Approved for Use With *Traveller*

Grand Survey

Exploring and Detailing Worlds

Digest Group Publications

WORLD PROFILE

1. Date of Preparation

2. World Name

3. Location

4. UPP

PHYSICAL DATA

Data describing the world's basic physical attributes in more detail.

5. Diameter

6. Density

7. Mass

8. Mean Surface Gravity

9. Rotation Period

10. Orbital Period

11. Seasons (*list*)

12. Axial Tilt

13. Orbital Eccentricity

14. Satellites

15. Surface Atmospheric Pressure

16. Atmospheric Composition

16a. Atmospheric Terraforming? ☐ Yes ☐ No

17. Hydrographic Percentage

18. Hydrographic Composition

18a. Hydrographic Terraforming? ☐ Yes ☐ No

TEMPERATURE

Data concerning world surface temperature and various modifiers.

19. Base Mean Surface Temperature

20. Axial Tilt Modifiers

21.Rotation Modifiers

22. Latitude Modifiers

23. Orbital Eccentricity Modifiers

24a. Weather Control? ☐ Yes ☐ No

24b. Greenhouse Effect Terraforming? ☐ Yes ☐ No

24c. Albedo Terraforming? ☐ Yes ☐ No

25. Other Modifiers

MAPPING DATA

Data describing the details of a world's makeup which affect world mapping.

26. Num. of Tectonic Plates

27a. Native Life? ☐ Yes ☐ No

27b. Terrain Terraforming? ☐ Yes ☐ No

28. Major Continents

29. Minor Continents

30. Major Oceans

31. Minor Oceans

IS Form 20 World Profile Form

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32. World Name

SEISMIC DATA

Data indicating the relative likelihood of seismic activity.

33. Stress Factor

34. Notable Volcanoes

RESOURCES

Data indicating the presence of resources of various kinds.

35. Natural Resources (*list*)

36. Processed Resources (*list*)

37. Manufactured Products (*list*)

POPULATION & PORTS

Describe the world's population centers and space facilities in detail.

38. World Population

39. Primary Cities (*list name, population, and starport type*)

40. Secondary Cities (*list number of cities, their population level, and their typical spaceport type*)

41. Tertiary Cities (*list number of cities, their population level, and their typical spaceport type*)

IS Form 20 (Reverse) World Profile Form

GRAND SURVEY

Explored space consists of 11,000 worlds in the Imperium, bordered by additional worlds inhabited by the six major races. When adventurers arrive in a system, questions fill their minds. What is out there? What is this world like? What dangers await, and how can I avoid them? What riches await, and how can I find them?

The Imperial Interstellar Scout Service has answered some of these questions, but adventurers must ask them again when they explore for themselves. The tools and techniques used by the Scouts open a world up so it can be read like a book—but only by those who know the language of *Grand Survey.*

Grand Survey is the comprehensive guide to surveying and detailing an individual world. *Grand Survey* consists of two main sections:

- **Surveying a World** is specifically designed for **Traveller** players. It details the survey procedures used by the Scouts, and includes complete plans for the *Donosev* Class Scout Survey Vessel. The rest of the section is packed with new high-tech equipment, including information on vacc suits and shipboard and handheld sensors.
- **Detailing a World** is for the Traveller referee. It shows how to take the Traveller UPP stats for a world and expand them into an accurate, detailed description of the world's temperature, oceans, continents, seismic activity, resources, cities, and starports. Included is information on how to create a carefully detailed world map, and how to use the expanded world information to introduce a new level of exciting realism into a game session.

USEFUL RELATED MATERIALS

A copy of the Traveller rules: either *Basic Traveller, Deluxe Traveller, Starter Traveller,* or *The Traveller Book* is required. Any of these versions of the **Traveller** rules is equally valid.

This book goes beyond Traveller Book 6, *Scouts*, and describes world generation in great depth. *Scouts* may be helpful in understanding some of the material in this book.

Those desiring an optimum reference set for detailed and realistic adventure settings should acquire *Scouts* (GDW), *Grand Survey* (Digest Group Publications), and *Grand Census* (Digest Group Publications, available Spring 1987).

Additional useful materials include pens, pencils, notebook paper, hex grid or square grid graph paper, colored markers, and similar items. Some areas of *Grand Survey* involve the use of mathematical formulas or chains of simple but tedious calculations. While these can be solved by hand, using a calculator or home computer is much faster and easier.

DIE ROLLING CONVENTIONS

Grand Survey uses the common die rolling conventions for Traveller, with one addition. Briefly, these conventions include:

Throw: That die roll required to achieve a stated effect. If only a number is stated, it must be rolled exactly. A number followed by a plus (such as 7+) indicates that number or greater must be rolled. Similarly, a number followed by a minus (such as 3-) indicates that number or less must be rolled.

Number of Dice: Generally a dice throw involves a roll of two six-sided dice. Throws requiring more (or fewer) dice are clearly stated. For example, a throw calling for one die would be stated as 1D.

Die Modifiers: Die roll modifiers (abbreviated DM) are always preceded by either a plus or a minus. Thus the notation DM+3 indicates that three is added to the dice roll before it is used. Some throws will be written to include a constant modifier; for instance, 2D-7 indicates that the throw required is a roll of 2D with a DM of -7 immediately applied.

Percentages: In addition, these rules occasionally call for generation of a number between 0 and 9, as for percentages and intervals between, say, 20% and 30%. Two six-sided dice can be used (although the results are slightly biased by the effects of probability) by rolling 2D-2 for a number between 0 and 10. Ignore and reroll a result of 10.

Optionally, there are 10- or 20-sided "percentile" dice available on the market for this purpose. Using percentile dice will give a more even distribution of roll results.

HOW TO USE THIS BOOK

Generally, the referee will use the section *Detailing a World* to generate the details of an individual world (or worlds) from the world UPP stats. During an adventuring session, the referee then has at his disposal a tremendous amount of useful detail about the world as the players adventure on it.

The referee can also use *Detailing a World* to detail a world as yet *unexplored.* The players can then use the section *Surveying a World* to discover the attributes the referee has already generated. The act of surveying an unknown world can be an exciting basis for an adventure.

A third option is for players to survey a world that the referee has no data on, with each specific item of data generated from *Detailing a World* by the referee as the players request it. The world's UPP is actually "discovered" as the survey proceeds.

THE BASIC TRAVELLER PLANET

The Universal Planetary Profile (UPP) is used by Traveller as the standard for recording coded information about a world. It consists of starport, size, atmosphere, hydrosphere, population, government, law level, and tech level.

Additional data such as trade classifications and remarks can be added to clarify or elaborate on the UPP.

Any world can be described by the basic UPP. These brief stats serve as the starting point for *Grand Survey.*

To generate the UPP for a system, use the basic Traveller rules or the system in *Scouts.* For many worlds, the UPP is not generated, but comes from a published source.

CREDITS FOR *GRAND SURVEY*

Surveying A World............... Joe D. Fugate Sr.,Robert Parker, Gary L. Thomas
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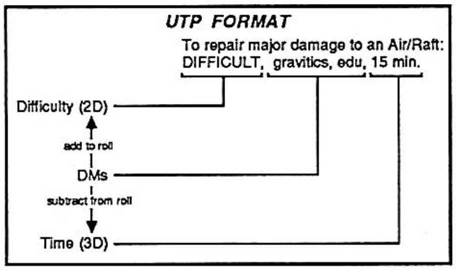
UTP: Universal Task Profile—handling tasks in *TRAVELLER*

UTP FORMAT



HOW CRUCIAL IS THE CRUCIAL SKILL?

If the character attempting the task has no skill (not even skill level-0) in the crucial skill, make the task at least one level harder and perhaps even IMPOSSIBLE.
However, in some cases, a related skill may apply (at a handicapped level).
Optionally, the combination of the character's intelligence and education may substitute for lack of skill (this represents all of the character's intellect, knowledge, and experience brought to bear).
If the crucial skill listed in the UTP is deemed to be merely helpful rather than vital, declare the task to be unskilled.

DIFFERENT KINDS OF TASKS

Unskilled task: If the crucial skill is not essential to a successful task attempt, declare the task to be unskilled. Do not increase the task difficulty if the character attempting the task does not possess the "crucial skill". Most tasks should be skilled—the unskilled task is an exception.

Hazardous task: If the task is hazardous, it should be declared as such. Hazardous tasks run a much higher risk of mishap if the attempt is unsuccessful. If the character fails in an attempt of a hazardous task, roll 3D (instead of 2D) on the FAILURE table.

Hasty task: If the character wishes, he can request that the task attempt be a hasty one. In this case, increase the task difficulty at least one level. Double the DMs before subtracting them from the TIME roll (a hasty attempt may take less time).

Uncertain task: If the result of a task attempt is laregly "opinion" or, because of the nature of the task, if immediate feedback on how successful the task has been is not possible, then declare the task to be uncertain. With an uncertain task, those associated with the task have some idea of how successful the task attempt was, but they are not certain.

When a character is attempting an uncertain task, both the player and the referee roll for the task attempt. The referee's roll is hidden from the player, and serves to modify the result of the player's roll.

If the player's roll...	If the referee's roll...	the player gets...
FAILED	FAILED	NO TRUTH
FAILED	SUCCEEDED	SOME TRUTH
SUCCEEDED	FAILED	SOME TRUTH
SUCCEEDED	SUCCEEDED	TOTAL TRUTH

Explanation of results:
NO TRUTH: the player is totally misled as to the success of the task attempt. Completely erroneous information is given.
SOME TRUTH: the player is given some idea of the success of the task attempt. Some valid information is given. Notice that it is possible for the character to fail at the task attempt and still get some helpful information—although he can not know for sure this is the case.
TOTAL TRUTH: the player is not misled in any way as to the success of the task attempt. Totally valid information is given. Notice that the player may still not believe all the information he is given, even though it is the complete truth.

SPECIAL CASES

As flexible as the UTP is, it can not cover all combinations of circumstances or conditions. Whenever such special case situations exist, the UTP will be immediately followed by a paragraph labeled REFEREE. The REFEREE paragraph is used to list any special conditions that apply to the task attempt. For example:

REFEREE: This task is NON-REPEATABLE; only one attempt is allowed.

or

REFEREE: Any mishap causes a security alert to sound.

or

REFEREE: If any non-Scout character attempts this task, it becomes DIFFICULT.

ATTEMPTING A TASK DEFINED BY A UTP

DIFFICULTY: Roll 2D for success. The roll needed depends on the task difficulty level: see the TASK DIFFICULTY table, below. A natural roll of 2 (regardless of DMs) is a "fumble" and results in automatic failure.

Task Difficulty	*Roll Needed*
SIMPLE	3+
ROUTINE	7+
DIFFICULT	11+
FORMIDABLE	15+

EXAMPLE: for a DIFFICULT task, a roll of 11+ (including DMs) is needed to succeed.

DMs: ADD DMs to the difficulty roll (better DMs improve the likelihood of a successful task attempt).
SUBTRACT DMs from the time roll (better DMs shorten the duration of the task attempt).

DMs typically listed are the CRUCIAL SKILL(S) and CRUCIAL CHARACTERISTIC(S). These DMs represent the skill(s) and characteristic(s) judged most crucial to task success. Generally, DMs are limited to these two items. Others factors will influence the task DIFFICULTY LEVEL, rather than be used as additional DMs.

- *crucial skill(s):* use the character's skill level as the DM.
- *crucial characteristic(s):* use the character's characteristic÷5 as the DM. (drop fractions; the DM range is 0 to 3).

EXAMPLE: a character with gravitics-3 (skill DM of 3) and an education of 9 (characteristic DM of 1) would have a total DM of 4.

TIME: The task attempt (successful or not) is assumed to take an average of ten UTP time periods. (Some tasks may instead have the time period omitted, in which case the task is assumed to be INSTANT and the time duration roll is ignored.)

To determine the actual duration of the task attempt , use the following method:

UTP TIME period x (3D - DMs) (the absolute minimum is 3 time periods)

EXAMPLE: a 3D roll of 15, minus a DM of 4 gives a modified roll of 11. For a UTP time period of 15 min., the duration of the task attempt is 165 minutes (2 hours, 45 minutes). The absolute minimum would be 3 time periods, or 45 minutes.

WHAT TO DO WHEN THE TASK ATTEMPT FAILS

If the needed difficulty roll is not obtained, the task attempt is unsuccessful and has failed; roll on the FAILURE table, below.

Die	*Failure Type*
2	reroll
3+	retry
7+	check determination
11+	Mishap (2D)
15+	Mishap (3D)

ORDINARY TASK: roll 2D on the FAILURE table.
HAZARDOUS TASK: roll 3D on the FAILURE table (greater chance of a mishap).

FAILURE table results explanation:
retry: failed the task, but character can retry it again with no penalty.
check determination: failed the task, and character must stay determined to retry the task without penalty. Staying determined is a special task which has a UTP of:
DIFFICULT, end, int (endurance and intelligence combined represents a character's force of will)
- if successful at staying determined, the character can retry the task with no penalty;
- if not successful at staying determined, the character has two choices:
  1. retry the task immediately, but the task difficulty increases ONE level
  2. retry the task at no increase in difficulty by waiting 10 times the actual duration of the failed task BEFORE retrying the task again.

NOTES: a FORMIDABLE task increased in difficulty becomes impossible, i.e., failure is permanent: no more retries are possible until circumstances change enough to allow a new UTP to be defined for the task.
JACK-OF-ALL-TRADES skill provides one free retry per level of skill (represents the character's resourcefulness).
Mishap (2D): failed the task, roll 2D on the MISHAP table, below. After correcting the effects of the accident, the task reverts to check determination, should a retry be desired.
Mishap (3D): same as MISHAP (2D), except roll 3D on the MISHAP table.

Die	*Mishap Type*
2	reroll
3+	SUPERFICIAL (1D)
7+	MINOR (2D)
11+	MAJOR (3D)
15+	DESTROYED (4D)

MISHAPS

If a mishap occurs from a roll on the FAILURE table, roll the indicated number of of dice (either 2D or 3D) on the MISHAP table.

MISHAP table results explanation:
SUPERFICIAL (1D): impose superficial damage on some device/vehicle involved in the task and/or 1D wounds to the character.
MINOR(2D): as above, except impose minor damage and/or 2D wounds.
MAJOR (3D): as above, except impose major damage and/or 3D wounds.
DESTROYED(4D): as above, except impose destroyed damage and/or 4D wounds.

UTP PROCEDURE SUMMARY

when attempt fails → when mishap →

Die	*Task Attempt*	*Failure*	*Mishap*
2	automatic failure	reroll	reroll
3+	SIMPLE	retry	SUPERFICIAL (1D)
7+	ROUTINE	check determination	MINOR (2D)
11+	DIFFICULT	Mishap (2D)	MAJOR (3D)
15+	FORMIDABLE	Mishap (3D)	DESTROYED (4D)

DAMAGE AND REPAIR

Whenever a device/vehicle is damaged, in the absence of detailed rules for diagnosis and repair, use the following procedure:
1. Diagnose the problem. The standard diagnosis task is ROUTINE; the referee must determine DMs and TIME.
2. Once the diagnosis task is successful, establish a UTP for performing the repairs based on the damage level, as per the table below.

DAMAGE AND REPAIR

Damage Level	*Operate?*	*Repair Task (shop)*	*Repair Cost (shop)*
SUPERFICIAL	Yes	SIMPLE	1D% of new price
MINOR	No	ROUTINE	1D x 1D% of new price
MAJOR	No	DIFFICULT	2D x 5% of new price
DESTROYED	No	FORMIDABLE	2D x 2D x 5% of new price

NOTES: Repairs can be made without a successful diagnosis at an additional cost multiplier of 1D (just replace the entire assembly if you can't determine what's wrong).
For REPAIRS IN THE FIELD increase the task difficulty one level.
For LACK OF TOOLS increase the task difficulty one level.
For LACK OF SPARE PARTS, increase the task difficulty one level. All difficulty increases are cumulative.

If a device/vehicle has SUPERFICIAL damage, any subsequent damage is automatically increased in severity by one level. Thus if the device/vehicle already has SUPERFICIAL damage, another SUPERFICIAL mishap is changed to MINOR instead; a MINOR mishap is changed to MAJOR, and a MAJOR mishap is changed to DESTROYED.

If a device/vehicle has had MAJOR damage repaired in the field, any task using that device/vehicle is automatically HAZARDOUS (high risk of accidental breakdown). This lasts until the original MAJOR damage is totally repaired in the shop.

EFFECTIVE USE OF THE UTP

To prevent a UTP from becoming buried in text and difficult to find, it is always indented and listed on a line by itself.

Besides providing a way to catalog and record groups of tasks, the UTP is also valuable when used in an adventure session for impromptu, on-the-fly task definitions—it serves to add immediate depth to an on-the-spot situation. When used in this way, a task can be handled as one large "macro" task, or the task can be subdivided in to two or more subtasks. A good example of this kind of division is the way the damage and repair segment has a DIAGNOSIS task and a REPAIR task. Other situations can be similarly divided.

The UTP has been designed to be easy to remember: notice that the three basic tables used all have the 3 – 7 – 11 – 15 breakdown, with each number 4 more than the last. With a little practice, you should find the system easy to remember and be able to use it strictly from memory.

One final note: be creative in your application of seemingly inappropriate results. Random dice have no idea of the difference between a challenging adventure and an utterly frustrating one. Use the UTP system as your tool—don't let it use you.

SURVEYING A WORLD

With these rules, a player may not want to muster a new character out of the Scouts—nor does he need to. "Surveying a World" tells what Scouts do in the Survey Office, when gathering data for producing and maintaining maps and charts of the Imperium and surrounding areas.

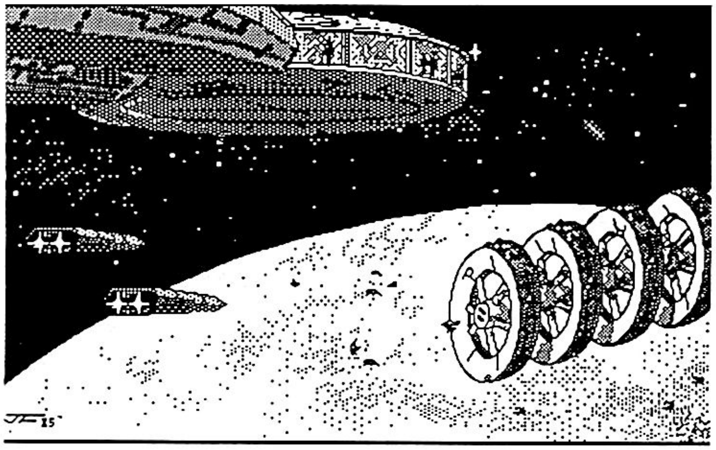
A variety of sensors are used in surveys: the densitometer detects gravity fields, the neutrino sensor detects energy sources, the neural activity sensor detects "brainwaves", and the EMS array detects objects and sources of radiation of different wavelengths along the electromagnetic spectrum.

Proper operation of these sensors is important to the success of a survey mission; rules are given for a new skill, and examples show how to interpret the sensor control panels.

Depending on what is being surveyed, the Scout Service spends various amounts of time at various sites. Different means of classifying surveys are listed, based on time spent and type of survey.

A planetographer's checklist describes typical techniques a Scout crew might use, from the time they decide to jump into a system, through the readings made at system's edge and in orbit around a world, to basic world surface techniques. How the *Donosev* Class "holo pit" is used to control the ship's sensors and mapping computer is then described.

A variety of equipment has special uses on survey missions, including self-precessing gyrocompasss, multichronometers, and vacc suits. The largest piece of equipment used on a survey, of course, is the ship itself: complete plans and description for the *Donosev* Class Scout Survey Vessel are included.



THE EMS SENSOR ARRAY

EMS Array Description: Among the different sensors that have been developed over the years, some of the most useful to a planetographer are descendants of the lowly camera. As technology advances, the camera is integrated with other electromagnetic sensors and computer enhancement, until scientists develop the first crude integrated electromagnetic sensor array at tech level 9. This technology is called electromagnetic spectrum sensing or EMS.

A proper understanding of the electromagnetic spectrum reveals why an array of different EMS sensors is needed. Various types of electromagnetic energy behave differently, even though each is part of a continuous spectrum. From low to high frequency, the type of energy progresses from radio through microwave, heat, infrared, visible light, ultraviolet, and x rays, to gamma rays and beyond. Since each type of energy occupies only a small part of the spectrum, no one sensor is effective over the entire range of frequencies.

Using the EMS Array: The passive EMS array detects sources of energy. When using the entire EMS array, a simultaneous scan is actually being conducted with three distinct sensor groups. A long dipole or wire antenna detects long waves. This antenna can be extended as much as 130 meters, or about three times the length of the ship. The parabolic dish at the end of the forward arm of the ship is used for detecting short waves and microwaves. The arm within the parabolic dish also contains a sensor for X rays and gamma rays. The V-shaped opening on the top of the bow of the ship is the opening for the optical array. This is used not only for visible light, but for infrared and ultraviolet scans.

Modern tech level 15 EMS optical sensors do not use material media as older cameras did. Instead, the picture is put directly into computer memory, allowing the picture to be manipulated with ease: it can be instantly shrunk, enlarged, or rotated with little loss of definition, and can be compared with another image to detect any change between the two. The picture is of course three dimensional.

Full spectrum, computer-enhanced EMS scans give the surface temperature of a world with such precision that the only way to get better results is to measure the temperature from the surface.

The active EMS array offers three options: radar for general purposes, m-radar (microwave radar) for excellent penetration even through disturbances such as storms, and ladar (laser beam "radar") for precise images of objects already located by the other two types. Radar and m-radar sweep in all directions; ladar does not sweep, but is instead a single aimed beam (it will only give away your position to the target). Any active sensor is limited by turnaround time at the speed of light and by signal attenuation. All three active EMS sensors output their data using augmented three-dimensional displays.

