R&R. If the pirate base is public knowledge, the Patrol can be expected to take an interest. Present on a roll of (8-CR) or less.

Prison. Prisons are often built on barren, unsettled worlds (to make escape difficult), or in remote areas on habitable planets. They are rigorously patrolled. Travel to prison worlds is heavily restricted. Prisons are rare; if no facilities other than Patrol or naval bases have yet been generated for the world, a prison is present on a roll of 8 or less.

Private research center. May be funded by industry, government grant or (secretly) by criminal organizations. Such centers investigate a wider range of topics than government centers, including many far-out theories (psionics, time travel, alternate universes, perpetual motion and so on). Present on a roll of (PR+4) or less; if one is present, roll again, up to a maximum of three.

Rebel or terrorist base. These range from hidden fortresses with full FTL facilities, to minor hideouts for ships "on the run." Rebels will have contacts among the local population, though the world government is seldom allied. Terrorists typically base themselves on friendly worlds, striking into foreign territory. The Patrol or the Navy take interest in such installations. Roll as for a Patrol base.

Refugee camp. A holding center for people who have fled their native world due to war or other catastrophe. These are usually run-down, filled with squalor and crime. Refugees are often disliked by the natives; the impoverished refugees are often desperate and militant, scheming to regain their lost lands. Present on a roll of (PR-3) or less.

Religious center. Sacred areas — shrines or temples, often with church administrative and meeting facilities. Ancient sites may be guarded by the Patrol. Pilgrims are likely. May be forbidden to non-members of the religion. Present on a roll of (PR-3) or less.

Special Justice Group office. See p. 18. Present on a roll of (PR-6) or less. There is a 1/3 chance that the office is covert, known only to Special Justice operatives; in that case, it will have an innocuous "cover" function.

Survey base. Roll as for a Patrol base.

University. A prestigious interstellar center of learning, with libraries and research facilities. See p. 20. Present on a roll of (PR-6) or less.

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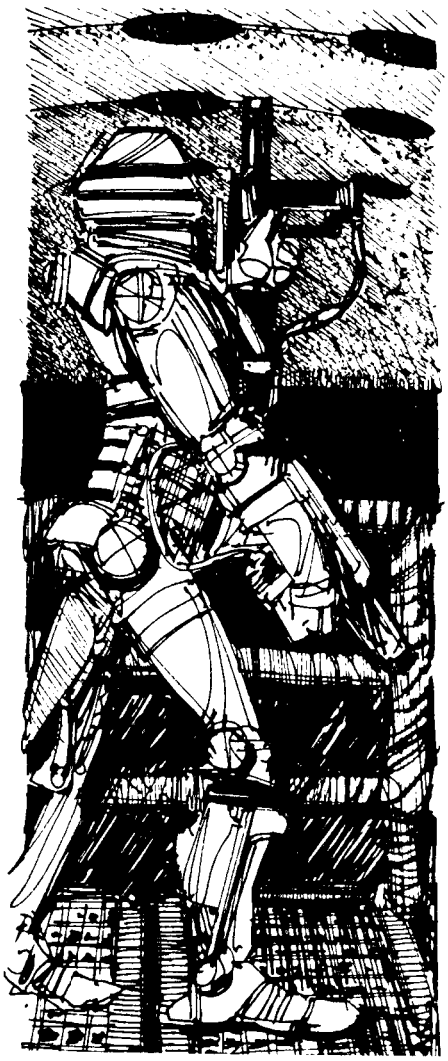


GLOSSARY

Technical and scientific terms, and some common science fiction abbreviations, used in this book:

AU: Astronomical unit. The distance from the Earth to the Sun — 93 million miles.

biozone: The area around a star at which the temperature allows water to exist as a liquid. This is the area in which a habitable planet can orbit.

c: The speed of light, 186,000 miles per second.

escape velocity: The speed at which a ship must travel in order to completely escape a planet's gravitational field. For Earth, this is 6.9 miles per second.

FTL: Faster than light.

G: A unit of acceleration equal to the gravitational pull of the earth. Thus, Earth gravity is "1 G."

gig, or **gigabyte:** A unit of computer data storage. 1 billion, bytes, or 1,000 megabytes.

kiloparsec: 1,000 parsecs.

light year (ly): 5.9 x 1012 miles.

main sequence: The normal course of evolution for stars. Most stars are "on the main sequence."

meg, or **megabyte:** A unit of computer data storage. 1 million bytes.

megawatt (MW): 1 million watts. A unit of power, used in this game to define power plant output.

megawatt-hour: A unit of energy, equal to the output of a 1-megawatt plant for 1 hour. Used to describe the amount of energy held by capacitors.

parsec (pc): 3.26 light years.

rad: A unit of radiation as it affects the human body.

STL: Slower than light.

Formula to determine escape velocity from a planet:

$V_E = 6.9 \times \sqrt{g \times R}$ **miles per second**

where V_E is escape velocity; g is the world's gravity in Gs; R is the planet's radius in Earth radii.

Time to reach escape velocity is [V_E divided by (ship's acceleration-g)] × 165 seconds.