Control Panel Readings: Though not used as much as some of the other control panels, the panel is still frequently used for establishing the nature and location of EM emissions. The panel gives readings as to which band is being detected, the intensity of the signal, the duration, the approximate range, and the size of the object being scanned.

The output of the integrated scan is usually in the nature of a numbered cursor on a map of the world with a comment as to the nature of the EM emission appearing on the computer readout.

Electromagnetic band readings can be:

long-wave radio: power line networks, lower end of broadcast band.

short-wave radio: broadcast FM radio, television, radar.

microwave radio: m-radar, energy beams.

heat/IR: any source of heat, including living beings.

ELECTROMAGNETIC BAND

☐ unknown
☐ long-wave radio
☐ short-wave radio
☐ microwave radio
☐ heat/IR
☐ light
☐ UV
☐ x-ray
☐ gamma

INTENSITY

☐ unknown
☐ faint
☐ moderate
☐ strong
☐ dangerous
☐ fatal

DURATION

☐ unknown
☐ constant
☐ intermittent

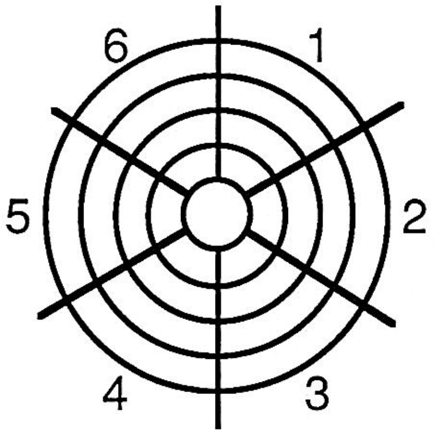
RANGE

☐ unknown
☐ short
☐ medium
☐ long
☐ very long
☐ distant
☐ very distant
☐ regional
☐ continental
☐ planetary
☐ far orbit
☐ extreme orbit
☐ interplanetary
☐ system
☐ sublight
☐ stellar
☐ beyond stellar

NUMBER

☐ unknown
☐ single source
☐ multiple source
☐ network

DIRECTION



EMS PASSIVE ARRAY Control Panel

(ELECTROMAGNETIC SPECTRUM SENSOR ARRAY)

RANGE

- ☐ unknown
- ☐ short
- ☐ medium
- ☐ long
- ☐ very long
- ☐ distant
- ☐ very distant
- ☐ regional
- ☐ continental
- ☐ planetary
- ☐ far orbit
- ☐ extreme orbit

SENSOR

- ☐ RADAR
- ☐ M-RADAR
- ☐ LADAR

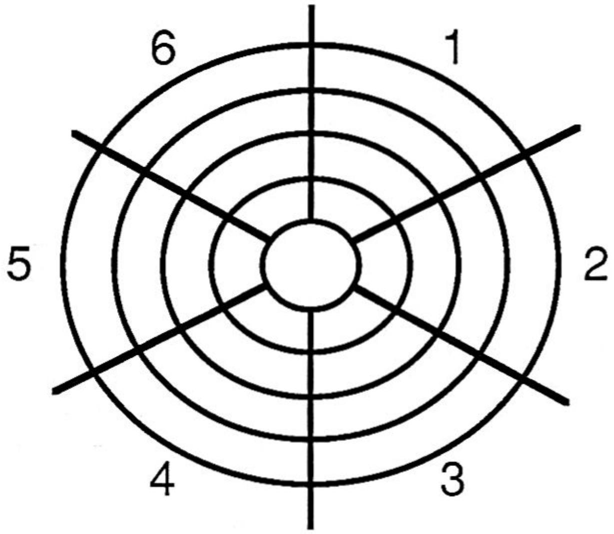
NUMBER

- ☐ unknown
- ☐ single object
- ☐ multiple objects
- ☐ debris

SIZE

- ☐ unknown
- ☐ 1 cm^2
- ☐ 10 cm^2
- ☐ 1 m^2
- ☐ 10 m^2
- ☐ 100 m^2
- ☐ 1 km^2
- ☐ 10 km^2
- ☐ 100 km^2
- ☐ world

DIRECTION



RELATIVE SPEED

- ☐ unknown
- ☐ slow creature
- ☐ fast creature
- ☐ ground veh
- ☐ slow air veh
- ☐ fast air veh
- ☐ starship

ACCELERATION

- ☐ unknown
- ☐ below 1G
- ☐ 1G
- ☐ 2G
- ☐ 3G
- ☐ 4G
- ☐ 5G
- ☐ 6G
- ☐ over 6G

MOVEMENT

- ☐ unknown
- ☐ none
- ☐ toward
- ☐ away
- ☐ parallel

EMS ACTIVE ARRAY Control Panel

light: any source of visible light.

UV: ultraviolet light from suns or unusual artificial lights.

x-ray: useful in radio astronomy.

gamma: stars and nuclear explosions.

Intensity is judged from the sensor's location rather than that of the source. A nuclear explosion seen from orbit is moderate or strong across the entire EM band, although from 5 miles away it would be fatal.

Relative speed is assessed by Doppler radar. Starship speeds range from 20,000 kph to almost light speed. Fast air vehicles range from 300 kph to 5000 kph. Slow air vehicles range from 100 to 300 kph. Ground vehicles range from 30 to 150 kph. Fast creatures run up to 30 kph. Slow creatures move from 5 kph down to a creep. If the sensor is moving and an object is approaching at slow creature speed, it is moving almost as fast as the sensor and slowly closing the gap.

Acceleration is calculated from several readings of relative speed and does not appear on the control panel for a period of five times the scan time used.

Specifications: The EMS array is available on all commercial, private, and military starships, survey air/rafts, and sensor probes. On nonmilitary starships, air/rafts, and sensor probes, the long wave radio end of the array is usually unavailable.

Sample UTPs:

To perform an EMS passive scan:
ROUTINE, sensor op, edu, 1 sec (uncertain)

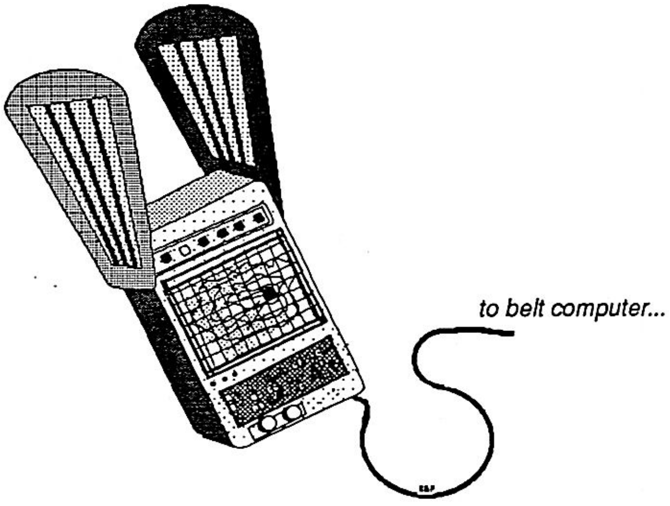
To perform an EMS active scan at continental range :
ROUTINE, sensor op, edu, 1 sec (uncertain)
REFEREE: If time is critical, remember that the acceleration reading does not appear until 5 times as long as the scan took.

Limitations:

- Continental range is the maximum range at which operation of active EMS is still a ROUTINE task for anything smaller than a world. The task difficulty increases one difficulty level per range band beyond this range. Thus a starship at extreme orbit range is IMPOSSIBLE to locate with active EMS.
- If the target vessel is "running silent" (not using any active EMS itself), the ROUTINE task range drops to regional.
- Solar flares make it DIFFICULT to conduct a scan in the area affected.
- If there is overpowering radiation, light, or radio output, it is a FORMIDABLE task to get accurate readings.
- If using the long wave radar or visible light sections of the EMS, clouds are an IMPOSSIBLE obstacle.
- Dense materials make an X-ray scan IMPOSSIBLE.
- Dense materials make a gamma ray scan DIFFICULT.
- Superdense materials make a gamma ray scan FORMIDABLE to IMPOSSIBLE.
- Being within close orbit distance of a nuclear explosion makes all EMS readings FORMIDABLE.
- Using active sensors (Radar, M-Radar, Ladar) in hostile territory may give away your position; this can make your situation awkward if the enemy is capable of reacting.

Examples: Scanning from a hovering air/raft, your survey and exploration team locates a moving object on the ground headed in direction 3 at a velocity of "slow creature" with occasional stops. The combined array also shows that the wind is blowing in direction 3 with gusts up to 5 kph. After some time the team notices that the moving object is running into stationary objects, which is when it stops. The moving object turns out to be a tumbleweed.

Your ship is doing full scans of asteroids. It picks up a moving object registering in the tens of meters at regional range. The object is emitting radio, microwave, and heat. It is a starship of moderate size.



THE DENSITOMETER

Densitometer Description: The remote densitometer, an outgrowth of gravitic technology, uses an object's natural gravity to directly measure the object's density (that is, its mass per unit volume). The remote densitometer is also sometimes called a "mass detector".

The densitometer records scan data in a three-dimensional matrix. The matrix is processed by the densitometer's computer to provide a 3D density map of the scanned object or region. Within certain limitations, an object's elemental makeup can be deduced from the densitometer's scan data.

A densitometer is a passive sensor.

Using a Densitometer: When using a densitometer, a cubic region is scanned to determine the general density of objects in the scan region. The size of the scan region is fixed and depends on the range setting. The range setting is adjustable. The scan also provides a rough idea of an object's weight. *Penetration* is the depth to which a reliable density differentiation is possible on objects within the scan area. Resolution of the 3D density map also depends on the range setting.

The densitometer can also perform a special *density search*, which takes an average of about 2 hours. The densitometer is set to automatically scan in all directions for a prespecified density at a given range. Upon completion of the density search, range and direction to any regions with the requested density are available. The density search is particularly useful for locating objects in the empty vacuum of space.

Control Panel Readings: The densitometer control panel has two general density class indicators, approximate weight (used only with a scan on discrete objects), a range scale

DENSITY CLASS 1

- ☐ unknown
- ☐ vacuum
- ☐ gaseous
- ☐ liquid
- ☐ nonmetal solid
- ☐ light metal
- ☐ medium metal
- ☐ heavy metal
- ☐ artificial grav field

RANGE SCALE

Handheld
Vehicle Portable

- ☐ unknown
- ☐ short
- ☐ medium
- ☐ long
- ☐ very long
- ☐ distant
- ☐ very distant
- ☐ regional

DENSITY CLASS 2

- ☐ unknown
- ☐ vacuum
- ☐ gaseous
- ☐ liquid
- ☐ nonmetal solid
- ☐ light metal
- ☐ medium metal
- ☐ heavy metal

RANGE SCALE

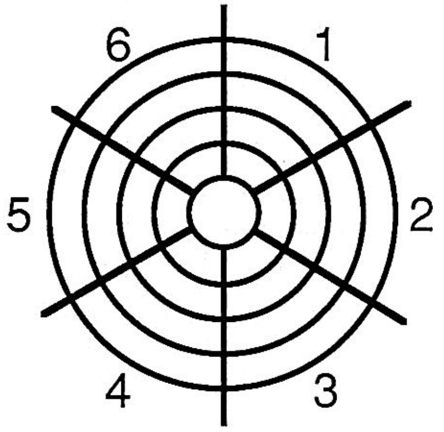
Starship

- ☐ continental
- ☐ planetary
- ☐ far orbit
- ☐ extreme orbit
- ☐ interplanetary
- ☐ system
- ☐ sublight
- ☐ stellar
- ☐ interstellar

APPROXIMATE WEIGHT

- ☐ unknown
- ☐ below 1 kg
- ☐ below 10 kg
- ☐ below 100 kg
- ☐ below 1 ton
- ☐ below 10 tons
- ☐ below 100 tons
- ☐ below 1000 tons
- ☐ below 10K tons
- ☐ below 100K tons
- ☐ below 1M tons
- ☐ over 1M tons

DIRECTION



Densitometer Control Panel

for handheld and vehicle portable densitometers, a range scale for starship densitometers, and a direction indicator for density searches. The density levels shown are:

unknown: indicates sensor difficulties, repeat the scan.

vacuum: indicates zero density.

gaseous: indicates an extremely low density, with very little liquid or solid present; densitometers are generally set to ignore gaseous density when used in an area with an atmosphere. However, a pinpoint scan for gaseous density can prove useful if trying to determine from a distance if an object in a vacuum contains any gas.

liquid: indicates a low density, often associated with liquids. Examples include petrochemicals and water.

nonmetal solid: indicates a solid with low or moderate density. Examples include paper, wood, rubber, pumice, plastic, glass, sand, stone, and concrete.

light metal: indicates a moderate density solid with metallic properties. Examples include magnesium and aluminum.

medium metal: indicates a dense solid with metallic properties. Examples include iron, copper, zinc, silver, and tin.

heavy metal: indicates a very dense solid with metallic properties. Examples include platinum, gold, mercury, lead, uranium, and any superdense material.

artificial grav field: the scan area contains an artificial gravity field or repulsor field. No other reading is possible. Artificial grav fields can be detected only at planetary distance or less; beyond this range, artificial grav fields do not interfere.

Specifications: Densitometers come in three basic sizes: handheld, vehicle portable, and starship. Versions of the handheld size are often used in small remote probes that do not use grav propulsion. The larger gravity shielded vehicle portable version is typically used in larger probes.

A densitometer can not be used if it resides in an area of artificial gravity, unless the densitometer has been gravity shielded. Gravity shielding greatly increases the weight, volume, cost, and power requirements of the densitometer. Handheld densitometers are never gravity shielded, while starship densitometers are always gravity shielded. Vehicle portable densitometers may or may not be gravity shielded, depending on whether or not they are to be used from operating grav vehicles.

Densitometers are commonly installed on military vessels, scout vessels, and belter ships. Commercial and private starships do not typically carry densitometers. See also "Starship Sensors in Combat".

Sample UTPs:

To perform a densitometer scan:
ROUTINE, sensor op, edu, 10 sec (uncertain)

To perform a densitometer density search:
ROUTINE, sensor op, edu, 2 min (uncertain)

Limitations (also see the Densitometer Tables):

- An artificial gravity field in the scan region makes an accurate scan a FORMIDABLE task. Artificial gravity fields are no longer a problem beyond planetary range.
- Superdense materials are difficult to penetrate with a densitometer scan.
- A densitometer without gravity shielding cannot be used if the densitometer itself is *in* an artificial gravity field.

Densitometers

Item	*TL*	*Wt*	*Volume*	*Price*
Handheld	14	7 kg	17.5 liters	Cr15,000
Handheld	15	2 kg	5.0 liters	Cr25,000
Veh Portable	12	110 kg	275 liters	Cr55,000
grav shielded	12	730 kg	1825 liters	Cr116,000
Veh Portable	13	75 kg	190 liters	Cr70,000
grav shielded	13	410 kg	1025 liters	Cr145,000
Veh Portable	14	40 kg	100 liters	Cr85,000
grav shielded	14	340 kg	850 liters	Cr175,000
Veh Portable	15	25 kg	65 liters	Cr100,000
grav shielded	15	140 kg	350 liters	Cr205,000

Densitometer Ranges & Scan Areas

Range	*Distance*	*Scan Dimension*	*Resolution*	*Density Scan can locate in open space (vacuum)*
short	1 – 5 m	0.1 m	1 cm	
medium	5 – 50 m	1 m	1 cm	
long	50 – 250 m	2 m	2 cm	
very long	250 – 500 m	5 m	5 cm	
distant	500 – 5000 m	20 m	20 cm	
very distant	5 – 50 km	100 m	1 m	
regional	50 – 500 km	1 km	10 m	
continental	500 – 5000 km	10 km	100 m	
planetary	5000 – 50,000 km	100 km	1 km	man sized objects
far orbit	50,000 – 500,000 km	1000 km	10 km	any sized starship
extreme orbit	0.5 – 5 million km	10,000 km	100 km	starships over 10,000 tons
interplanetary	5 million km – 1 AU	1 million km	10,000 km	small asteroids (over 10 km)
system	1 – 1000 AU	1 AU	1 million km	large asteroids (over 200 km)
sublight	1000 – 100,000 AU	100 AU	1 AU	planets size 1 to A
stellar	100,000 AU – 1 parsec	10,000 AU	100 AU	small gas giants
interstellar	1 – 2 parsecs	50,000 AU	500 AU	large gas giants

Scan Dimension: shows the smallest value possible for a scan within the given range. For example, at VERY LONG range, one scan can cover a region (cube) 5 m on a side (objects in the scan region are subject to the limitation of the densitometer's penetration).

Resolution: shows the smallest detail possible, thus at greater ranges densitometer scans become "fuzzier", providing less detail of the scan region.

Density Scan: shows the size of objects discernable in the empty vacuum of open space. Within an empty vacuum, any object raises the average density of the region around it. Even at great ranges, with correspondingly coarser resolutions, large objects can still be located. Thus at planetary range, a man-sized object can be delimited to a region of 1 cubic km in size. At far orbit range, the location of a starship can be fixed to within a region of 1000 cubic km.

Limits – Handheld

TL	*Range*	*Penetration*
14	Distant	2 m
15	V. Distant	10 m

Limits – Vehicle Portable

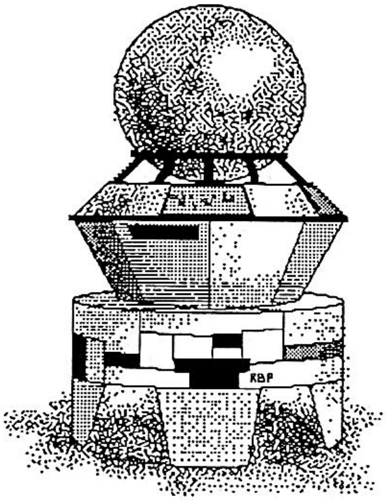
TL	*Range*	*Penetration*
12	Distant	5 m
13	V. Distant	20 m
14	V. Distant	50 m
15	Regional	100 m

Limits – Starship

TL	*Range*	*Penetration*
10	System	surface
11	System	1 m
12	Sublight	5 m
13	Sublight	50 m
14	Stellar	250 m
15	Interstellar	1 km

Examples: You are using a handheld densitometer to scan a table containing shiny yellowish disks in an enemy encampment 50 meters distant (medium range). The scan (1 meter scan area, with 1 cm resolution) indicates nonmetal solid (the trees, the table, and so on), and medium metal (the disks). The disks are not worth the risk—they're probably brass. (Gold would read "heavy metal" in the scan.)

You are on a search and rescue mission in space, using a starship densitometer to look for a missing 200-ton merchant ship. A density search for medium metal at far orbit range (50,000 to 500,000 km distant, with a 1000 km scan area) locates a medium metal object in direction 3, probably the missing starship. A regular scan of the object's area indicates densities medium metal and gaseous with an approximate weight below 1000 tons: the ship apparently still has an intact atmosphere inside, a good sign that there may be survivors.



THE NEUTRINO SENSOR

Neutrino Sensor Description: The neutrino sensor, a development of research into subatomic particles, is the instrument used most often for detecting high energy sources.

Since neutrinos travel in straight lines from their source, it is easy to determine the direction to their source. The range to the source must be determined by dispersion of the particles rather than by attenuation because of distance. Because of this property of neutrinos, to pinpoint the exact range to the source requires that the sensor take multiple readings over a period of time.

Neutrino sensors are passive sensors.

Using the Neutrino Sensor: Begin with an area scan. The panel will indicate direction of any neutrino sources and their apparent magnitude. (Apparent magnitude is a function of both distance and strength, so a far, strong source can look just like a close, weak source.) For each of the points noted, follow up with a pinpoint scan. The panel will give range, absolute magnitude (in kilowatts, megawatts, gigawatts/EP (energy points), or stellar class), and emission type.

Control Panel Readings: In an area scan, direction is shown on a polar grid. Apparent magnitude readings are:

unknown: indicates sensor difficulties, repeat the scan.

below background: indicates an unnaturally low area of neutrino radiation, possibly indicating the presence of a black globe.

faint: may be a star seen from another solar system (or a dwarf somewhat closer). Occasionally an air/raft or robot uses a fission or fusion power plant and will show as a faint source if it is close by.

moderate: may be a medium-size ship or a system's star seen from an outer planet.

strong: may be a nearby power plant or a star from its inner planets. Strong neutrino emissions are often accompanied by other radiation—an EMS scan is advised for safety.

intense: may be a very close power plant or a more distant giant star. Check EMS for dangerous radiations.

In a pinpoint scan, EP in the absolute magnitude scale stands for energy points, and can be used to determine the size (output) of a starship power plant.

Type readings include:

unknown: sensor difficulties, repeat the scan.

other: alien type of power generation, particle accelerator.

fission: heavy radioactive elements breaking down. Radioactive ores, nuclear power plants of tech level 7 or 8, or stockpiled nuclear weapons.

fusion: hydrogen nuclei fusing into heavier elements. Stars, starship power plants, planetary power plants tech level 9+.

antimatter: not common below tech level 17.

Specifications: Neutrino sensors are commonly installed on military and Scout vessels. Commercial and private starships do not typically carry neutrino sensors. See also "Starship Sensors in Combat". Neutrino sensors are not available in handheld models, but vehicle portable models are available at tech level 11, weighing 450 kg.

Sample UTPs:

To perform a neutrino sensor area scan:
ROUTINE, sensor op, edu, 2 sec (uncertain)

To perform a neutrino sensor pinpoint scan:
ROUTINE, sensor op, edu, 1 min (uncertain)

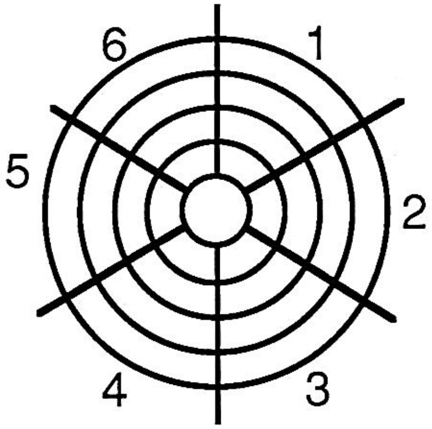
Limitations (also see Neutrino Tables):

- If a ship or some other neutrino source is behind a star or directly in front of it, it is IMPOSSIBLE to detect it, because of the neutrino output of the star itself.
- If the neutrino sensor is surrounded by starships or other strong neutrino sources, it is DIFFICULT to scan anything outside of that shell.
- To conduct a pinpoint scan requires two readings from separate places. If the sensor or the source is moving 40+ kph, this triangulation is automatic.

NEUTRINO SENSOR
CONTROL PANEL

AREA SCAN

DIRECTION



APPARENT MAGNITUDE

- ☐ unknown
- ☐ below background
- ☐ faint
- ☐ moderate
- ☐ strong
- ☐ intense

PINPOINT SCAN

RANGE

- ☐ unknown
- ☐ short
- ☐ medium
- ☐ long
- ☐ very long
- ☐ distant
- ☐ very distant
- ☐ regional
- ☐ continental
- ☐ planetary
- ☐ far orbit
- ☐ extreme orbit
- ☐ interplanetary
- ☐ system
- ☐ sublight
- ☐ stellar
- ☐ beyond stellar

ABSOLUTE MAGNITUDE

- ☐ unknown
- ☐ 1 kw
- ☐ 10 kw
- ☐ 100 kw
- ☐ 1 Mw
- ☐ 10 Mw
- ☐ 100 Mw (1 EP)
- ☐ 1 Gw (4 EP)
- ☐ 10 Gw (40 EP)
- ☐ 100 Gw (400 EP)
- ☐ 10^3 Gw (4000 EP)
- ☐ 10^4 Gw (40,000 EP)
- ☐ dwarf star
- ☐ main seq. star
- ☐ subgiant star
- ☐ giant star
- ☐ supergiant star

TYPE

- ☐ unknown
- ☐ other
- ☐ fission
- ☐ fusion
- ☐ antimatter

Neutrino Sensors

Item	*TL*	*Wt*	*Volume*	*Price*
Veh Portable	11	450 kg	1125 liters	Cr60,000
Veh Portable	12	300 kg	750 liters	Cr75,000
Veh Portable	13	170 kg	425 liters	Cr90,000
Veh Portable	14	95 kg	235 liters	Cr110,000
Veh Portable	15	75 kg	180 liters	Cr 120,000

Examples: Your starship is on a moon that orbits a hostile world and you are trying to locate the main power sources on the planet. The neutrino area scan shows an apparent magnitude of strong, in all directions from your starship. Don't worry about the planet: you are surrounded by other ships, and it is time to power down and lie low or to get out with all possible speed.

Your system defense boat has located a starship at far orbit distance using EMS sensors. A neutrino pinpoint scan shows the ship to have a fusion power plant with an absolute magnitude of 400+ energy points (100s of Gigawatts). This is a rather large power plant: it is probably a military vessel. (In actual fact, it is an *Azhanti High Lightning* Frontier Cruiser, a 60,000 ton craft with a power plant producing 3000 energy points.)

Sensitivity & Range

	Minimum Absolute Magnitude		*ROUTINE Maximum Range*	
TL	*Veh Portable*	*Starship*	*Veh Portable*	*Starship*
11	1 Gw	1 Gw	very distant	planetary
12	1 Mw	100 Mw	very distant	planetary
13	100 kw	10 Mw	regional	planetary
14	10 kw	1 Mw	regional	planetary
15	1 kw	100 kw	continental	planetary

Minimum Absolute Magnitude: The minimum absolute magnitude detectable by a neutrino sensor of that tech level.

ROUTINE Maximum Range: The maximum range band at which operation of a neutrino sensor of that tech level is still a ROUTINE task when detecting an absolute magnititude of 10 Gw or less. The task difficulty increases one difficulty level per range band beyond this range. For example, for a starship neutrino sensor to do a scan at extreme orbit range for another starship is a FORMIDABLE task. Scanning for stars is unaffected by this restriction.

THE NEURAL ACTIVITY SENSOR

Neural Activity Sensor Description: Developed from tech level 12 psionic helmet theory, the neural activity sensor (NAS) was first used medically. It remotely detects the electrical activity of a life form's central nervous system and classifies it according to amount and complexity. The data system compares the activity pattern to known types of life, especially intelligent life.

The neural activity sensor is a passive sensor.

Using the NAS: Because of range limitations, the NAS is used only in probes and by landing parties. An area scan is done first, to determine if any subjects are within range. The readings indicate number, range, and motion of beings exhibiting neural activity in the area. The directional antenna can then be pointed at selected objects for a directional scan, which can classify the creatures according to intelligence.

Control Panel Readings: The NAS control panel displays altitude, pattern, number, range, motion, speed, and direction for area scans; neural class and intelligence for directional scans.

Direction is shown on a polar graph. Altitude, number, and motion scales are self-explanatory; range and speed readings are defined as in Traveller.

Pattern readings shown are:

unknown: the NAS computer can't analyze its data.

simple: the neural activity of the creature or group of creatures is low-level.

complex: the being or beings have highly developed brains, and should be scanned for possible intelligence.

cluttered: a number of different life forms are grouped in one area, muddling the readings.

Neural class readings shown are:

unknown: the pattern matches no known pattern.

Human/Vargr: the pattern matches Terran brain patterns.

Aslan: matches Aslan brain patterns.

Droyne: matches Droyne brain patterns.

K'Kree: matches K'kree brain patterns.

Hiver: matches Hiver brain patterns.

Other: resembles one of the minor races the sensor is programmed to recognize.

Intelligence readings shown are:

unknown: computer is unable to analyze.

lower form: extremely simple brain, handles only sensations, reflexes, instincts. Examples: worms, insects, fish.

not intelligent: limited learning ability. Examples: cattle, birds, bees.

semi-intelligent: adequate brain capacity but lacks complexity of true sentience. Examples: dogs, apes, dolphins.

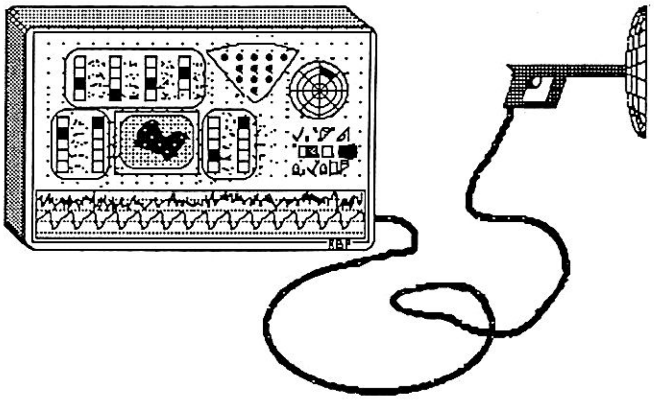
intelligent: very complex brain functions characteristic of sentient life. Refer to neural class.

Specifications: At tech level 13, the neural activity sensor masses 5kg, displaces 2 liters, and costs Cr20,000. At higher tech levels, range increases while the size and cost stay the same.

Sample UTP's:

To perform an NAS area scan:
ROUTINE, sensor op, edu, 1 sec (uncertain)

To perform an NAS directional scan:
ROUTINE, sensor op, dex, 5 sec (uncertain)



AREA SCAN

ALTITUDE

- ☐ unknown
- ☐ above
- ☐ level
- ☐ below

PATTERN

- ☐ unknown
- ☐ simple
- ☐ complex
- ☐ cluttered

NUMBER

- ☐ unknown
- ☐ single
- ☐ multiple
- ☐ horde

RANGE

- ☐ unknown
- ☐ short
- ☐ medium
- ☐ long

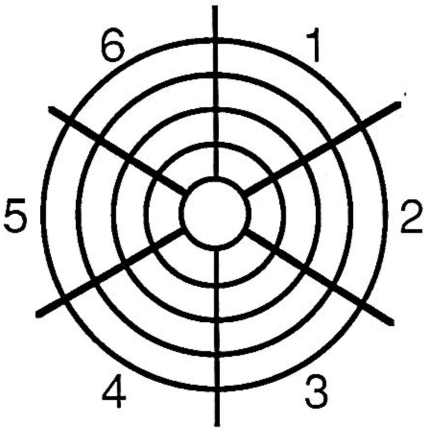
MOTION

- ☐ unknown
- ☐ none
- ☐ away
- ☐ parallel
- ☐ toward

SPEED

- ☐ unknown
- ☐ speed 1
- ☐ speed 2
- ☐ speed 3
- ☐ speed 4

DIRECTION



Remote
Neural Activity Sensor
CONTROL PANEL

Range Limits

TL	*Range*
13	Short
14	Medium
15	Long

DIRECTIONAL SCAN

NEURAL CLASS

- ☐ unknown
- ☐ human/vargr
- ☐ aslan
- ☐ droyne
- ☐ k'kree
- ☐ hiver
- ☐ other

INTELLIGENCE

- ☐ unknown
- ☐ lower form
- ☐ not intelligent
- ☐ semi-intelligent
- ☐ intelligent

Limitations (also see the NAS Tables):

- If the lifeform has a psionic helmet or psionic shield, no reading will be obtained.
- If there are dense materials between the sensor and the lifeform (concrete wall, starship hull), no reading will be obtained.
- No reading will be obtained if the relative motion between the sensor and the life form is faster than 40 kph.
- High relative motion of sensor (but slower than 40 km/hr), will cause "unknown" readings.
- Excessive numbers of lifeforms within range result in a "cluttered" scan.
- Excessive varieties of lifeforms within range yield a "cluttered" scan or multiple classes in one reading.
- Heavy electromagnetic interference, such as an electrical storm or radiation, makes accurate sensor readings a DIFFICULT or FORMIDABLE task.

Examples: Your exploration team, in an air/raft, is cruising slowly over forested terrain and the sensor reads: altitude above, pattern complex, number multiple, range short, motion parallel, speed 2, direction 5. One Scout notices a flock of birds in that direction and points the antenna. Neural class is unknown, semi-intelligent. This level of intelligence in a bird is surprising and may interest your team enough to observe the flock's behavior for some time.

Your team approaches a savanna on foot and the sensor reads: altitude level, pattern cluttered, number horde, range medium, motion unknown, speed unknown. The plain is full of milling animals, both predators and prey, and among them in the distance are large tripedal creatures. A directional scan from medium range resolves one of the large creatures (carrying a spear-like object) into an intelligent being of unknown class. Study from concealment will be necessary before attempting contact (the spear-like object suggests a low tech level and possible hostility).

USING THE SENSOR CONTROL PANELS

Control panels for the neutrino sensor, the densitometer, and the neural activity sensor are included elsewhere in this book; their proper use in an adventure can make play sessions a lot more fun.

Before any character can properly operate a sensor, or interpret its readings, the character needs to have some level of a new skill, sensor operation.

Sensor Operation: The individual has practical experience as well as training in operating various standard high-tech sensors and interpreting their readings.

Referee: Navigators, surveyors, and reconnaissance officers need this skill, and in fact they usually have it. Sensor operation skill does not give any other skills, but navigation, recon, and survey skill each give one level less of sensor operation skill. For example, navigation-3 would confer the benefits of sensor operation-2. Any time a new character rolls navigation, recon, or survey skill, sensor operation skill may be taken instead.

Sensor operation uses the following UTP:

To operate a standard sensor and interpret its results:
ROUTINE, sensor operation, edu (uncertain)
REFEREE: Time for this task depends on the sensor and the object sensed. Sensor operation is FORMIDABLE for characters without sensor operation, navigation, recon, or survey skill. All sensor operation tasks are uncertain tasks.

To use the sensor control panels, the only things needed other than dice and the panels themselves are a number of tokens or markers. The small square colored cardboard pieces often used in war games are ideal, but small coins or even dice could be used instead.

When the character operates the sensor, the referee and the player each roll two dice (the referee secretly), and the success of the task is determined from the uncertain task table of the UTP page. The referee then places the markers on the appropriate squares of the control panel to show the reading. As with any uncertain task, not all of the markers need be placed correctly.

The entire process can be more easily understood by following a few examples.

Example 1: A landing party wants to avoid contact with any local sentient life, so an ex-Scout with survey-3 maintains surveillance using a tech level 14 neural activity sensor. Survey-3 is equivalent to sensor operation-2, and the ex-Scout has a dexterity stat of 4 and an education stat of 7. Unbeknownst to the party, a group of five Vargr are about 75m away in a wooded area east of the party.

The ex-Scout first conducts an area scan. The UTP for the task is ROUTINE, sensor operation, edu, 1 sec (uncertain), so the roll to succeed is 7+, with a DM+2 for the sensor operation skill and a DM+1 for the education. The player rolls 10, and the referee secretly rolls 7. Both rolls have succeeded, so after consulting the uncertain task chart the referee gives the player TOTAL TRUTH.

The player rolls 3D to determine the time the task took. A result of 10, minus the two DMs, equals a time of 7 seconds.

A tech level 14 neural activity sensor has an effective operating limit of medum range, or up to 50m. Since the Vargr are 75m away, no markers need to be placed on the control panel, because the neural activity sensor does not detect them.

The Vargr are walking toward the party at a normal rate; this means that in 15 seconds (one combat round) they are within range of the neural activity sensor. The ex-Scout, meanwhile, knows the limitations of the device and is starting to take another reading.

This time, the player rolls 8, and the referee secretly rolls 11. Both rolls have succeeded, so again the player is given TOTAL TRUTH.

The referee in this case would mark the control panel as follows: altitude level, pattern complex, number multiple, range medium, motion toward, speed 1, direction 2.

A roll of 5 on 3D, minus the DMs, results in a time period for the reading of 3 seconds (recall that 3 time periods is the minimum for any task).

The ex-Scout turns the neural activity sensor in the direction indicated, and conducts a directional scan. The UTP for the task is ROUTINE, sensor operation, dex, 5 sec (uncertain), so the roll to succeed is 7+, with a DM+2 for the sensor operation skill and no DM for the dexterity. The player rolls 11, and the referee secretly rolls 7, a result of TOTAL TRUTH. (This player has been lucky—so far.) The referee marks the directional scan control panel as follows: neural class human/Vargr, intelligence intelligent.

Rolling 3D for the task duration gives a result of 11; deducting the DMs gives a result of 9 time periods. The time period for the directional scan is 5 sec, so the reading required 45 sec. Unfortunately, it takes the Vargr less time than this to reach the party. Next time the ex-Scout would be wise to use a more powerful tech level 15 neural activity sensor.

Example 2: After the fight with the Vargr (the ex-Scout and the Vargr group were killed, and some other landing party members were injured), the landing party returned to their orbiting ship via their air/raft. Once they are on board, they are curious about where the Vargr came from, so the navigator operates the vessel's neutrino sensor to look for any powerful energy readings. Unbeknownst to the crew, the Vargr ship (after depositing its landing party) headed for the nearest gas giant to refuel.

The Vargr corsair (type VP) mounts a power plant-K. In its 400-ton hull (M=400), this is equivalent to a power plant number (Pn) of 5. Calculating energy points with the formula E=0.01MPn, we find that the ship generates 0.01x400x5=20 energy points. (Each energy point equals 250 megawatts, so this ship generates 5000MW, or 5 gigawatts.)

The navigator on our friends' ship has navigation-2, equivalent to sensor operation-1. His dexterity stat is 9 and his education stat is 4. He first performs an area scan for any power sources. The UTP for the task is ROUTINE, sensor op, edu, 2 sec (uncertain), so the roll to succeed is 7+, with a DM+1 for the sensor operation skill and no DM for the navigator's education. The player rolls 2, and the referee secretly rolls 3. Both rolls have failed, so after consulting the uncertain task chart the referee gives the player NO TRUTH.

This character muffed the operation entirely! The referee places a marker on apparent magnitude unknown, and randomly decides to place a marker on direction 5.

The player rolls 3D to determine the time the task took. A result of 8, minus the DM, equals a time of 14 seconds.

The character wants to try again, but since he has failed once, he must first roll 2D on the failure table. A result of 7 shows that he must check his determination. Staying determined has a UTP of DIFFICULT, end, int. The navigator's endurance is 7 (for a DM+1) and his intelligence is A (for a DM+2). He rolls 7, which with the combined DM+3 is not good enough to succeed at this DIFFICULT task. The character waits a few minutes (10 times the duration of the failed sensor operation task) so that he can try the task again without a penalty.

This time he rolls 3, and the referee rolls 7, so the player is given SOME TRUTH. The corsair is in direction 4, and the referee marks direction 3 and apparent magnitude faint. Rolling 3D and subtracting the DM determines that the task took another 28 sec.

The player rolls 2D on the failure table, resulting in a roll of 12: a 2D mishap. Rolling 2D on the mishap table gives a result of 2 the first time (just reroll), and 11 the second time. Evidently, the reason the awkward navigator failed in his neutrino scan was that he accidentally caused MAJOR damage to the sensor, perhaps by channeling too much power to the sensor in order to enhance any reading. Repairing the neutrino sensor is best done at a stardock, and would take more time than our friends have.

(If the player's roll had succeeded, the results would have been type fusion, range interplanetary, 1Gw.)

Example 3: The navigator is dissatisfied with the results so far, because he thinks that the Vargr ship must be in orbit around the world or on the world's surface, and the failed neutrino sensor reading seemed to indicate the opposite direction. Now that he has broken the neutrino sensor he decides to use the ship's densitometer to look for the suspected Vargr ship. (Remember that this series of examples is a little far fetched—most starships do not carry this range of sensors, unless they are Scout ships or military vessels.) He suspects that the ship is on the world's surface, near where they encountered the Vargr.

The Vargr were on foot when encountered, so their vessel couldn't be too far away. He consults the Densitometer Ranges and Scan Areas Chart, and sees that a continental scan would cover an area 10km on a side, with a resolution down to 100m, and a penetration of 1 km (tech level15 starship densitometer). This should be enough to find any ship on the surface. The navigator asks the pilot to move within range of the scan area.

Once the densitometer is in position, the navigator makes the reading. The UTP for the scan is ROUTINE, sensor op, edu, 10 sec (uncertain), so the roll to succeed is 7+, with a DM+1 for the sensor operation skill and no DM for the navigator's education. The player rolls 8, and the referee secretly rolls 8. Both rolls have succeeded, so the referee gives the player TOTAL TRUTH. The player rolls 3D to determine the time the task took. A result of 11, minus the DM, equals a time of 100 seconds.

The referee in this situation should roughly sketch what will be the region of interest: the densitometer, after all, does produce a three dimensional image. He points out one 100m region and marks the densitometer control panel as follows: general density medium metal, approximate weight below 100 tons. With a resolution of 100m, this vague outline is all that can be hoped for. The other parts of the control panel are not used in this case.

The navigator's reputation, after breaking the neutrino sensor, is now somewhat mended. He has found the Vargr's cutter on the world's surface.

Example 4: The navigator is curious now. Is there anyone with the cutter?

Referring again to the Densitometer Ranges and Scan Areas Chart, the navigator sees that the densitometer must be within 50km to achieve a scan resolution of 1m. The navigator's ship is streamlined, so moving it within range is no problem for the pilot.

Once in range, the navigator sets the instrument and rolls the dice. He rolls 6, and the referee secretly rolls 7. The navigator's skill pays off, with a result of TOTAL TRUTH. (Remember that with an uncertain task, the player does not know whether he is getting the whole truth or not.) The referee sketches the cutter, and the 1m resolution is good enough to determine that there is no one on board. "Salvaging" this "abandoned" cutter could certainly help pay for the broken neutrino sensor. A few members of the crew are sent down in an air/raft to pick up the cutter.

Example 5: Where there's a cutter, there's bound to be a ship. Since the cutter is on the world's surface, the ship is probably in orbit. A density search should find it, using a little more time. The world has a UPP size digit of 5, so its diameter is about 8000km. Look again at the Densitometer Ranges and Scan Areas Chart. A continental density search would cover anything from 500km to 5000km away.

The UTP for a density search is ROUTINE, sensor op, edu, 10 min (uncertain). The player rolls 6 (successful with his sensor op DM), and the referee secretly rolls 3 (failure), for a result of SOME TRUTH. Rolling 3D for the time the task took results in 14, minus the DM for sensor op skill, resulting in a time of 130 minutes.

The Vargr ship is out of range, but the referee marks the densitometer control panel as artificial grav field in direction 1, toward the planet.

Example 6: The navigator is not so easily fooled: he realizes immediately that the grav field detected is that of his own ship's air/raft, which was sent down to the planet to get the Vargr cutter. The navigator decides that the Vargr mother ship is farther away, so he sets the densitometer to planetary range (5,000km to 50,000km) and conducts another density search.

The player rolls 5 (failure), and the referee secretly rolls 9 (success), so the player is given SOME TRUTH. Rolling 3D for the time the task took results in 17, resulting in a time of 160 minutes after the skill DM is taken into account.

Since the Vargr ship is still out of range, the referee rolls 1D for a result of 3, and then tells the player SOME TRUTH. He marks direction 3 as picking up an artificial grav field. (Sometimes, SOME TRUTH is an outright lie.) Only by coincidence, the Vargr ship actually is in direction 3, but at a farther distance than supposedly detected.

Since the player failed the roll, he needs to roll on the failure table. A result of 4 indicates that the character can retry the task immediately. He does so, and rolls 5 (failure). The referee also rolls 5, so the hapless player gets NO TRUTH. Simple enough: the referee marks direction 3 again. Since the corsair is still out of range, this marking is still not true. Rolling 3D determines that this attempt took 140 minutes.