Formula to determine planetary gravity in Gs:

g = Diameter × Density × .0000229

Formula for length of planetary year: *see sidebar, p. 111*

Formula for time dilation as a ship approaches light speed:

$$\text{T-ratio} = 1/\sqrt{(1-(v^2/c^2)}$$

SHIP RECORD

Class _____ Size _____ TL _____
Registration _____ Owner _____ Captain _____

	Total Cost	*Mass*	*cy*	*Power*
Hull: Size _____ cy $/cy _____ mass/cy _____				
Armor: DF _____ cy $/cy _____ mass/cy _____				
Force Field: DF _____				
Streamlining: _____				
Compartmentalization: _____				
Stress rating _____				
Power plant: _____ Base _____				
Output _____ MW $/MW _____ cy/MW _____ mass/MW _____				
Fuel _____				
Capacitors: MW-h _____				
Maneuver Drive: _____ Thrust _____ tons				
Reaction Mass: _____				
FTL Drive: _____				
Crew: _____				
Passengers: _____				
Lifesystem: _____				
Weapons: _____ Total FP _____				
_____ Total FP _____				
_____ Total FP _____				
_____ Total FP _____				
_____ Total FP _____				
Sensors: _____				
Computer: _____				
Airlocks: _____				
Accessories: _____				
_____				
_____				
_____				
_____				
_____				
Totals				
Cargo Capacity				
Loaded Mass				

Notes _____
_____
_____
_____
_____

Combat Record

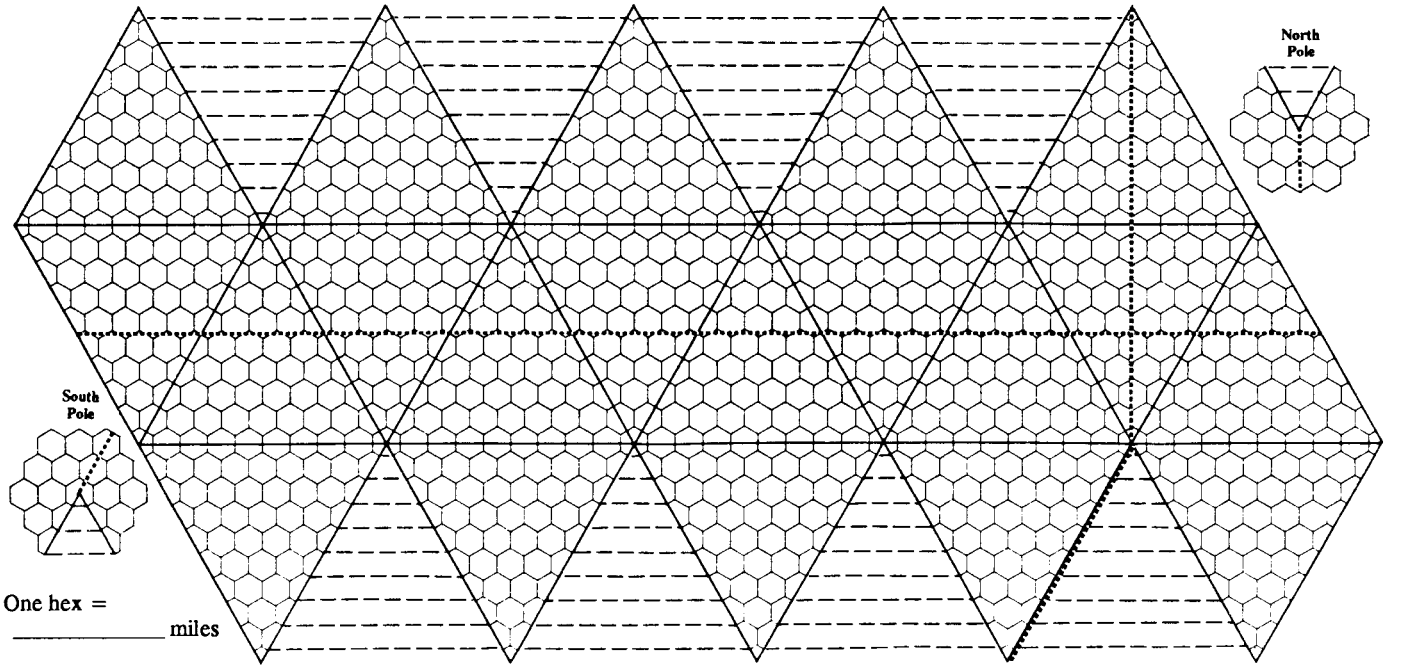
Name _____ Size _____ cy Capt. _____ (Tactics _____)
TL _____ Compartmentalization _____ Hull Integrity _____
Armor DF _____ Force Field DF _____ Other DF _____ Total DF _____ PF _____

Weapon	Gunner (Skill)	FP	Power	Weapon	Gunner(Skill)	FP	Power

Missile Load	Type	FP	Qty.	Type	FP	Qty.

Damage: _____
_____
_____
_____
_____

PLANETARY RECORD



One hex = _____ miles

Planet type _____ Diameter_____ mi. Gravity_____ G Density _____ Composition _____
Axial Tilt_____ ° Seasonal Variation _____ Length of Day_____ hrs. Length of Year_____ days/ _____ Earth years
Atmosphere: Pressure_____ (_____) Type and Composition _____
Climate _____ Temperatures at 30° latitude: Low_____ ° Average_____ ° High_____ °
Surface Water_____ % Humidity_____ % Primary Terrain _____
Mineral Resources: Gems/Crystals_____ Rare Minerals _____ Radioactives _____
Heavy Metals _____ Industrial Metals _____ Light Metals_____ Organics _____
Moons _____

Biosphere: Dominant life form _____
Other significant life forms _____

Civilization: Population(s) _____ Tech Level(s)_____ Control Rating_____
Society _____
Starports _____
Installations _____

Economic/Production _____

Other notes: _____

System Information:

Star Name_____ Type _____ Location _____
Biozone_____ Inner Limit _____ Number of Planets _____

Planet	*Orbit*	*Distance*	*Type*	*Diameter*	*Density*	*Gravity*	*Atmosphere*	*Notes*
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							