Since the player failed, remember, he again needs to roll 2D on the failure table. A result of 8 indicates that the character needs to check his determination before retrying. The player handling the navigator character is suspicious. He failed his own dice rolls twice now, but he got the same result both times. He doesn't know what the referee rolled, but he wants to try again.

Rolling 10 on 2D is successful for the determination roll; the navigator sets the instrument and takes another reading. He rolls 10, and the referee secretly rolls 6. With the DM, both have succeeded, so the player gets TOTAL TRUTH. The referee removes the marker from the direction indicator, since no artificial grav field is within planetary range. The task took another 140 minutes, as determined by a roll on 3D.

Incidentally, where is the Vargr ship now? So far, the densitometer readings have taken 130 plus 160 plus 140 plus 140 minutes, for a total of 9 hours 30 minutes. Looking at the typical travel times in the Traveller rules, we see that a ship with 5G acceleration is by now more than 10 million km from the planet, but still quite a distance from the gas giant. Since a starship-sized object can not be detected more than 500,000km away using a densitometer, we will end the densitometer example here.

Example 7: The cutter has been recovered, and the ship will now head for the gas giant to refuel, still not knowing that the Vargr corsair is ahead of them, also headed in that direction. Gas giants can emit dangerously high levels of gamma rays. Moons, rings, and asteroids are also hazardous to navigation, so the navigator points the EMS array in the direction of the gas giant. Nothing of interest happens during the flight, but a few days later, the ship reaches the gas giant and it's time for some UTP rolls again.

The EMS is usually operated on a constant setting, and it is impractical to roll the dice for another reading every few seconds of game time. Instead, let the referee roll the dice at random intervals, or when something is there to detect, and then notify the players when something appears on the instruments. In such a case, time duration of the UTP task is usually irrelevant. To determine DMs, use the stats of the character who set the device or who is interpreting the control panel.

Also, realize that the EMS detects many things at once, and it is pointless to try to mark every item on the panel. Keep it playable by showing only those items of interest to the characters, and by including a few red herrings as needed.

The UTP for an EMS scan is ROUTINE, sensor op, edu, (uncertain). The navigator wants to find any moving body in space, as well as anything else that passive sensors might pick up. When the ship gets within range of the corsair, the referee secretly makes two rolls of 8 and 9, for a result of TOTAL TRUTH.

The best way to mark the EMS control panel is to use markers of different colors; mark the readings for each band with the same color. In this case, say, the referee would use blue markers to mark electromagnetic band light, intensity moderate, duration constant, range far orbit, size 100m2, and direction 5. In green, he would mark electromagnetic band radio, intensity strong, duration intermittent, range far orbit, and direction 5. In yellow, he could also mark electromagnetic band heat/IR, intensity faint, duration intermittent, range far orbit, and direction 5. By this time the navigator should suspect that something is afoot. If he's clever enough to check the bridge of the cutter, he will find that its radio is set on the same frequency of the radio signals from the unknown object.

The navigator notifies his captain of the situation; active EMS scans will not be attempted in this potentially hostile situation.

USING STARSHIP SENSORS IN COMBAT

Military vessels carry EMS arrays, densitometers and neutrino sensors. Smaller ships lack the long wave antennas that Scout ships and larger vessels have. Passive sensors do not reveal position, so they are used more frequently in combat.

FINDING THE ENEMY

Starship combat is conducted from great distances, far beyond the range of unaided visual contact. Visual range (10km or less) is close enough to start a boarding action. Weapons must be aimed entirely by sensor readings. A good commander will use all the sensors he has at his disposal, so that his aim is as accurate as it can be. Different sensors provide different information; relying on only one instrument is a sure road to disaster.

The sensor capable of first detecting an approaching starship is the neutrino sensor. To locate the fusion drive of a starship, set your neutrino sensor on area scan and watch for moderate to strong sources. If your ship or the target ship is in motion, triangulation is automatic; otherwise, two ships must find the same source to triangulate and do a pinpoint scan.

The dangerous "Diskhili" maneuver can be used to evade neutrino detection. As popularized by Cmdr. Diskhili during the Interstellar Wars, a ship enters a system at great distance. Once the attacker is on the proper ballistic course to the target, it shuts down its power plant, thus interrupting its neutrino emissions. Since it takes time to power up the plant, and the onboard capacitors can only supply the weapons and screens for about 20 minutes in combat, the maneuver is risky. Nevertheless, the advantage of slipping past the first ring of defenders is so great that some captains will risk it. Powering up the plant requires the following UTP:

To power up a starship power plant:
ROUTINE, engineering, edu, 5 minutes
REFEREE: Remember that 20 minutes equals one High Guard combat round. On the average, this task requires more than one such round. The value of a competent engineer in the Diskhili maneuver can not be overstated.

Densitometers can be used to locate such a "cold" ship: set the densitometer on general scan, far orbit range, and place defending ships so that their detection spheres overlap. Look for medium or heavy metal objects, and destroy them once they are in range. They could, of course, be asteroids, but what's one asteroid more or less?

Of course, this technique works only if the starship is more than 10km away from another gravity source, such as a planet or moon, since 10km is the resolution limit at far orbit range. Hugging an asteroid in an asteroid belt, or a planet's rings, can also throw off densitometers.

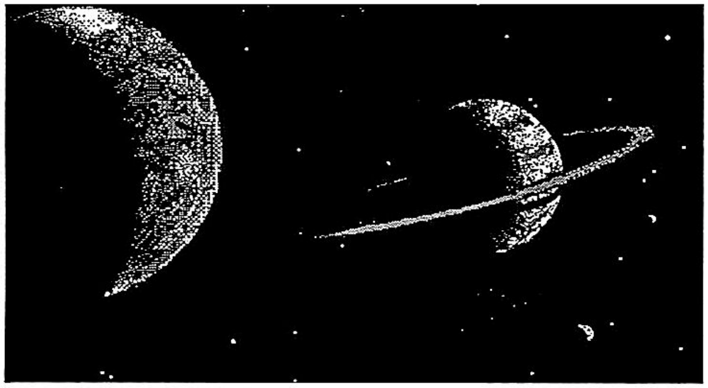
A tech level 15 ship may be equipped with a black globe which hides its radiation and neutrinos. The disadvantage to this technique is that the black globe also blanks natural neutrino sources behind it, so a "hole" in the starfield appears on the sensor. A skilled operator will notice this "below background" reading on an area scan. Since only an enemy would try to sneak up in this manner, such points may be attacked on detection. The densitometer will show the approximate weight of the "hole".

A canny commander will "flicker" his black globe to try to match background radiation with his released energy level. This will fool automatics but an experienced sensor operator can detect it on a UTP of:

To detect a flickering black globe matching background readings:
FORMIDABLE, sensor op, int, 10 sec (uncertain)
REFEREE: A mishap signifies fatigue: lower the character's endurance 1 point.

Another way to avoid sensors is to maintain a position between the system's star and the target ship. This won't fool the densitometer, but the neutrino sensor and the EMS visual array are effectively blinded.

In any case, passive EMS sensors can positively identify any standard class ship once it is within 50,000km (short range in High Guard). Farther than this distance, ship class can only be estimated by its density and energy output.



SURVEY PROCEDURES

In order to maintain up-to-date information on the Imperium and surrounding regions, the Imperial Interstellar Scout Service conducts surveys on an ongoing basis. Although all systems are surveyed, not every system is surveyed to the same degree of detail. System surveys can be grouped into five categories:

Class I surveys are the briefest, usually taking 2D hours. Probes and landing parties are rarely deployed. Class I surveys are used most often on exploratory surveys of new systems. Such surveys may be conducted from as far as a parsec away, in order to determine some stellar information and the possible presence of a gas giant in the system.

Class II surveys take 2D days, and may use probes at the commander's initiative. Landing parties are rare. Class II surveys are usually used to determine special information. The survey ship is sent into the system for this purpose, and leaves as soon as the question has been answered.

Class III surveys take 2D weeks, including deploying probes into the habitable zone. Landing parties may be used at the commander's initiative. Class III surveys are the most common.

Class IV surveys take 2D months. Probes are sent into the system's habitable zone, and landing parties visit the habitable zone's worlds. Both major Imperium-wide surveys (published in 420 and 1065) were Class IV surveys.

Class V surveys take 2D years. Probes and landing parties are sent to all surveyed bodies. The extensive Class V survey is performed only when requested by the surveyed system's government or by the Imperial military.

In a survey (as opposed to an exploration), contact with local sentients is avoided; duration and extent of the survey must take this factor into account. Landing parties typically use the neural activity sensor to locate local life forms; non-sentients may be captured as specimens, while sentients are avoided.

In many system surveys, landing parties are not used. Thus surveys may be classified by scan range: long range (1-2 parsecs distant), system perimeter (50,000-100,000 AUs from the primary), outer system (beyond the habitable zone), inner system (before the habitable zone), or habitable zone.

Other possible survey classifications are by distance, by whether active or passive sensors are used, by whether probes are used, and by whether landing parties are used.

Specialized surveys may be made of the habitable zone of a system, its gas giants, planetoid belts, or the star itself. Some systems are resurveyed because newer sensors are available.

Thus a survey may be a Class II system perimeter probe scan, or a Class IV habitable zone landing party resurvey, for example. Particularly disconcerting to a Scout is a Class V "desk scan", which occurs if he is involuntarily transferred from the Field to the Bureaucracy.

PLANETOGRAPHER'S CHECKLIST

Traveller players occasionally find themselves in a Scout crew, helping the Scouts to survey a system, or searching for resources on an uncharted world. This planetographer's checklist should help in playing out these roles. For convenience, the checklist is divided into sections by location of survey instruments. Remember that some survey instruments are active rather than passive; their use should be minimized in possible contact situations.

From One Parsec Distance: Use the densitometer to determine the number of stars and to estimate the presence of gas giants in the system. Use EMS spectrography to determine stellar types (see IISS Table A for Stellar Distances breakdown).

At System's Edge: Use densitometer to locate all possible planets and to measure the mass of each planet and each star. Use EMS spectrography to determine stellar compositions with greater accuracy. Use neutrino detector to determine internal structure and stability of each star. Use EMS radio telescope to determine general location, type, and intensity of radio transmissions, both artificial and natural. The UPP size digit can be determined for each world (see IISS Table 1).

In Planetary Orbit: Use EMS radar, ladar, and m-radar (microwave radar) to map the surface. Use densitometer to locate major plates and mineral areas. Use EMS infrared sensor to locate major climatic features: icecaps, deserts, and major air and ocean currents. Use EMS radiation sensors to determine the presence or absence of a magnetosphere for the world and to locate radiation belts. Use EMS spectrography to determine atmospheric composition. A combination of EMS spectroscopic, infrared, and optical sensors will yield the world's albedo and a rough estimate of its greenhouse effect. If artificial radio transmission was detected earlier, use EMS radiotelescopes again to pinpoint sources. The UPP atmosphere and hydrosphere digits can be estimated (IISS Tables 2 and 3).

In Upper Atmosphere: Continue survey as desired, using close range for higher accuracy. Use densitometers, thermometers, EMS radar, ladar, m-radar, infrared, and optical sensors to finish accurate mapping. Use spectrography and chromatography to precisely determine atmospheric composition data. Use the EMS radiation sensors to locate local magnetic anomalies. Use EMS radioactivity detectors to get an initial reading on local sources of radioactivity. Use EMS mapping instruments mentioned above to ascertain terrain types. Use densitometers and EMS infrared sensors to search for minor faults and volcanism. The UPP atmosphere and hydrosphere digits can be precisely determined.

On World Surface: Continue survey as desired, using surface and lower atmosphere sensor scans for greater accuracy. Use vacc suits and standard anticontamination procedures for all *newly explored* worlds. Collect samples as desired. Use neural activity sensor to avoid sentient life. (Complete dirtside exploration procedures, including standards for contacting native life, will be detailed in *Grand Census*).

USING THE PLANETOGRAPHER'S CHECKLIST

Referees can instantly generate "into the unknown" adventures for their players. Have each player generate a Scout character. Use the *Donosev* Class Survey Scout described in this book, and generate as many NPC Scouts as needed to fill out the crew. Randomly choose a location on the edge of the Imperium (or within the Imperium) and let the players have at it.

At each stage of the survey, the characters will learn a little more about the area they are in. At first, all they know is the stellar composition of nearby stars and the possible presence of gas giants. After they decide which way to go and lay in the course, they can go into jump. When they reach the new system, there may be possible ship encounters as they study and approach desirable worlds.

The referee does not need to have an entire system generated, but it helps if he does have some information on one world. In this way, wherever the characters go, the referee can use that system as their destination. Using this technique will not keep the referee's campaign consistent with the published Traveller universe, but if the referee uses a border area or an area with unpublished UPP information, this will be minimized.

If the referee desires consistency, he must pre-generate some information or be fast on his feet (or dice) when the characters arrive. He can use UTP uncertain task rolls to give himself more time while generating important information as the characters discover it. Various other adventure possibilities will present themselves as the referee generates system data.

OPERATING THE HOLOGRAPHIC SURVEY STATION

The "holo pit" is the hub of shipboard survey activity on *Donosev* class vessels. The holo pit lies in the foreward section of the ship, in a round room with a diameter of 12m. The pit itself is hexagonal, about 4.5m on a side and 1.5m deep. In the holo pit are stations for a lead surveyor and four survey assistants.

The number of surveyors on duty in the holo pit depends on the intensity and importance of the survey, but no matter how many are there, one is designated the lead surveyor, and he sits at the lead station. The lead surveyor is usually the crew member with the greatest level of survey skill, but on different shifts of round-the-clock operations this is not always true.

Meanwhile, on the bridge the pilot mans his station and the navigator takes the mission control station. The accuracy and completeness of the survey results depend not only on the survey skills of the crew members in the pit and the accuracy of the survey instruments they control from there, but also on the skills of the pilot and navigator, who must orient the ship properly for the sensors to operate most effectively.

Each computerized station in the holo pit has its own controls, which can be configured to operate any combination of sensors. In a typical survey, the four survey stations will be divided up as follows. One surveyor will operate the densitometer and neutrino sensor. One surveyor will operate any probes being used. Two surveyors will share operation of the EMS sensor array. The lead surveyor coordinates this activity between surveyors and the bridge crew.

The holographic projection is devised in such a way that each surveyor sees the information important to him. For example, while pinpointing an artificial radio transmission on a world's surface, a surveyor might see a projection of an area's geographic features with the radio source highlighted. Meanwhile, digital readouts would show the transmission's other characteristics, such as frequency and strength.

At the same time, the surveyor operating the densitometer would see, from his station, an entirely different area map projection, along with other information pertaining to his survey.

When a surveyor detects something unusual, important, or just interesting, he reports this to the lead surveyor in two ways. He calls out the data to the lead surveyor, while at the same time queuing the report into the computer. The oral report does not contain as much information as the computer report, but it alerts the lead surveyor sooner.

From the information accumulating, the lead surveyor decides which items deserve more attention. He calls these out to the appropriate surveyors, while queuing these back onto their computer lists. At the same time, he can pass on precise guidance requests to the navigator on the bridge by using the computer reports queued at his station.

The navigator, at the mission control station, gives course information to the pilot. The pilot maneuvers the ship, and once it is in position for proper sensor operation, the navigator notifies the lead surveyor that the sensor is ready. The navigator thus must keep a close eye on the ship's course, while keeping in mind the orientation of each of the ship's sensors.

LANDING PARTIES

Landing parties are more common on exploration missions than on survey missions, but some brief comments are in order here. Complete landing party procedures will be included in *Grand Census*.

As mentioned above, landing parties may be sent down to check findings of unusual interest or to pick up resource specimens. Survey parties avoid contact with indigenous life forms whenever possible but are always armed for self-defense. Survey parties usually spend 1D hours on the surface.

Exploration Branch landing parties are the planetside experts. Many Scout survey ships carry a complement from both branches. An exploration party typically consists of three Scouts, an air/raft, and the necessary equipment. The air/raft serves as shelter for the Scouts and carries a week's worth of supplies, including handheld or raft-carried versions of the sensors, chemical analysis kits, seismographs, biological sample kits, and culture media. The raft carries a mechanic's kit and spare parts for itself.

Holorecorders are used for behavioral studies of animals and people. If the Scouts are to contact local sentients they will approach unarmed. A second armed party, waiting out of sight but within radio range, supports the contact group.

Scouts are equipped to survive in the environment they enter, and may be equipped with grav belts.

Extended surveys on a worlds' surface are sometimes conducted to gather more information on the world's ecology, geology, seismic activity, weather patterns, and resources.

Landing parties will look for edible organisms, dangerous plants and animals, pathogenic microorganisms, agricultural and pharmaceutical potential of local life, accessibility of resources already located from orbit, stable and unstable terrain areas, volcanoes, faults, adaptations of local life to prevailing conditions, and dangerous weather. Such landing parties remain on the planet (one week at a time with resupply breaks) for 2D weeks unless otherwise ordered.

IISS Table 1

SIZE

Digit	General Description	Min. Diameter	Max. Diameter
0	Asteroid/Planetoid Belt	multiple bodies	under 200 km
R	Ring (around a world)	multiple bodies	under 200 km
S	Small World (500 km)	200 km	799 km
1	1,000 miles (1,600 km)	800 km	2,399 km
2	2,000 miles (3,200 km)	2,400 km	3,999 km
3	3,000 miles (4,800 km)	4,000 km	5,599 km
4	4,000 miles (6,400 km)	5,600 km	7,199 km
5	5,000 miles (8,000 km)	7,200 km	8,799 km
6	6,000 miles (9,600 km)	8,800 km	10,399 km
7	7,000 miles (11,200 km)	10,400 km	11,999 km
8	8,000 miles (12,800 km)	12,000 km	13,599 km
9	9,000 miles (14,400 km)	13,600 km	15,199 km
A	10,000 miles (16,000 km)	15,200 km	16,799 km

IISS Table 3

HYDROGRAPHICS

Digit	Min. %	Max. %
0	0%	4%
1	5%	14%
2	15%	24%
3	25%	34%
4	35%	44%
5	45%	54%
6	55%	64%
7	65%	74%
8	75%	84%
9	85%	94%
A	95%	100%

Percentage of free standing surface liquid, typically water.

IISS Table 2

ATMOSPHERE

Digit	General Description	Min. Pressure	Max. Pressure	Remarks
0	No atmosphere	—	0.00	Requires vacc suit
1	Trace	0.001	0.09	Requires vacc suit
2	Very thin, tainted	0.10	0.42	Requires combination respirator/filter
3	Very thin	0.10	0.42	Requires respirator
4	Thin, tainted	0.43	0.70	Requires filter mask
5	Thin	0.43	0.70	Breathable
6	Standard	0.71	1.49	Breathable
7	Standard, tainted	0.71	1.49	Requires filter mask
8	Dense	1.50	2.49	Breathable
9	Dense, tainted	1.50	2.49	Requires filter mask
A	Exotic	varies	varies	Requires special protective equipment
B	Corrosive	varies	varies	Requires protective suit
C	Insidious	varies	varies	Requires protective suit
D	Dense, high	varies	varies	Breathable above a minimum altitude
E	Ellipsoid	varies	varies	Breathable at certain latitudes
F	Thin, low	varies	varies	Breathablebelow a certain altitude

Pressure is in atmospheres. 1 atm = 760 mm of mercury, or 1.033 kg per square cm.

IISS Table 4

POPULATION

Digit	Min. Population	Max. Population	Description
0	0	9	Few or no inhabitants.
1	10	99	Tens of inhabitants.
2	100	999	Hundreds of inhabitants.
3	1,000	9,999	Thousands of inhabitants.
4	10,000	99,999	Tens of thousands.
5	100,000	999,999	Hundreds of thousands.
6	1,000,000	9,999,999	Millions of inhabitants.
7	10,000,000	99,999,999	Tens of millions.
8	100,000,000	999,999,999	Hundreds of millions.
9	1,000,000,000	9,999,999,999	Billions of inhabitants.
A	10,000,000,000	99,999,999,999	Tens of billions.

The population digit is an exponent of 10 and refers to sophonts (intelligent beings; not necessarily human) on the world.

IISS Table A

STELLAR DISTANCES

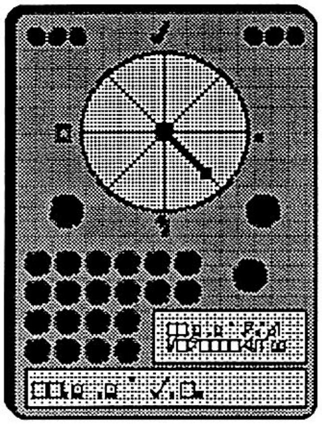
Parsec Distance	Light Year Range
0	0.00 – 1.63
1	1.64 – 4.89
2	4.90 – 8.15
3	8.16 – 11.41
4	11.42 – 14.67
5	14.68 – 17.93
6	17.94 – 21.19

NOTES:

1.63 light years is considered to be in the same "system"; thus 102,800 AU is still in the same "system"

1 parsec = 3.26 light year = 205,600 AU
1 light year = 63,072 AU

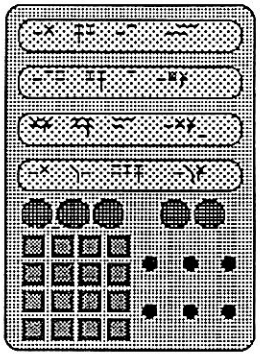
SURVEY EQUIPMENT



SELF-PRECESSING GYROCOMPASS

A necessary improvement in navigational equipment for other worlds is the self-precessing gyrocompass, used both on survey vehicles and in handheld models. The gyrocompass does not need a magnetic field to operate, and sets itself automatically. When a landing party stops on the surface of the world, the air/raft gyrocompass senses the world's rotational motion and sets itself. This process takes about half an hour, during which time the party should not move the air/raft. All personal gyrocompasses are precessed along with the main one.

Raft compass: TL 9, 3kg., 8 liters, Cr 1100.
Handheld Compass: TL 12, 0.5 kg, 1 liter, Cr 2000.

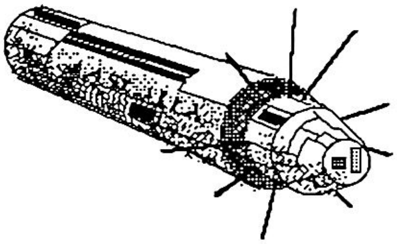


MULTICHRONOMETER

An important survey sensor, but one easily overlooked by those who have never left their home planets, is the Scout multichronometer. This timepiece sets itself, in one planetary rotation, to local zero meridian time, local solar time, and local sidereal time. A setting allows for automatic time zone corrections according to world size. The multichronometer also keeps Imperial standard time.

The sidereal and zero meridian times are of interest mainly to the astronomer and navigator, giving them the spin plane of the world, its year length, and other information.

Personal Multichronometer:
TL 10, 0.1 kg, 2cm x 5cm x10cm, Cr 500.



REMOTE NEURAL ACTIVITY SENSOR PROBE

A variety of probes are carried on Scout survey vessels. The remote NAS probe is a good example of these. The probe's batteries power its grav locomotion and sensors for up to 24 hours at a time, and its continental range communicator allows total control of its operations from the orbiting ship.

The neural activity sensor (the functional equivalent of the handheld model described above) is guided by a surveyor who can see and hear what is going on around the probe, by means of an audio microphone and a holographic camera, complete with telescopic and light intensifying abilities.

The probe is cylindrical, about 1 meter long and 0.1 meter diameter.

Remote NAS Probe: TL 13, 50kg, 20 liters, Cr100,000

VACC SUITS FROM TL 9 TO TL 15

To make up for the discomforts of long missions, Scout survey vessels are designed for greater comfort than is customary on other commercial and military ships. Staterooms are more spacious, the lounge is more entertaining, food is tastier, and shipboard life in general is informal and relaxed.

The rigors of alien environments contrast sharply with these idyllic shipboard conditions. Scouts face extremes of temperature, pressure, and atmospheric composition. A vacc suit is the principal survival tool under these circumstances.

GENERAL PURPOSE VACC SUITS

The general purpose vacc suits use in hostile environments are a historical outgrowth of the earlier pressurized suits used by high altitude aviators. At lower tech levels, these suits are unwieldy and uncomfortable, but with each technological advance vacc suits become lighter and more flexible. At the higher tech levels, the suits provide improved armor protection. At an additional cost, suits may be made self-sealing at tech level 13. At tech level 15, all suits are self-sealing. General purpose vacc suits consist of suit, gloves, boots, and standard helmet; they protect against temperatures from +100°C to -110°C and pressures of up to 5 atm.

GENERAL PURPOSE VACC SUITS

TL	*Armor*	*Weight*	*Price*	*Encumbrance to Dexterity*
9	cloth	8 kg	Cr 7000	–3
10	cloth	6 kg	Cr 7000	–3
11	cloth	4 kg	Cr 7000	–2
12	cloth-1	2 kg	Cr 7000	–1
13	cloth-1	—	Cr 7000	—
	Self-seal Option	1 kg	+Cr 6000	–1
14	cloth-2	—	Cr 7000	—
	Self-seal Option	0.5 kg	+Cr 5000	—
15	cloth-2	—	Cr 9000	—

TAILORED VACC SUITS

TL	*Armor*	*Weight*	*Price*	*Encumbrance to Dexterity*
14	cloth-2	—	Cr 9000	—
	Self-seal Option	0.5 kg	+Cr 5000	—
15	cloth-2	—	Cr 10,000	—

Tailored suits include a soft helmet: PLSS air supply duration is divided by 2 with this helmet.

At tech level 14, individually tailored vacc suits become available at higher cost. These include a soft helmet which is more comfortable but is wasteful of air supply. The other advantages of a tailored suit are style and status.

At tech level 10, holographic heads-up displays become common in hard-helmet suits. The display shows the condition of the suit, along with the current battery level and air supply.

The front cover shows two Scouts surveying a desert world. Their tech level 15 vacc suits are styled as Scout uniforms, and provide more comfort on the hot surface. Their soft helmets and gloves are folded and stored in their pockets.

UTPs for putting on and removing various suits can be generated by the referee as needed.

ACCESSORIES

Unless a character can hold his breath for a considerable period of time, he will need certain accessories along with his vacc suit. Portable life support systems (PLSS) are a necessity; they can be purchased with different supplies of air. Batteries are needed to power the air supply recycler in order to achieve the full stated capacity; a recharge lasts as long as the PLSS oxygen supply. Each PLSS needs as many oxygen tanks as stated. Lighter tanks with greater pressure are available at higher tech levels.

PORTABLE LIFE SUPPORT SYSTEMS (PLSS)

TL	*Type*	*Tanks*	*Duration*	*Weight*	*Price*
9	PLSS A	2 Std	4 hours	7 kg	Cr 3000
9	PLSS B	3 Std	24 hrs (recycle)	14.5 kg	Cr 5000
9	PLSS C	6 Std	48 hrs (recycle)	29 kg	Cr 8000
12	PLSS A	1 HP	4 hours	4 kg	Cr 3000
12	PLSS B	1 HP	24 hrs (recycle)	11 kg	Cr 5000
12	PLSS C	2 HP	48 hrs (recycle)	18 kg	Cr 8000
14	PLSS A	1 UHP	12 hrs (recycle)	0.5 kg	Cr 6000
14	PLSS B	2 UHP	24 hrs (recycle)	2 kg	Cr10,000
14	PLSS C	4 UHP	48 hrs (recycle)	3.5 kg	Cr16,000

OXYGEN TANKS

TL	*Type*	*Weight*	*Price*	*Refill*
5	Standard (Std)	2.5 kg	Cr 500	Cr 10
12	High-Pressure (HP)	2.0 kg	Cr 400	Cr 10
14	Ultra High-Pressure (UHP)	0.5 kg	Cr200	Cr 10

Hard bubble helmets can be used instead of soft bubble helmets. Soft bubble helmets can be folded up and put in a pocket, but as mentioned above, air loss is more rapid using a soft helmet. Hard helmets have the other advantage of allowing a 360° field of view.

HARD BUBBLE HELMETS

TL	*Special Features*	*Weight*	*Price*
8	None	2 kg	Cr 800
14	Integral Heads-up Display	1 kg	Cr 1200

Magnetic grips, handheld or fastened on boots, can make movement easier in low-gravity situations.

Suit patches come in handy in the event of a vacc suit breech. They are unnecessary for small holes on self-sealing suits.

The thermal-meteoroid garment is a hooded, coverall-like garment added over the top of a regular vacc suit. It lessens the risk from micrometeoroids, and can be used to temporarily "harden" a soft suit. It protects from +130° to -160°C.

The long range thruster pack is heavy, but it provides 2G acceleration for up to 48 hours, using standard starship fuel. For more information, see *High Passage* No. 3.

MISCELLANEOUS ACCESSORIES

TL	*Description*	*Weight*	*Price*
5	Magnetic Grips	—	Cr 20
7	Suit Patches	—	Cr 2
8	Thermal-Meteroid Garmet	—	Cr 400
12	Long Range Thruster Pack (LRTP)	38 kg	Cr 14,000

SPECIAL PURPOSE VACC SUITS

The body pressure suit is light and comfortable, designed to work for short periods of time under mildly hostile atmospheric conditions. It can be worn under clothes, but is of no benefit in pressures less than 0.43 atm (thin atmosphere) without the vacuum belt. The suit protects against temperatures +50°C to -40°C and pressures up to 2.5 atm.

Hostile environment suits are usually hard molded. This makes them heavier and more unwieldy, but when they are needed, nothing else will do. Vacc suit skill or battle dress skill is required to use a hostile environment suit; if the character has no such skill, any task attempted is automatically considered hazardous.

BODY PRESSURE SUIT (LT. DUTY VACC SUIT)

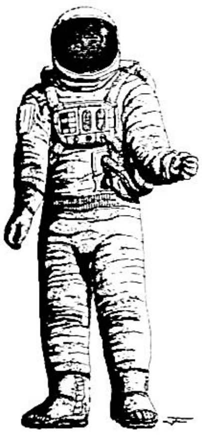
TL	*Armor*	*Weight*	*Price*	*Encumbrance to Dexterity*
10	jack	—	12,500	—

Other Suit Accessories:

Gloves, helmet, air charge (20 min): 0.75 kg, Cr 250
Vacuum belt: 1.5 kg, Cr 2,500

HOSTILE ENVIRONMENT VACC SUITS

TL	*Armor*	*Weight*	*Price*	*Encumbrance to Dexterity*
8	cloth-1	35 kg	Cr 12,000	–3
9	cloth-2	40 kg	Cr 16,000	–3
12	cbt armor+2	40 kg	Cr 18,000	–3
13	cbt armor+1	10 kg	Cr 20,000	–3
14	cbt armor	25 kg	Cr 150,000	–2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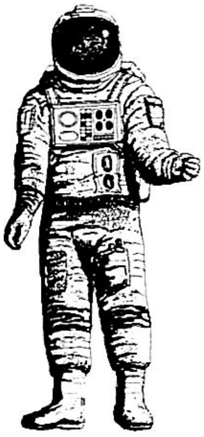
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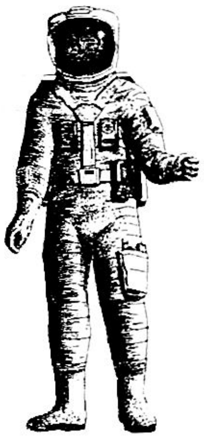
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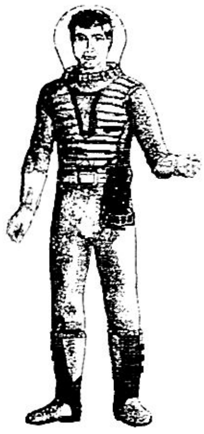
TL 12


TL 13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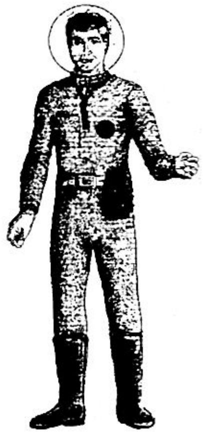

TL 15

DONOSEV CLASS SURVEY SHIP

Villemina Donosev held the post of Master Chief Surveyor of the Imperial Grand Survey when the First Survey was published in 420. Her unstinting devotion was instrumental in bringing the hundred-year project to a successful close. When a new class of ship was commissioned for the Second Survey, it was decided to name the class for her. Individual ships are named for famous scouts in the Imperial service.

The ship is categorized as "SZ", or "Scout experimental", and in fact three different versions of this ship have been built. The most recent, described here, was the result of improvements to sensor placement made during the Second Survey.

Donosev SZ-4732352-000000-00000-0 MCr211.05 400 tons
TL=15. Crew=10. Cargo=15. Fuel=132. EP=12. Agility=2.
One cutter with two modules. 3 air/rafts.

Using a 400-ton hull, the *Donosev* Class Survey Scout is used to continually resurvey the interior regions of the Imperium, updating maps and charts and maintaining beacons and markers for astrogation hazards. It mounts jump drive-3, maneuver drive-2, and power plant-3, giving a performance of jump-3 and 2G acceleration. Fuel tankage for 128 tons supports the power plant and one jump-3, as well as the onboard sensors. Below the bridge is a computer Model/5. There are ten staterooms and no low berths. The ship has four standby hardpoints; no weapons are normally mounted. There are four ship's vehicles: one modular cutter with two modules (typically, a survey module and a fuel skimmer module) and three air/rafts. Cargo capacity is 20 tons. The hull is not streamlined. The *Donosev* Class Survey Scout requires a crew of 10. Occasional passengers are possible if crew members double bunk. The ship costs MCr211.05 and requires 16 months to build.

Construction and material standards for exterior features, interior details, and interior conditions are typical of those found in Imperial military vessels.

As is the case with most modern Scout vessels, the *Donosev* Class Survey Scout is not equipped for use in hostile areas.

When a *Donosev* Class Survey Scout is on a survey (as opposed to exploration mission), its crew of 10 typically includes the following members with the minimum skill levels shown: a pilot (pilot-2), a navigator (navigation-2), a chief engineer (engineering-2), an engineer (engineering-1), a doctor (medical-3), a lead surveyor (survey-2), and several surveyors (survey-1). Air/raft-1, ship's boat-1, and survival-1 are other important skills that should be possessed by some combination of the surveyors.

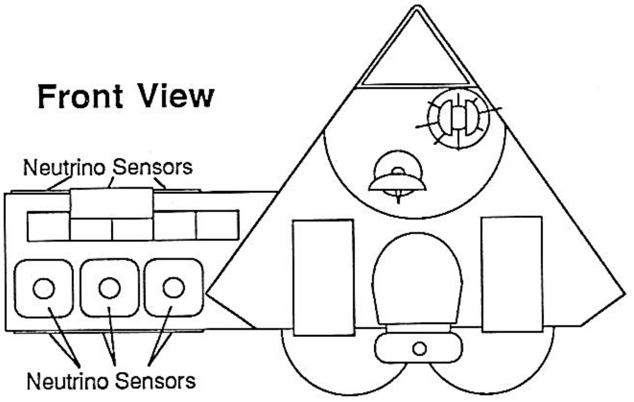
1. Bridge: The foreward wall of the bridge contains a large window, giving a view of the area fore and starboard of the vessel. All of the non-engineering functions of the ship except for piloting can also be controlled from the holo pit (Area 41) when the ship is in orbit around a world or otherwise surveying a star system.

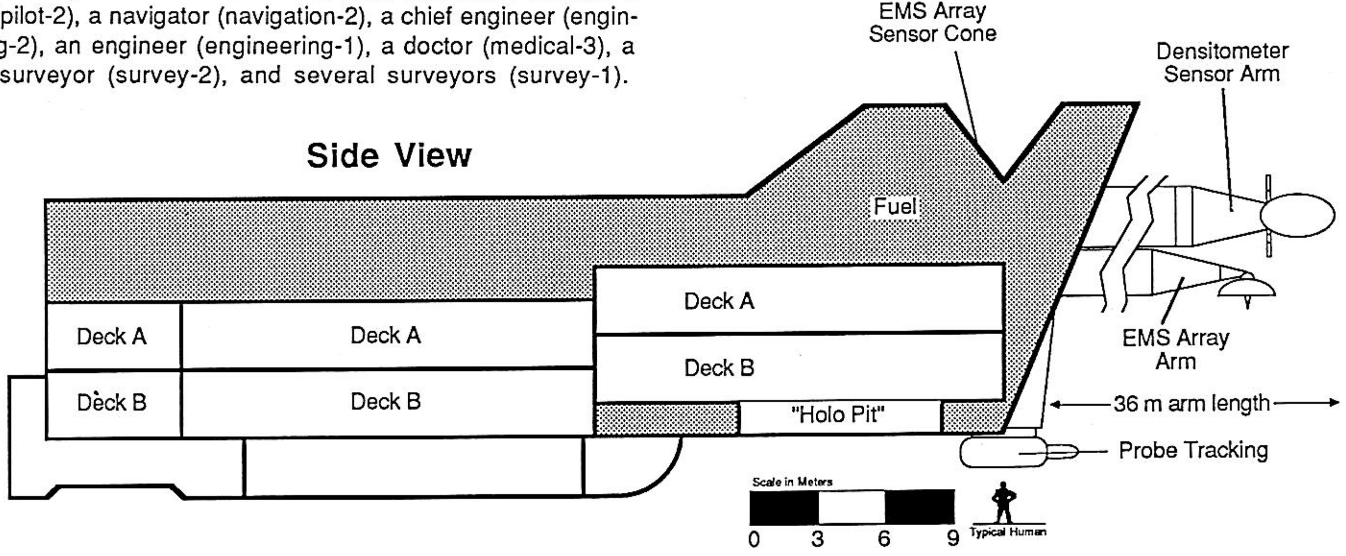
2. Pilot Station: The pilot station is always occupied by a Scout with a skill of at least pilot-2. Adjustments to an orbit are common during a survey, as are adjustments to ship orientation. The pilot from this station controls general operations of the ship, including instructions to engineering .

3. Navigator Station: The navigator is responsible for plotting and planning a ship's course. During survey operations, the navigator usually operates the mission control station.

4. Mission Control Station: The navigator sits here during a survey. He receives requests from the lead surveyor, who oversees operations in the holo pit. The navigator monitors the position of the ship and the status of ship sensors, and tells the pilot where the ship needs to be.

5. Engineer Station: The engineering station on the bridge is a slave panel, displaying status of the maneuver drive,





the jump drive, and the power plant, as well as reporting on energy consumption by various ship operations.

6. Fuel Purification Plant: Free fuel can be scooped from a gas giant or ocean using the cutter, as long as the fuel is purified before it is used in the ship's engines or power plant.

7. Lounge: Scout survey voyages can be long and tedious; the ship's lounge is better than those typically found on military vessels. It includes both recreation and eating areas.

8. Galley: Food and food preparation equipment is housed here.

9. Stateroom: Staterooms on *Donosev* class vessels are made to be comfortable for extended expeditions. Each stateroom is three tons, about fifty percent larger than typical starship staterooms.

10. Stateroom:

11. Stateroom:

12. Stateroom:

13. Stateroom:

14. Stateroom:

15. Stateroom:

16. Jump Drive: A 16-ton jump drive allows jump-3, using 120 tons of fuel, or shorter jumps at a cost of 40 tons per jump.

17. Jump Engineering Station: An engineer mans this station to calibrate the jump drive and to monitor the drive during entry into jump.

18. Maneuver Drive: A 20-ton maneuver drive allows 2G acceleration.

19. Cargo Hold: The cargo hold has a capacity of15 tons. The hold can be pressurized if desired. Special baffles reduce the amount that the hold's artificial atmosphere mixes with the atmosphere of the rest of the ship. Even so, most samples are kept in airtight containers.

20. Cargo Hold Airlock: The outer door to the hold is 4.5m wide and 3m tall.

21. Power Plant: A 12-ton power plant supplies 12 energy points, using 12 tons of fuel. This allows power for 4 weeks, including time spent in jump.

22. Power Plant Main Engineering Station: An engineer operates this station on an as-needed basis.

23. Power Plant Secondary Engineering Station: An engineer operates this station on an as-needed basis.

24. Power Plant Secondary Engineering Station: An engineer operates this station on an as-needed basis.

25. Computer: The Model/5 computer is supported by extensive data banks, accounting for its larger than normal size. About two trillion words of data are stored online. The massive processing capacity supports not only the usual bridge and engineering functions, but also the sensors and holo pit display. The main console is located in this area. The computer, avionics, sensors, and holo display use fully one-fourth of the ship's electrical power.

26. Air/Raft Garage Airlock: Access to the air/raft garage from within the ship is provided through this airlock.

27. Survey Module Hangar Airlock: Access to the survey module hangar from within the ship is provided through this airlock. Also at this location, an iris valve in the ceiling leads up to A Deck for emergency use.

28. Laboratory: The research laboratory houses special equipment for specimen study, as well as technical facilities for calibration and maintenance of handheld survey devices.

29. Stateroom:

30. Air/Raft Garage Area A: Survey air/rafts hold four passengers (or two passengers and four tons of cargo) and are enclosed. Cruising speed is 100 kph.

31. Air/Raft Garage Area B:

32. Air/Raft Garage Area C:

33. Commander's Office: The pilot of a Scout survey ship is commander of the mission, and as such merits a private office as well as a stateroom.

34. Commander's Stateroom:

35. Avionics: Avionics equipment on a *Donosev* class vessel includes a transponder, a gyroscope, and general instruments for flying the ship.

36. Survey Module Hangar: Two 30-ton modules are available for use with the cutter: a fuel skimmer module and a survey module. The fuel skimmer module is intended to dive into gas giants and skim their hydrogen gas for fuel. The module may be used to dip water from oceans as well. It carries 28 tons of fuel. One trip into the atmosphere of a gas giant and back takes three hours, so the ship can be refueled in five trips, or 15 hours. The survey module is used for suborbital surveys, when a special-purpose, closer scan is needed.

37. Cutter Hangar: The cutter consists of a 20-ton frame, which is used in combination with one of the 30-ton modules. The combination is capable of 4G operations and carries a crew of one (pilot). When the survey module is used, a lead surveyor assists the pilot while up to four other surveyors gather data using the module's instruments. The cutter has a four-ton bridge with a Model/1 computer. When the cutter is operated without a module, it has a smaller total displacement and thus greater performance: its 4G acceleration is increased to 6G.

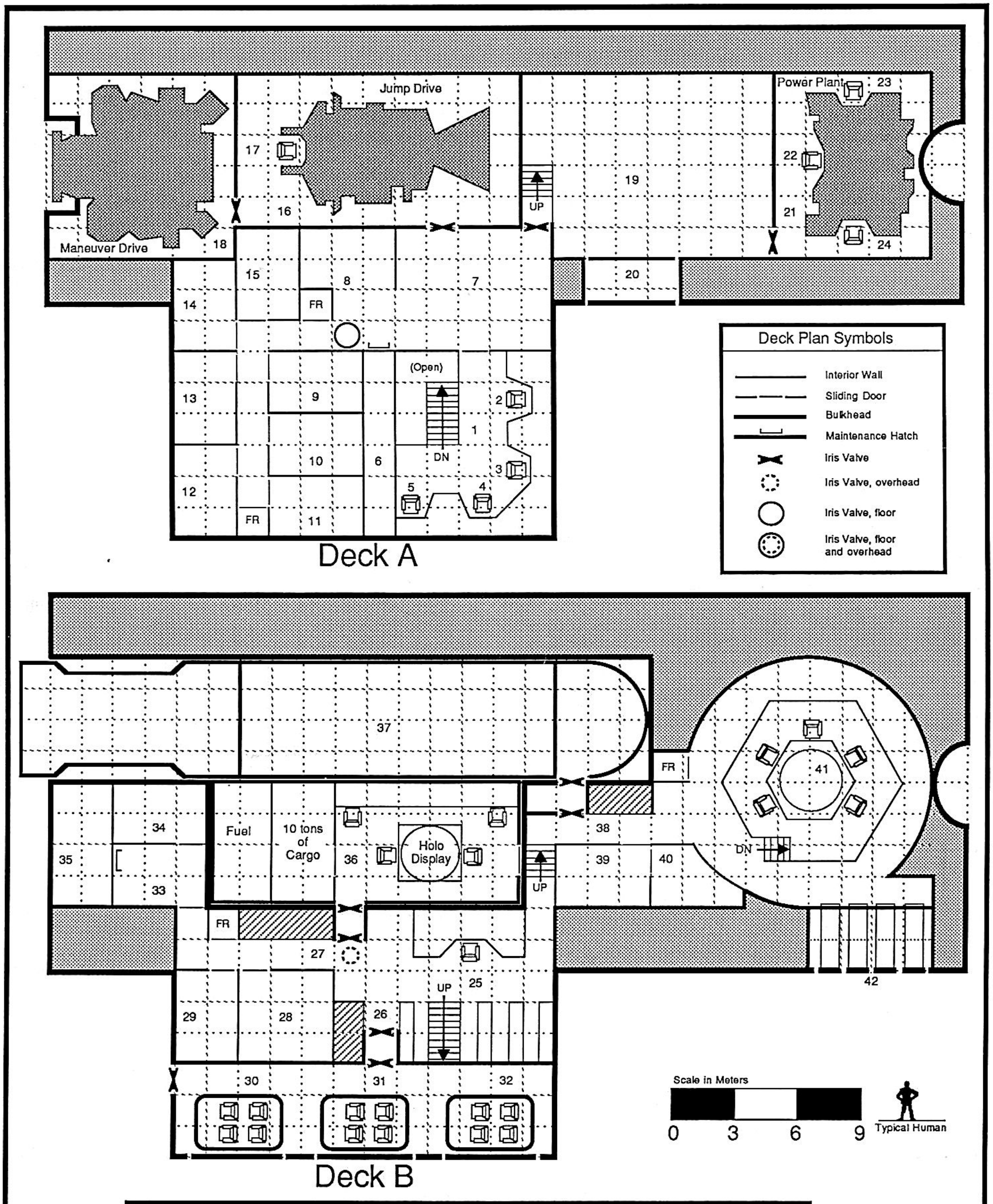
38. Cutter Hangar Airlock: Access to the cutter hangar from within the ship is provided through this airlock.

39. Survey Office: The lead surveyor uses this office to coordinate the ongoing gathering of information, and to assemble the data collected into its final form.

40. Lead Survey Stateroom:

41. Holographic Survey Station: The "holo pit" has stations for the lead surveyor and four survey assistants. More detail on holo pit operations and procedures can be found elsewhere in this book.

42. Probe Storage and Launching: A variety of special-purpose probes may be used during a world survey, particularly when unsafe conditions prevent the use of landing parties. These probes are stored and launched from this area.



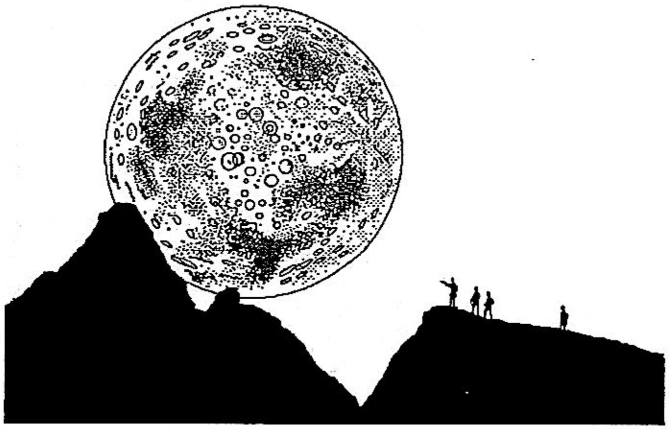
Donosev Class Scout Survey Ship

DETAILING A WORLD

The second main section of *Grand Survey* is meant for referees and other world-builders. Start with the basic UPP for a world, and then physical data, temperature variables, mapping information, seismic conditions, presence of resources, types of starports, and unusual atmospheric compositions can be generated and determined. A new form, IS 20, is used to record this wealth of information.

Once this information is available, the referee can map the world in as great detail as desired. A new, larger world map grid is used to locate tectonic plates, continents, oceans, ice caps, glaciers, mountains, volcanoes, rivers, deserts, jungles, forests, cities, starports, and various resources. Special rules are given for mapping tidally locked worlds.

All of this information can be used to add extra spice to an adventure or campaign. Guidelines and suggestions are given to make this easy for the referee.



CREATING THE WORLD PROFILE

Once the basic world UPP has been generated or looked up, a World Profile can be developed which greatly enhances it. A special World Profile Form is provided for recording this information; this chapter describes how to determine each item step by step.

The chapters "Mapping a World" and "Using World Data" draw heavily on the information created using the procedures in this chapter.

PHYSICAL DATA

The first section of the World Profile deals with expanding the world's basic physical attributes.

Diameter: The UPP size digit gives a basic figure for world diameter in multiples of 1,000 miles. For a more exact size, roll 2D-7 (giving a range from -5 to +5; reroll a "+5" result), multiply by 100 (-500 to +400), and add this number to the basic size in thousands of miles. Roll 2D-2 (reroll 10) for the value of the tens and ones places in the size figure. Multiply by 1.6 to convert the size to kilometers.

Example: A world has a UPP size digit of 5, representing a basic diameter of about 5000 miles (8000 kilometers). We roll 2D and get 4; subtracting the DM of 7 gives a result of -3. Multiplying this by 100 gives -300, which we subtract from the basic size of 5000 to get 4700 miles. Rolling 2D-2 for the tens digit gives 8 (roll of10, minus 2) and for the ones digit, 2 (roll of 4 minus 2). The diameter is thus 4782 miles; converting to kilometers (4782 x 1.6) gives a final diameter of 7652 kilometers.

Density: Basic Traveller assumes all worlds have a density of "1". A world's actual density influences its gravity, mass, and other related features. Density is also important to the process of mapping and to the possible existence of certain resources.

To determine a world's true density, consult the General World Type Table (Table 6.1) and the Mean World Density Table (Table 6.2). First, determine the general world type: gas giant, molten core, rocky body, or icy body. Gas giant will be known automatically; Table 6.1 handles determination of the other types.

Secondly, determine the exact density from the Mean World Density Table by consulting the proper column for the world type and rolling 3D. Densities are expressed in values based on Terra's density, a standard of 1 (5.517 grams per cubic centimeter). The density is referred to as K in later formulas.

Example: A world has a UPP size of 5 and an atmosphere of 2. Consulting the General World Type Table indicates no DM for size 5 and a +1 DM for atmosphere 2. We roll 2D and get 10, which with the DM of +1 gives 11. Consulting the table yields a general type of "Rocky Body". Moving to the Mean World Density Table and rolling 3D on the Rocky Body column results in an 11, for a mean density (K) of 0.66 standard.

Mass: A world's mass can be computed using the formula:

$M=K(R\div8)^3$

M is the world's mass in standard masses (Terra=1), K is the world's density, and R is the UPP size digit.

Example: A world has a UPP size of 5 and a density of 0.66. Plugging these values into the equation results in a world mass of 0.161 standard.

Mean Surface Gravity: The surface gravity of a world can be computed using the formula:

$G=M(64\div R^2)$

G is in standard gravities (Terra=1), M is the world's mass, and R is the UPP size digit.

Example: A world has a UPP size of 5 and a mass of 0.161. Using these values in the gravity equation yields a surface gravity of 0.41 g.

Rotation Period: The rotation period of a world can vary from infinite (tidally locked, such as Terra's moon) to very rapid rates of less than 10 hours.

The basic formula for rotation period is [(2D-2)x4]+5, which yields a rotation period from 5 to 45 hours.

When using *Scouts*, modify this number by further adding stellar mass divided by the AU distance from the star (round fractions down). The greater the effect of the star's gravity, the slower a world's rotation becomes, thus increasing the rotation period. In extreme cases, a world will be tidally locked. In the case of a satellite orbiting a world, modify the basic rotation period by adding world mass divided by the distance from the world in kilometers divided by 400,000. (The division by 400,000 is to convert the distance to Earth-Moon units, as on page 46 of *Scouts.*)

If the final number is greater than 40, roll 2D and consult the Rotation Period Table (Table 9), which covers special cases.

Days are standard days consisting of 24 hours.

For results expressed in tens of days, further refine the figure by adding 2D-7 (-5 to +5, reroll +5) days to the basic figure to give a result in actual days.

To further refine rotations expressed as days, add 1D x 4 hours to the basic rotation period to arrive at a rotation period in actual hours.

For color, the exact rotation period can be further described in minutes (0-59) and seconds (0-59), if desired.

Example: We roll 2D-2 and get 4. Multiplying by 4 and adding 5 yields a basic rotation period of 21 hours. Since the rotation period is less than 40 hours, we do not need to consult the special cases table. We want a final rotation period expressed in minutes and seconds, so we settle on a detailed rotation of 21 hours, 28 minutes, and 2 seconds (21h 28m 2s).

Orbital Period: The length of a world's orbital period ("year") is obtainable from *Scouts* (page 46), based on distance from the star and the stellar mass. Alternatively, set a year length arbitrarily, from several days, to several weeks, to several standard years.

Example: We use the formulas from *Scouts* and arrive at an orbital period of 478.17 days.

Seasons: Divide the year into equal segments. Two is a minimum, but additional subdivisions might be used for long planetary years. The typical year with four seasons includes: summer, winter and two transition periods (spring and fall). The world's axial tilt is usually the main determinant of seasonal variations.

Example: We divide our year of 478.17 days into four seasons (spring, summer, fall, winter) of 119.5 days each.

Axial Tilt: To determine a world's axial tilt, consult the Axial Tilt Table (Table 12). Roll dice to arrive, first, at a general figure in tens of degrees, then roll 2D-2 (reroll 10) for the value of the ones digit, resulting in an exact measurement in degrees. A colorful refinement is to express degrees, minutes (from 0-59) and seconds (also 0-59), such as 21° 22' 3.3".

There is no axial tilt if the world is tidally locked.

Example: Rolling 2D on the Axial Tilt Table results in a 7 giving a table entry of 20° + (2D-2)°. Rolling 2D-2 for the ones digit gives a 7, for an axial tilt of 27°. We add some additional color and come up with a final detailed axial tilt of 27° 44' 7.4".

Orbital Eccentricity: A world may not have a perfectly circular orbit around its star. Roll on the Orbital Eccentricity Table (Table 13) to obtain the eccentricity factor.

Assign a time of year to apastron (furthest separation from the star) and periastron (closest approach). Eccentricity need not coincide with local seasons. A result of "extreme" orbital eccentricity is included to permit special, highly unusual cases. You can also assign a value higher than those given on the table, and proceed from there. Such cases can produce quite unusual effects, especially on otherwise Terran worlds.

Orbital eccentricity also causes seasons to have different lengths; this effect is most noticeable in the lengths of transition seasons.

Example: We roll 2D on the Orbital Eccentricity table and get 11, indicating 0.020 as the eccentricity.

Satellites: See *Scouts* (pages 28, 36–37) for exact rules to determine the number and orbits of satellites (i.e., moons). To recapitulate, planets (size 1 — A) tend to have 1D-3 satellites, small gas giants (20,000 — 60,000 km) generally have 2D-4 satellites, while large gas giants (60,000 — 120,000 km) typically have 2D satellites. The Satellite Orbits Table (Table 14, reproduced from *Scouts*) can be used to determine the orbital distance of the satellite from its central primary.

Example: We roll 1D-3 for a size 5 planet and get -2. The final result is less than zero, so the planet has no moons.

Surface Atmospheric Pressure: The Surface Atmospheric Pressure Table (Table 15) is used to determine the pressure found at the surface level of a world. Surface level is identical to sea level on worlds with a hydrosphere; on other worlds, surface level is the level where the most significant fraction of a world's surface lies.

For atmosphere types 1 through 9 (trace, very thin, thin, standard, and dense), use the table as shown. Vacuum (type 0) has a pressure below the lowest trace value. Pressure on worlds of atmosphere type A-C depends on composition (determined below); types D, E, and F are special cases where you are free to choose an appropriate base pressure (very dense for the D or E; trace or very thin for F).

Results from the atmospheric pressure table are in terms of atmospheres, a measure of pressure in which Terra's pressure rates at 1 atm. This surface atmospheric pressure can be manipulated to show the effects of different altitudes or depths (see the chapter "Using World Data").

Example: A world has an atmosphere UPP digit of 2 (very thin, tainted). Rolling 2D on the Surface Atmospheric Pressure table results in a roll of 2 giving a surface pressure of 0.10 atm.

Atmospheric Composition: Atmospheres of types 2-9 are assumed to be standard oxygen-nitrogen mixes. Vacuum and trace atmospheres, of course, don't matter much in terms of composition, since there isn't enough there to matter. Otherwise normal atmospheres may be tainted; exotic, corrosive, and insidious atmospheric compositions may also be of interest. These are covered on the Atmospheric Composition Table (Table 16), and explained below.

Tainted Atmospheres: The table results give a variety of reasons why an atmosphere might be considered tainted. They can be chosen deliberately or rolled at random. Results are explained below.

Disease: This indicates the atmosphere carries microorganisms, viruses, fungi, spores or other such life forms which can be harmful to humans. It is possible that inhabitants (even humans native to the world) could be immune to these diseases, but visitors may be affected.

Gas Mix: This indicates that there is some element of the gas mix which is generally harmful to humans. Adaptation by humans is highly unlikely.

High Oxygen: This indicates an excessively high proportion of oxygen in the atmosphere. Persons breathing the atmosphere unaided may be subject to oxygen intoxication, loss of judgment and coordination, giddiness, and eventual unconsciousness. Adaptation by the inhabitants may occur.

Pollutants; This generally indicates that specific industrial chemicals, suspended debris, or radioactive pollutants are present in the atmosphere. Industrial worlds usually have this kind of taint. Pollutants are sometimes a specialized case of "gas mix".

Sulfur Compounds: This denotes a situation resulting from high volcanism. The world should be given a high seismic stress factor (see seismic activity rules below); volcanoes will be common. This is another case of gas mix.

Low Oxygen: This indicates that the proportion of oxygen is too low. Persons breathing the atmosphere unaided will pass out, and could suffer brain damage from an oxygen shortage. Adaptation by the inhabitants may occur.

Exotic Atmospheres: The gas mix of exotic atmospheres is unbreathable. The important considerations of this table are density and nature of the atmosphere; for specific gas mixes, see the section "Unusual Atmospheric Compositions"at the end of this chapter.

Densities are rolled on the appropriate column of the pressure table. The notation "irritant" indicates the atmosphere is a borderline case between exotic and corrosive, possibly requiring more than a simple oxygen supply to survive. An "occasional corrosive" atmosphere is one which is generally exotic, but sometimes becomes corrosive. An example might be a nitrogen/oxygen atmosphere which, under certain conditions, precipitates nitric acid, a corrosive agent.

Corrosive Atmosphere: The corrosive atmosphere table concentrates on pressures and temperatures. Again, see "Unusual Atmospheric Compositions" at the end of this chapter for specific gas mixes. An atmosphere may be corrosive because of the gas mix, or because of temperature effects. If world temperature is already known, choose the appropriate entry instead of rolling randomly. If temperature isn't known, the table is a good source for setting the temperature.

Insidious Atmospheres: The table for insidious atmospheres gives the basic cause of the atmosphere's danger. Again, see "Unusual Atmospheric Compositions" at the end of this chapter for specific gas mixes.

"Gas mix" denotes that the atmosphere is composed of a highly corrosive combination of gases (or a gas which is simply difficult to keep out, such as simple hydrogen).

"Radiation" indicates the presence of high radioactivity; cumulative exposure limits activity outside the protection of heavily shielded structures.

Example: A world has an atmosphere UPP digit of 2 (very thin, tainted). Rolling 2D on the Atmospheric Composition Table results in a roll of 4, giving a taint of high oxygen.

Atmospheric Terraforming: Come back to atmospheric terraforming after determining whether or not the world has native life.

Atmospheric terraforming refers to significant improvements in the world's original composition by its inhabitants. This type of terraforming is the most difficult and requires the highest tech level; it is not surprising, then, that it is also the least common.

The Wide Scale Terraforming Table (Table 27) is used to set the chance that atmospheric terraforming has already occurred on a world. Add all the indicated values appropriate to the world conditions to yield a number. A throw of 2D for this number or less means atmospheric terraforming has been conducted on the world. If this is the case, the old original atmosphere can be determined if desired. The atmospheric terraforming progression, from the best atmospheric conditions to the worst, is untainted, tainted, exotic, corrosive, and insidious.

The current world UPP atmosphere digit must remain unchanged, since the terraforming has already occurred.

Example: A size 2 world has an atmosphere digit of 6, a hydrosphere digit of 4, a population digit of 9, a tech level of 12, and does not have native life. Consulting the Wide Scale Terraforming table for atmosphere yields a number of 7 (+2+0+1+2+2). Rolling 2D for this number (7 or less) results in a 7: this world has had global atmospheric terraforming performed sometime in its past, which we surmise was probably to remove some taint (say, the original UPP atmosphere digit was 7).

Hydrographic Percentage: The UPP digit gives a broad hydrographic percentage figure—10%, 20%, and so on. For a more exact percentage, roll 2D-7 (giving a range from -5 to +5; reroll a "+5" result), and add this number to the basic percentage already obtained. For a UPP digit of 0, a result of less than 0% is treated as 0%. Similarly, for a UPP digit of A, a result of greater than 100% is treated as 100%.

Notice that a world with a UPP hydrograpic digit of 0 may actually have an actual hydrographic percentage of 0% to 4%. In fact, over a third of the time, the actual hydrographic percentage can be 1-4% for a world with a UPP hydrographic digit of 0.

Example: A world has a UPP hydrographic digit of 6, representing a basic hydrographic percentage of around 60%. We roll 2D and get 6; subtracting the DM of 7 gives a result of -1. Adding this to the basic percentage of 60% gives a final detailed percentage of 59%.

Hydrographic Composition: In most cases, the hydrosphere of a world is considered to be liquid water. However, a world's seas may vary slightly under certain conditions.

Tainted Atmospheres: An unusual gas mix (including sulfur compounds or industrial pollution) can also cause hydrographic composition to become tainted; tainted water requires purification to be used for drinking or cooking, and might be mildly acidic and thus dangerous to swimmers.

Exotic Atmospheres: The hydrosphere on an exotic atmosphere world is water on a roll of 10+; otherwise it is some other combination of components.

Corrosive Atmospheres: The hydrosphere of these worlds is almost always something other than water.

Insidious Atmospheres: The makeup of the hydrosphere is dependent upon the nature of the atmosphere. Extreme temperatures, pressures, or unusual gas mixes will tend to exclude water; with radiation as the primary problem, the world's water might be perfectly normal (but dangerous because of the radiation).

Example: A taint of high oxygen has no affect on our standard hydrosphere of liquid water.

Hydrographic Terraforming: Come back to hydrographic terraforming after determining whether or not the world has native life.

Hydrographic terraforming refers to significant increases in the world's original hydrographic percentage by its inhabitants by diverting ice asteroids, releasing subterranean water, and so on.

The Wide Scale Terraforming Table (Table 27) is used to set the chance that hydrographic terraforming has already occurred on a world. Add all the indicated values appropriate to the world conditions to yield a number. A throw of 2D for this number or less means hydrographic terraforming has been conducted on the world. If this is the case, the old original hydrographic percentage can be determined if desired (the modification will rarely have been more than +5%).

In the case of desert worlds, the hydrographic percentage can be raised, perhaps as far as the limit of 4%. The modified hydrographic percentage must leave the current world UPP hydrographic digit unchanged, since the terraforming has already occurred.

Example: A size 2 world has an atmosphere digit of 6, a hydrosphere digit of 4, a population digit of 9, a tech level of 12, and does not have native life. Consulting the Wide Scale Terraforming table for hydrosphere yields a number of 11 (+2+1+2+3+3). Rolling 2D for this number (11 or less) results in an 8: this world has had global hydrographic terraforming performed sometime in the past. We decide the locals experimented with raising the hydrographic percentage, and after raising it an additional 1%, decided the project was not worth it, and have discontinued it.

TEMPERATURE

World surface temperatures have a major bearing on the process of detailing a world. The location of ice caps, for example, depends on the world's surface temperature. Other details are also influenced by temperature factors.

Tidally Locked Worlds: Before determining temperature data, establish the world's rotation period to make sure that the world is not tidally locked. The chapters "Mapping the World" and "Using World Data" describe other special procedures for dealing with tidally locked worlds.

Base Mean Surface Temperature: The exact method for determining termperature depends on whether you are using basic Traveller or *Scouts*.

Determining the Base Temperature when using basic Traveller: When using the basic rules, it is up to the referee to choose a base surface temperature. For worlds similar to Terra, the temperature falls within some narrow limits. The Temperature Effects Table (Table 19) gives the effects of various temperature levels in degrees Celsius.

Determining the Base Temperature when using Scouts: The Astronomical Data section of *Scouts* (pages 47, 48) provides formulas for calculating temperatures and orbital distances, using the stellar type, world albedo, greenhouse effect, and other information. When *Scouts* is available, these formulas give a highly accurate picture of the world's basic climate.

Using the Base Surface Temperature: The base mean surface temperature as derived above is an average, and thus an abstract figure. Avoid a literal reliance on statements like "the surface temperature of Caledon is 15°C", which is similar to saying "it was 20°C on the planet Terra today". Many locations on a world's surface can experience significant variations from the base temperature. The base temperature is, in fact, merely a starting point from which actual temperatures are calculated.

The base mean surface temperature is the average surface temperature at hex row 4 before any other modifications are applied. Temperatures will be warmer towards the equator, and cooler towards the poles, because of the angle at which sunlight strikes the world.

Axial Tilt Modifiers: A world's axial tilt influences the seasonal temperature variations on a world. Summer and winter modifications establish a range of possible temperatures.

Scouts presents one approach to calculating the effects of axial tilt; alternatively, the system here meshes with the other temperature rules, without using *Scouts*. From axial tilt, seasonal temperature modifications can be calculated:

summer: +0.6°C per degree of tilt
winter: -1.0°C per degree of tilt

Seasonal modifiers apply only in specific seasonal latitudes (specified by map hex row) which vary based on axial tilt. This is covered in detail in "Mapping a World".

Example: We have previously determined a world to have an axial tilt of 27°. The modifiers are thus +16°C (rounded) in the summer and -27°C in the winter.

Rotation Modifiers: As a world rotates, the basic temperature increases during the day, and decreases at night. Two factors affect the rise and fall of the temperature: the density of the atmosphere (dense atmospheres take longer to heat up during the day, and retain more heat at night) and the length of the day (worlds with longer days absorb more heat during the day, and lose more heat at night).

Length of days and nights: Divide the rotation period by 2 to determine the length of day and night at the equator. The world's arctic circles (see below) mark the area where days are longer for half the year, followed by similarly long nights during the other half of the year.

Arctic Circles: To determine the latitude of the world's arctic circles, compute 90 - axial tilt degrees. The result is the degrees latitude north, and the degrees latitude south at which the world's arctic circles begin.

The length of daylight is interpolated for other latitudes from these two extremes. The length of night is found by subtracting the length of daylight from the world's rotation period.

To determine the number of °C to add to the base mean surface temperature during the day, consult the Rotation Temperature Effects Table (Table 21). Locate the world's general atmospheric pressure category: the daytime columns give the amount to add to the temperature per hour of daylight, and the absolute limit which can be added. This represents the hottest point of the day (generally midafternoon).

The number of °C to subtract from the base mean surface temperature at night is given in the nighttime columns. Shown is the amount to subtract from the temperature per hour of darkness, and the absolute limit which can be subtracted. This temperature is the coldest point of the night (generally between midnight and dawn).

Temperatures at any specific time between these two points can be interpolated as needed.

Example: A world with no atmosphere has a base mean surface temperature of 95°C and a rotation of 28 days. Looking on the Rotation Temperature Effects Table using the atmospheric pressure entry of "None", we find that we add 1.0° C per hour. We have 336 hours of daylight (14 days at the equator x 24 hours per day), which means we would add 336° C. However, the "absolute limit" column indicates that we can add at most 36.8° C ([95+273]x0.1). So the daily high base mean surface temperature is 131.8° C (95+36.8).

Computing the nighttime temperature drop gives us -6720° C (20°Cx336 hours). However, the "absolute limit" column computation tells us at most we can subtract 294.4° C ([95+273]x0.80). The daily low base mean surface temperature is thus -199.4° C (95-294.4).

Latitude Modifiers: Determine the hex row latitude modifier by computing:

(UPP World Size digit + 2) + 3

These figures are used to determine the effect of latitude on the base temperature.

Example: For a size 4 world, the latitude modifier is ±5°C ([4+2]+3) per hex row.

Orbital Eccentricity Modifiers: Orbital eccentricities are generally small and minor in their effects on temperature. However, "extreme" orbital eccentricity can produce quite unusual effects, especially on otherwise Terran type worlds. Again, the system used here is different from the one presented in *Scouts*, to make it congruent with the other temperature rules.

To determine the modifier for apastron (the furthest separation), multiply the eccentricity by -30°C. For periastron (the closest approach), multiply the eccentricity by +30°C.

Example: We have previously determined a world to have an orbital eccentricity of 0.020. This gives an apastron modifier of +0.6°C and a periastron modifier of -0.6°C.

Weather Control: Starting at tech level 8, weather control is introduced on some worlds. The introduction of weather control depends on the need for manipulation of the environment and the technical ability to carry it out. Roll 2D; if the result is less than both the world's tech level and the world's population, weather control is practiced. How weather control affects an adventure session is covered in the chapter "Using World Data".

Example: A world's UPP tech level is 10 and its UPP population digit is 7. Rolling 2D gives 3, which is less than the tech level and the population digit. Weather control is practiced on this world.

Greenhouse Effect Terraforming: Come back to greenhouse effect terraforming after determining whether or not the world has native life.

Greenhouse effect terraforming refers to global modifications to the world's original greenhouse effect by its inhabitants.

The Wide Scale Terraforming Table (Table 27) is used to set the chance that greenhouse effect terraforming has already occurred on a world. Add all the indicated values appropriate to the world conditions to yield a number. A throw of 2D for this number or less means global greenhouse effect terraforming has been conducted on the world. If this is the case, a more favorable base temperature can be recomputed from *Scouts* (page 48) using an abnormal greenhouse effect (any greenhouse effect improvement beyond 10% is uncommon).

Occasionally, the modification will result in a less favorable greenhouse effect, perhaps even to the point of an accidental runaway greenhouse effect (over 100%).

Example: A size 2 world has an atmosphere digit of 6, a hydrosphere digit of 4, a population digit of 9, a tech level of 12, and does not have native life. Consulting the Wide Scale Terraforming Table for greenhouse effect yields a number of 8 (+2+0+2+2+2). Rolling 2D for this number (8 or less) results in a 10: this world has not had any global greenhouse effect terraforming performed to date.

Albedo Terraforming: Come back to albedo terraforming after determining whether or not the world has native life.

Albedo terraforming refers to global modifications to the world's original albedo by its inhabitants.

The Wide Scale Terraforming Table (Table 27) is used to set the chance that albedo terraforming has already occurred on a world. Add all the indicated values appropriate to the world conditions to yield a number. A throw of 2D for this number or less means global albedo terraforming has been conducted on the world. If this is the case, a more favorable base temperature can be recomputed from *Scouts* (page 48) using a modified albedo (any albedo improvement beyond ±0.05 is uncommon). Occasionally, the modification results in an unfavorable albedo.

Example: A size 2 world has an atmosphere digit of 6, a hydrosphere digit of 4, a population digit of 9, a tech level of 12, and does not have native life. Consulting the Wide Scale Terraforming table for albedo yields a number of 9 (+2+0+2+3+2). Rolling 2D for this number (9 or less) results in a 3: this world has had global albedo terraforming performed. We specify that in this case, the albedo modifications were an indirect result of the locals' abandoned hydrographic project.

Other Modifiers: The movements of binary and trinary suns require the calculation of luminosity for each of 3 points: closest approach, farthest separation, and the median distance. Using this information in the *Scouts* temperature formulas (on page 47) yields base mean surface temperatures for each of these instances and can be used to develop appropriate modifiers to the base temperature.

Any other appropriate modifiers can be included.

MAPPING DATA

This section provides the fundamental data needed to ultimately draw a detailed map of the world. Using this data to draw the map is covered in the chapter "Mapping the World".

Number of Tectonic Plates: Tectonic "plates" are rigid rock segments forming the outer layer of a world's structure, floating independently of one another on a layer of molten fluids. The gradual movement (perhaps 1-6 inches per year, on Terra) of these plates results in many important elements of planetary development. Where plates come together, there may be areas of volcanism, heavy seismic activity, and mountain-building. On Terra, there are eight major plates, and a number of minor ones.

Only a molten core world has a chance of multiple major plates; rocky and icy bodies automatically have only one tectonic plate. The number of major plates on a molten core world is established by taking UPP size + UPP hydrosphere, and subtracting a roll of 2D. A result of 1 or less indicates that there is little geological activity on the planet, with the entire surface being one major plate (and, perhaps, a few minor plates).

Example: A molten core world has a UPP size of 8 and a UPP hydrosphere of 3, which yields a sum of 11. Subtracting a 2D roll of 5 means this world has 6 tectonic plates.

Native Life: Many worlds have locally evolved native life. The presence of native life on a world is based on a 2D roll of 10+, with the following DMs:

if atmosphere 0, DM-3
if atmosphere 4-9, DM+4
if hydrosphere 0, DM-2
if hydrosphere 2-8, DM+1
if base mean surface temperature is less than -20°C, DM-1
if base mean surface temperature is greater than +30°C, DM-1

When using *Scouts*:
if stellar type G or K, DM+1
if stellar type F, A, or B, DM-1

Note that a world can have a UPP population stat greater than zero and not have locally evolved native life. In this case, the local population is a transplant from another world. The world may harbor local plant and animal life forms, also transplanted.

Example: A world has a UPP atmosphere digit of 2, a UPP hydrosphere of 6, a base mean surface temperature of 18°C, and orbits a type F star. The net DM is zero, and a roll of 2D gives a result of 12; the world has locally evolved native life.

Terrain Terraforming: Terrain terraforming refers to hex-size changes to the original terrain by its inhabitants.

The Wide Scale Terraforming Table (Table 27) is used to set the chance that hex-size terrain terraforming has already occurred on a world. Add all the indicated values appropriate to the world conditions to yield a number. A throw of 2D for this number or less means hex-size terrain terraforming has occurred on the world. This information is useful during mapping.

Example: A size 2 world has an atmosphere digit of 6, a hydrosphere digit of 4, a population digit of 9, a tech level of 12, and does not have native life. Consulting the Wide Scale Terraforming table for terrain yields a number of 14 (+4+0+3+4+3). There is no need to roll 2D for this number: the result is automatic. This world has had hex-size terraforming performed—once again we stipulate that the terrain terraforming was the indirect result of the aborted hydrographic project.

Continents and Oceans: When mapping the world, you will either locate major continents or locate major oceans. In the first case, the rest of the world will be water (or other hydrosphere); in the second case, the rest of the world will be land. Whether you locate continents or oceans depends on the world's hydrographic percentage.

If the actual hydrographic percentage of a world is 50% to 99%, consult the Continents Table (Table 28) to determine the number of continents. Should the actual hydrographic percentage be 100%, then there is no significant land surface: the number of major and minor continents are both zero.

If the hydrosphere is 1% to 49%, consult the Oceans Table (Table 30) to determine the number of oceans.

A true 0% hydrosphere indicates there is no significant water surface (no freestanding water anywhere); the number of major and minor oceans is zero. (This does not necessarily indicate the absence of water vapor in the air or in subterranean water supplies; there just isn't any usable surface water.)

Example: A world has a UPP hydrographic digit of 6 and an actual hydrographic percentage of 59%, which means we must consult the Continents Table. Rolling 1D+ (6x3) gives a result of 23. From the table, we find the world has 1D major continents and 2D-2 minor continents. After rolling the dice as indicated, we find the world has 1 major continent and 4 minor continents. We enter these data on the World Profile Form; the boxes for major and minor oceans are left blank.

SEISMIC DATA

Seismic data describe a world's likelihood of geologic activity, based on a seismic stress factor. These data are purely optional, but can lend considerable interest to a world, and can become the basis for intriguing adventure situations.

Stress Factor: The stresses which cause seismic activity stem from several sources, including the nature of the world, its distance from its star, the size and distance of planetary satellites, and a variety of less important factors. These are accounted for by a stress factor, which indicates the relative occurrence of seismic activity.

To compute a stress factor for a world (drop fractions):

Basic Traveller:
(2D-3) + Planet Modifier + Satellite Modifier(s)
Scouts:
(1D-3) + Planet Modifier + Satellite Modifier(s) + Orbit Modifier

Planet Modifier:
Molten Core = 1D-3
Rocky Body, Icy Body = 0

Satellite Modifier (compute for each satellite)=
Satellite diameter in km ÷ (orbit distance in world radii x 64)

Orbit Modifier:
Stellar Mass (from *Scouts*) ÷ Orbital distance (in AU's)

Example: A molten core world has 2 satellites (one, diameter1200 km, at a distance of 7 radii and another, diameter 600 km, 25 radii distant) and orbits its star (stellar mass of 1.7) at 1.6 AU's. Rolling the first 1D-3 in the *Scouts* formula results in -1. Rolling 1D-3 for the planet modifier (molten core) gives 3. The satellite modifier for the first satellite is 1200÷(7x64), or 2. The satellite modifier for the second satellite is 600÷(25x64), or 0. The orbit modifier for the world is 1.7÷1.6, or 1. The computed stress factor is thus -1+3+(2+0)+1, or 5.

Volcanoes: Once the stress factor is known, the number of volcanoes that exist on the world can be determined, if desired. Roll 2D-7 and add the stress factor÷2 (drop fractions). Make this roll once for each continent, or 1D times where only one continent exists. The results give the number of important volcanoes on each land mass.

Undersea volcanoes can be ignored, except where undersea colonization is important (such as on a tech level 10+ water world). If they are determined, the same procedure applies, once per ocean or 1D times for a water world.

Example: A world has 6 continents and a stress factor of 5. Rolling six times, 2D-7 + stress factor÷2, gives: 2+3+0+2+0+3, or 10 notable volcanoes on the world.

RESOURCES

The presence or absence of various types of resources on a world can be important. Resources which are present on a world can influence trade potentials of that world; it is also possible that characters will wish to prospect for certain types of resources, which can be the grounds for an adventure situation or even an entire campaign.

Resources are divided into three categories:

Natural Resources are resources that can be found readily on a world. Included are both natural mineral products and natural living products.

Processed Resources are derived from natural resources, but require processing by local inhabitants.

Manufactured Goods are possible only through local industry, requiring both a population base and a fairly good local technology.

Resource Presence: The Natural Resources Table (Table 35), the Processed Resources Table (Table 36), and the Manufactured Resources Table (Table 37) are used to set the chance of any particular resource being present on a world. For each listed resource, add all the indicated values appropriate to particular world conditions to yield a number. A throw of 2D for this number or less means the indicated resource is present on the world in significant quantities. The terrain columns are used when mapping resources on the world map (see the chapter "Mapping a World").

The resource listings with each table break the general resource groupings into specific entries from the trade and commerce table in basic Traveller.

Example: A molten core world has an atmosphere digit of 2, a population digit of 5, a tech level of 7, and has native life. Consulting the Natural Resources Table for agricultural goods yields a number of 5 (+4-3+0-1+5). Rolling 2D for this number (5 or less) results in a 7: this world does not readily have natural agricultural resources.

POPULATION

This section explains how to arrive at detailed population demographics for a world.

The basic Traveller UPP population digit indicates the world's population as an order of magnitude in powers of 10. GDW's Traveller releases *The Spinward Campaign* and Alien Module 6, *Solomani* also include a population multiplier. The population multiplier, which we will call M, is used as follows:

$$A = M \times 10^P$$

where:

A = the "actual" population
M = the population multiplier
P = the UPP population digit

For example, a world with a UPP population digit of 6 may have anywhere from 1,000,000 to 9,999,999 inhabitants. However, if we include a population multiplier of 7, we know the world has 7,000,000 to 7,999,999 inhabitants—a much more specific population figure.

These rules treat actual population figures as two components, the population digit (P) and a population multiplier (M).

World Population: The population digit is the power of ten exponent, identical to a world's UPP population digit. The population multiplier is the first digit of a detailed population figure. When the population multiplier is not known, determine it by rolling 2D-2 (reroll 10). If desired, also roll 2D-2 (reroll 10) for the second and third digits.

Example: Rolling 2D-2 results in a population multiplier of 6. A UPP population digit of 7 and population multiplier of 6 indicates an actual world population of 60,000,000. Two more rolls of 2D-2 yield 9 and 3, for a detailed world population of 69,300,000.

Orbital Cities: Some or many of the cities generated below may be in orbit. Each orbital "city" may consist of one or more orbital habitats.

If a world has a type A, B, or C atmosphere, no native life, and its tech level is 9+, then roll 3D-3. If the roll is less than or equal to the world's population digit, then tech level - 6 of the population is in permanent orbit. If these conditions do not apply, determine the number and size of orbital cities after ports have been determined below.

For class A starports, there is at least one orbital city (of at least secondary size) for each class A starport on the ground. There does not always need to be a ground class A starport—in some cases, the orbital class A starport is all there is.

For class B starports, there must be at one orbital city (of at least tertiary size) no matter how many class B starports are on the ground. There does not always need to be a ground class B starport at all: the orbital starport may be all there is.

For class C starports and class F spaceports, there is an orbital city on a roll of 2D if it is less than both the world's tech level and the world's population. The orbital city may be all there is in some cases; there may be no ground port. The orbital city can be no larger than secondary city size, and may be smaller.

Worlds with a government type of 12 or more tend to have fewer inhabitants in orbit.

In all cases, the absolute limit of the population that can be in permanent orbit is the world's tech level - 6.

Example: A world has two ground class A starports, over 20 class F spaceports, a UPP population digit of A, and a tech level of 15. The absolute population limit that can be in orbit is 9 (billions). Two of the secondary cities are placed in orbit: one for each class A starport on the ground. We easily roll less than the tech level (15) and the population digit (10) on 2D, so we place another secondary city in orbit to serve the class F ground spaceports.

Primary, Secondary, and Tertiary Cities: Following is a series of steps that establish the size and number of cities on a world. P refers to the population digit, and M refers to the population multiplier. Begin by setting P to the world's population digit, and M to the world's population multiplier.

Worlds where P is 5 or less: Roll 1D; if the result is greater than P, all inhabitants are in a single town or community. In this case, the world has one primary city and no secondary or tertiary cities; otherwise, go on to the following steps. If P is 3 or less, and this roll fails, there are no cities at all.

Cities with a population digit of P: Occasionally, the bulk of a world's population may live in only a few cities. Roll 3D; if less than P, one or more large cities of size P exist on the world. Roll 2D-2 (reroll 10) to determine the population multiplier of the city; if the city's population multiplier is greater than M-1, set the city's population multiplier to M-1.

If the city's population multiplier is less than 30% of M, more cities of size P may exist; continue to roll city population multipliers until the combined total of all the city population multipliers is 30% or more of M. In all cases, the upper limit on the total of all the city population multipliers is M-1.

Once all the cities of size P have been determined, a new value of M is computed for use in the next step. Subtract the population multipliers for all the cities from M and multiply the result by 10. This new value for M is used in the next step.

Example of P sized cities: A world has a population digit of A and a population multiple of 8. We thus set P to 10 and M to 8. Rolling 3D results in 9, which is less than P (10): cities of size P exist on the world. We detemine the population multiplier of the first city to be 2, which is less than 30% of M (8). We roll the population multiplier for a second city and get 9.

The combined population multipliers for the two cities is 11, which is more than M-1 (7), so the second city can have a population multiplier no larger than 5, so the sum of the two city's population multipliers (2+5) does not exceed M-1 (7). This world of 80 billion has two cities of size P, one with 50 billion, and another with 20 billion. We compute a new value for M to be 10 (the old value of M (8) minus the population multipliers of the two cities (2+5), times 10).

Cities with a population digit of P-1: Roll 2D; if less than P, one or more cities of size P-1 exist on the world. Roll 2D-2 (reroll 10) to determine the population multiplier of each city. Continue rolling population multipliers for additional cities until the combined total of all the cities' population multipliers equals or exceeds 50% of M.

Once all the cities of size P have been determined, compute a new value of M for use in the next step. Subtract the population multipliers for all the P-1 cities from M and multiply the result by 10. This new value for M is used in the next step.

Example of P-1 cities: Continuing with the world above with a population digit of A and a population multiple of 8, P is 10 and the new value for M is 10. Rolling 2D results in 5, which is less than P: cities of size P-1 exist. Rolling 2D-2 tells us that the population multiplier of the first city is 7, which is more than 50% of M, so we don't generate any more cities of size P-1. The world has one city with a population of 7 billion. Computing a new value for M gives 30 (the old value of M (10) minus the population multiplier of the city (7), times 10).

Cities with a population digit of P-2: Roll 1D; if less than P, cities of size P-2 exist on the world. Rather than rolling for individual cities (which could amount to several hundred), a shortcut computation of M x (1D+9)% gives the number of cities of size P-2 (round fractions).

These cities are assumed to have an average population multiple of 5. When dealing with large numbers of cities, there will be 3D-3% (round fractions) of the total number of cities with a population multiplier of 9. If we have 100 cities, for example, there will be 1 to 15 cities with a population multiplier of 9. This way, a reasonable number of the largest cities can be singled out and listed individually, if necessary.

Again, compute a new value of M to carry forward to the next step. Multiply the number of cities generated in this step by 5 and subtract the product from M. Multiply this calculated difference by 10 to arrive at the new value for M.

Example of P-2 cities: Continuing with the example world, P is 10 and the new value for M is now 30. Rolling 1D results in 3, which is less than P (10): cities of size P-2 exist. Rolling 1D to use in the computation gives a 6. The calculation for the number of cities is thus 4.5, which rounds to 5 (The value of M (30) times 1D+9% [6+9, or 0.15]). The world has five cities with a population of about 500 million. Computing a new value for M gives 50 (the old value of M (30) minus the number of cities times 5 (5 cities x 5, or 25); multiply the resulting difference (30-25, or 5) by 10).

Cities with a population digit of P-3: Cities of size P-3 automatically exist on the world. The procedure is identical to that used for P-2 sized cities.

Example of P-3 cities: Continuing on with the example world, P is 10 and M is now 50. Rolling 1D gives a 2, which is used in the calculation for the number of cities. The result is 5.5 ([50x(2+9)]/100), which rounds to 6. The world has six cities with a population of circa 50 million. Computing a new value for M gives 200 (the old value of M (50) minus the number of cities times 5 (6 cities x 5, or 30); multiply the resulting difference (50-30, or 20) by 10).

Cities with a population digit of P-4: Cities of size P-4 automatically exist. The procedure is identical to that used for P-2 and P-3 sized cities.

Example of P-4 cities: Again using the example world, P is 10 and M is now 200. Rolling 1D gives a 3, when used in the calculation for the number of cities gives a result of 24 ([200x(3+9)]+100). The world has 24 cities with a population of circa 5 million. Computing a new value for M gives 800 (the old value of M (200) minus the number of cities times 5 (24 cities x 5, or 120); multiply the resulting difference (200-120, or 80) by 10).

Cities with a population digit of P-5: Cities of size P-5 automatically exist. The procedure is identical to that used for P-2, P-3, and P-4 sized cities.

Example of P-5 cities: Using the example world, P is 10 and M is now 800. Rolling 1D gives a 1, when used in the calculation for the number of cities gives a result of 80 ([800x(1+9)]+100). The world has 80 cities with a population of circa 500,000.

The cities with the largest population digits are designated as primary cities. Several of the largest population digit levels may be combined together as long as the total number of primary cities does not exceed 10. The world's primary cities are often P and P-1 sized cities. Occasionally a world will not have any cities larger than P-3: in this case, the largest P-3 cities are the primary cities. Secondary cities are those with a population digit one less than the primary cities; tertiary cities are those with a population digit one less than the secondary cities.

It may not be necessary to generate the number of P-4 or P-5 cities if the tertiary cities are size P-3.

PORTS

The world starport/spaceport type is, of course, already known. One primary city, designated by the referee, includes a starport/spaceport of the type in the world's UPP. For each other primary city, roll 2D for less than or equal to the city population digit to place another port of that size in the city. If the roll fails, looking on the Starports and Spaceports Table (Table 39), cross index a roll of 1D with the starport/spaceport code of the world to yield the primary city's port type.

If the world's tech level is 5+, each city (primary, secondary, and tertiary) automatically has a spaceport of type H present.

If the world's tech level is 10+, each secondary city automatically has a spaceport of type F.

Each port functions as a normal port of the given class, and it is usually possible to land at ports other than the main starport.

Example: A tech level 15 world has a type A starport, and a UPP population digit of 8. The world has 3 primary cities, 24 secondary cities, and 185 tertiary cities. One primary city automatically has a type A starport. Consulting the Starports and Spaceports table for the other two primary cities and rolling 1D (plus a DM of +2 because of the population) gives two type B starports at the other primary cities. Since the world is tech level 15, the 24 secondary cities each automatically have a type F spaceport and all the 185 tertiary cities automatically have type H spaceports.

Orbital Cities: Some of the cities generated earlier may be placed in orbit, rather than on the world's surface, using the procedures described above.

UNUSUAL ATMOSPHERIC COMPOSITIONS

Exotic, corrosive, and insidious atmospheres require some special consideration concerning composition, and the special hazards they pose. By introducing this extra detail, you can paint a much more vivid picture of the environment in which the characters are adventuring.

Few worlds have an atmosphere composed of a single chemical. Most atmospheres have a complex gas mix that includes a variety of specific elements, some in great amounts, others barely detectable.

A world's atmosphere consists of active and inert gases. On Terra, for example, the atmosphere consists of nitrogen (78%), oxygen (21%), carbon dioxide, argon and other gases (1%). While there is 3 times as much nitrogen (N_2) as there is oxygen (O_2), oxygen is the active gas in the Terran atmosphere; it is the oxygen that is essential to the chemical reactions of Terran life.

Thus when determining the composition of an unusual atmosphere, only one item needs to be identified: the atmosphere's active gas or gases, which may only make up a fraction of the total atmospheric gas mix.

Some of the possible gases are discussed below.

Carbon Dioxide (CO_2): A non-irritant gas, CO_2 occurs commonly, either by itself or in various combinations. Terra itself once had an atmosphere composed mostly of carbon dioxide, before certain organisms learned to use photosynthesis to break down CO_2 and release oxygen into the air.

Worlds with carbon dioxide in the atmosphere may be in the early stages of developing carbon-based life (although within just a few hundred million years the atmosphere will have changed completely). On the other hand, the local life may be evolving in a totally alien direction—perhaps with life forms which draw their energy from sunlight (without using a form of photosynthesis), or from thermal, radioactive, chemical, or even more unusual sources. Or a world with CO_2 in the atmosphere may not have developed native life at all.

Carbon dioxide atmospheres have the property of trapping heat, causing a high greenhouse effect, which may force the world's base temperature far above the range in which humans can flourish without complete protective equipment. A runaway greenhouse effect (over 100%) can rapidly turn a world into a hostile inferno (and thus be rated as a corrosive or insidious atmosphere).

Nitrogen (N_2): A semi-irritant gas, nitrogen is relatively inert in atmospheres with standard temperatures and pressures. If nitrogen and oxygen are present in an atmosphere with unusual temperature and pressure conditions, the atmosphere becomes more hostile, forming nitrides (nitrogen-oxygen compounds) or nitric acid (NHO_3). Nitrogen occurs in world atmospheres more often than any other gas.

Methane (CH_4): A non-irritant gas, methane (also known as "natural gas") is quite dangerous if mixed at a low (7-14%) concentration with a standard oxygen-nitrogen atmosphere. Any spark can cause the methane to explode and burn fiercely. This can pose a hazard to adventurers if methane leaks into their habitat, space ship, or vacc suit. Pure methane is an odorless, colorless gas, making detection almost impossible.

It is unlikely that free oxygen will be found in an atmosphere containing a significant amount of methane. Methane generally occurs as an active component of the atmosphere on large, cold worlds (size 8+, base temperature below -20°C, dense or very dense atmosphere). There are exceptions—the moon Titan (size 3) in the Terran solar system has methane in its atmosphere, but it is also a very cold world.

Ammonia (NH_3): An irritant gas, ammonia requires protective measures even in mild concentrations. Unlike methane, ammonia has a sharp, pungent odor, and leaks are quickly noticed.

Worlds on which ammonia is found in the atmosphere are much like those described for methane: large, cold, and with standard to very dense pressure.

Ammonia is postulated as an alternative to oxygen as a life-supporting gas. Ammonia is more active than oxygen, so a world harboring ammonia-based life will likely have a cold, very dense atmosphere.

Chlorine (Cl_2): An irritant gas, chlorine is geeenish-yellow in color, and a deadly poison even in small concentrations, although it can be detected by odor long before it reaches a lethal level. It is far more dangerous to exposed skin than ammonia, and requires head-to-toe protective clothing. An atmosphere with chlorine is corrosive in all but the smallest concentrations.

A world with a significant amount of chlorine in its atmosphere would have a mysterious and eerie environment, with the shifting yellow-green haze causing the landscape to waver in a murky green half-light, hiding and distorting objects and shapes.

The superior reactive properties of chlorine make it a prime candidate as a life-supporting gas. Chlorine is in many ways similiar to oxygen, reacting readily in the same ways as oxygen in various chemical processes. Life forms evolving in a chlorine atmosphere would be quite alien in appearance, and might be expected to be more active and energetic than their oxygen gas counterparts.

Fluorine (F_2): A corrosive gas, fluorine is similiar in nature to chlorine. Atmospheres containing fluorine are considered corrosive at best. Fluorine shares many properties with chlorine, including the possiblility of supporting completely alien forms of life. It is easily detected by smell and color, but can be quickly lethal if a significant leak occurs.

Sulfur Compounds: A variety of sulfur compounds can be found in various types of atmospheres, ranging from non-irritant to corrosive. These compounds can be found in atmospheres of otherwise perfectly Terran worlds, and indeed are one of the prime components of smog.

Sulfur compounds in the atmosphere can result from prolonged heavy industrialization, or can occur naturally from heavy volcanic activity.

Sulfur compounds are a possible alternative to the more usual carbon-based organic chemistry. Such life forms would likely be totally alien.

Hydrogen (H_2): A non-irritant gas, hydrogen is not poisonous. However, like methane, hydrogen combines explosively with oxygen. A spark can cause an explosion, followed by the precipitation of water, the product of the combination of these two elements. Hydrogen will make up a significant proportion of the atmosphere on large, cold worlds, and is often found in combination with methane and ammonia.

The smallest and lightest of atoms, hydrogen poses a special problem that can require an atmosphere containing any significant amount of it to be rated insidious. The atoms are so small that they can seep right through fabrics, plastics, and even solid metal in a process known as diffusion. An airtight seal is not necessarily hydrogen-tight. Starship hulls and the walls of buildings can be sealed against hydrogen leakage; vacc suits, however, can not.

Worlds with exotic atmospheres are essentially Terran in everything but atmosphere. An exotic irritant atmosphere with sufficient concentration of the active gas becomes corrosive. An irritant atmosphere causes only minor damage, while a true corrosive atmosphere can kill unprotected humans in a short time.

Corrosive effects requiring the use of a protective suit can be the result of factors other than just the gas mix. No matter what the gas mix, a very low or very high temperature will kill an unprotected human in a matter of minutes.

Worlds with extremely high temperatures can include oxygen, carbon dioxide, nitrogen, chlorine, fluorine, or sulfur compounds. Low temperature worlds tend to have methane, ammonia, and hydrogen in their atmosphere.

Corrosive atmospheres can, with sufficient concentrations or proper temperature and pressure, be considered insidious. For example, a world with a high percentage of chlorine at standard pressure and temperature can be expected to have large amounts of hydrogen chloride gas in the air and seas of hydrochloric acid. Hydrochloric acid would fall as rain.

By and large, gas mixtures revolve around one or two active ingredients. When combining gases, their effects are combined. Some fairly common mixes are carbon dioxide; carbon dioxide and sulfur dioxide; methane, ammonia, and hydrogen; chlorine and nitrogen; fluorine and carbon dioxide; fluorine and sulfur tetrachloride; hydrogen; carbon dioxide and nitrogen; methane and ammonia; chlorine and carbon dioxide; chlorine and disulfur dichloride; and fluorine and nitrogen.

In using this information on unusual atmospheric compositions, use imagination and creativity to supplement the bald facts produced by the world detailing process.

MAPPING THE WORLD

This chapter describes how to draw an accurately detailed world map from the data on the World Profile form. For an item-by-item description on how to develop the World Profile, see the chapter "Creating the World Profile".

THE WORLD MAP GRID

Traveller uses a hex grid in the form of a flattened icosahedron (20-sided solid) for mapping the surface of a world, referred to as the "World Map Grid". By using the icosahedron, the world's surface is depicted with minimal distortion.

The World Map Grid is divided into twenty interlocking triangles (hereafter referred to as "map triangles") of 25 hexes each, for a total of 500 hexes per map. The equator is 35 hexes in length. Each hex is approximately 9° from north to south (top of the map is north, bottom is south, and equator is the center line). Two lines are also present, running at 30° N and 30° S latitude.

Useful Mapping Formulas and Data: When mapping a world, Table 42 has useful formulas for scales and scale conversions. The table also has some helpful data about the world map grid.

MAPPING TECTONIC PLATES

Tectonic plates come in a variety of shapes, occurring as blocks of contiguous hexes. Item 26 on the World Profile indicates the number of major tectonic plates a world has: roll on the Tectonic Plate Size Table (Table 43) to determine the number of hexes in each tectonic plate. By default, the last tectonic plate is always as large as the number of hexes left on the world map grid. Exact placement of the plate boundaries is left to the one drawing the map; the key elements of reasonable plate boundaries are logic and imagination.

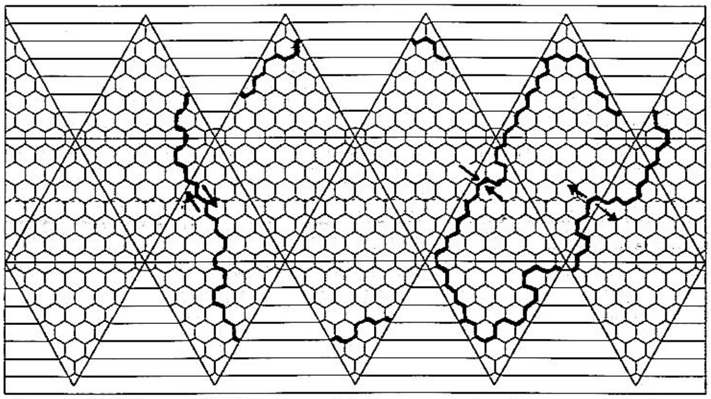
The plate boundaries are sketched lightly in pencil on the world map grid. They do not actually appear on the final map of the world, but are useful for determining the layout of continents and oceans, establishing seismic effects, and in locating certain terrain features on the final map.

Tectonic Plate Movement: For each plate boundary, roll 2D to determine plate movement. On 2-5, the plates are "converging"; 6-8, the plates are "transversing", and on 9-12 are "diverging".

Converging plates are coming together, causing heavy seismic activity and mountain building.

Transversing plates are moving sideways in relation to each other, forming prominent fault lines such as California's San Andreas fault.

Diverging plates are moving apart, creating vast trenches.



Example: The world Regina, with the tectonic plates mapped.

CONTINENTS AND OCEANS

Once the tectonic plates have been located, outlines of continents and oceans can be established.

This procedure is governed by the world's detailed hydrographic percentage. Notice that a world with a UPP hydrograpic digit of 0 may have an actual hydrographic percentage of 0% to 4%; a world with a UPP hydrographic digit of A may have an actual hydrographic percentage of 95% to 100%.

Mapping When the Hydrographic Percentage is 0% to 49%: If the actual hydrographic percentage of a world is 1% to 49%, mapping determines the location of the oceans, seas, and lakes; the land area is located automatically as a by-product of locating the bodies of water. A true 0% hydrosphere indicates that no free standing water is present on the surface anywhere, and mapping proceeds directly to determining terrain.

Total Number of Water Hexes: Multiply the actual hydrographic percentage by 5. Thus, a world with an actual hydrographic percentage of 33% will have 165 water hexes.

Scattered Lakes: Scattered lakes are very small bodies of water; a hex containing scattered lakes is considered to be 1/2 of a hex of water surface. Scattered lakes are determined prior to calculating small seas, minor oceans, or major oceans; divide the number of scattered lakes by two and subtract it from the total number of water hexes.

If a planet's total hydrosphere is scattered lakes, there will be no significant sea or ocean; such a world is likely to have many swampy areas around these clusters of lakes.

If a planet's total hydrosphere is not scattered lakes, there will always be 2D hexes of scattered lakes present. See the "Mapping Details" column on the Oceans Table (Table 30).

Small Seas: Small seas are bodies of water covering roughly 1 hex of water surface. The "Mapping Details" column on the Oceans Table (Table 30) indicates how many small sea hexes a world has. The small sea hexes are deducted from the total number of water hexes before the size of major and minor oceans are established.

Major Oceans: A major ocean is a body of water that covers 15% or more of the world's water surface area. For example, if a world is determined to have 160 hexes covered by water, each major ocean must have at least 24 hexes. If there is only one major ocean, and no minor oceans present, almost all of the water surface of the world will be in a single body of water.

Minor Oceans: Any water surface left after major oceans have been designated is divided among the minor oceans present. A minor ocean covers less than 15% of the world's water surface area. Most minor oceans are small, often even less than 10% of the world's water surface area; establish the exact size as desired.

Any body of water can have major islands (roughly 1 hex of land area) and archipelagoes (roughly 1/2 hex of land area).

Mapping When the Hydrographic Percentage is 50% to 100%: If the actual hydrographic percentage of a world is 50% to 100%, mapping determines the location of the continents; the oceans are located automatically as a by-product of locating the land masses. Should the hydrographic percentage be 100%, then any land which is present on the world will be a few incidental islands, if there is any land at all.

Total Number of Land Hexes: Multiply the actual hydrographic percentage by 5 and subtract the result from 500. For example, a world with an actual hydrographic percentage of 83% will have 85 land hexes (500-[83x5]).

Archipelagoes: Archipelagoes are groupings of small islands, considered to be 1/2 of a hex of land surface. Archipelagoes are determined prior to calculating major islands, minor continents, or major continents; divide the number of archipelago hexes by two and subtract the result from the total number of land hexes.

If a planet's total land surface is not archipelagoes, there will still be 2D hexes of archipelagoes present. See the "Mapping Details" column on the Continents Table (Table 28).

Major Islands: Major islands are land areas covering roughly 1 hex. The "Mapping Details" column on the Continents Table (Table 28) indicates how many major island hexes a world has; deduct the number of major island hexes from the total number of land hexes before the size of major and minor continents are established.

Major Land Masses: A major land mass is an area of land covering at least 15% of the land surface area of the world. The Terran equivalents of major land masses are Eurasia (37%), Africa (20%), and North America (16%). The other continents are minor land masses according to these rules.

Minor Land Masses: Any land surface remaining after major continents have been designated is divided among the minor land masses. A minor land mass covers less than 15% of the world's land surface. Most minor land masses are less than 10% of a world's land surface; establish the exact size as desired.

Remember that any land mass can have land-locked small seas (roughly 1 hex of water area) and scattered lakes (roughly 1/2 hex of water area).

Placement: Once the general form of the world's continents and oceans has been developed, placement is next. This process requires a certain amount of creativity—and cannot be regulated by rules or random tables. General guidelines are given below, but you must be the final judge of what looks right for a specific world.

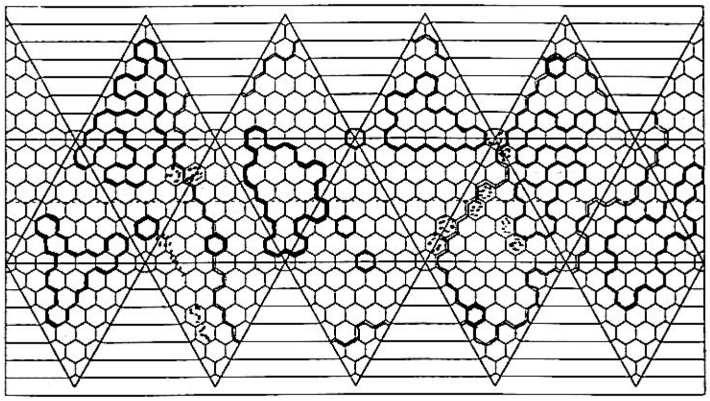
When placing continents, it is best to divide them up as evenly as possible among the various plates, ideally with one continent per plate. If there are more continents than plates, some continents must be doubled up on one plate. If there are fewer, some plates will lack a continent.

Overlap: As a continent is placed on a given plate, roll 2D. On 2-7, the continent is placed in the center of the plate with no overlap onto adjacent plates (unless it is too large to fit). On 8+, the continent is placed so that it overlaps onto an adjacent plate (the exact amount of overlap is up to you). An overlap can indicate the location of seismic disturbances, and can influence the charting of terrain features, especially mountain ranges. This is explained in detail later.

Isthmus: Any time two continents are separated by only one hex, they are joined by an isthmus on a roll of 9+.

Strait: Likewise, any time two oceans are separated by only one hex, they are joined by a strait on a roll of 9+.

The exact placement of features is, of course, up to you when creating the map, but the die rolls help introduce a certain degree of randomness.



Example: Map of Regina, with the land masses placed.

DRAWING THE MAP

Once the locations of the continents and oceans are known, they are sketched in. The size of each is determined as discussed previously.

Drawing the map is a creative process, balancing an eye for what is aesthetically pleasing with good judgment of the scientific possibilities. For example, even if you like the "nice, crinkly bits" of fjords, they might not look suitable as equatorial terrain, since fjords typically result from glaciation. (Some of these details suggest themselves when data on terrain and temperatures are assembled.)

Once the outlines of continents and oceans have been sketched in, the basic mapping step is complete. For further refinements, other data must be considered.

MAPPING TERRAIN

Terrain can be classified into three general categories:

- terrain resulting from surface features such as mountains and rivers;
- terrain resulting from local life forms, such as jungles or steppes;
- terrain artificially influenced by civilization, such as cities and roads.

Surface Features Terrain: Surface features include the following types: mountains, rugged, and open. An additional type, tundra, is any open hex adjacent to the freezing line of a world. Placement of surface features is described below.

Freezing Line: In the northern hemisphere, a world's permanent freezing line is located north of the hex row in which the temperature is below 0°C year-round. A similiar situation exists in the southern hemisphere.

A temperature worksheet is used to locate this hex row. See "Using World Data, Local Temperature Determination" for details on how to create this worksheet.

Within the freezing line, place sheet ice on both land and water, and place tundra hexes on any open land hex in the hex row just beyond the freezing line.

Glaciation: If the world has ever experienced major changes in climate, it is possible that glaciation will have caused significant changes in terrain, primarily by carving mountains. Roll 1D-1; this is the number of hexes from the freezing line towards the equator that the polar caps once extended. Land areas within that radius have a greater chance of mountainous terrain (see "Mountains", below).

Where extreme variations in surface temperature occur regularly (from axial tilt, orbital eccentricity, or whatever), determine the limits of the freezing line at the coldest time of year, and use this as the baseline for the glaciation roll.

Mountains: Mountains are caused either by the actions of plate tectonics, or by the effects of glaciation. (Other causes are possible, but these are the primary causes.)

Mountain ranges are represented by mountain hexes, with rugged hexes often adjoining the mountain chains. Most mountains are placed along plate boundaries (see "Tectonic Plate Movement"). A total of [(2D-2)x1D]% of the land hexes are mountain or rugged; the exact number of each and their placement is up to you, but placement should conform roughly to the plate boundary.

Outward from the glaciation line determined previously, each "map triangle" can contain 1D additional rugged hexes (up to the limit of available land hexes, of course) with an equivalent number of mountain hexes.

Notable Volcanoes: Place the volcano hexes with a strong bias towards placement in converging or transversing plate boundary areas. First preference of placement should be rugged terrain or on islands and archipelagoes. Second preference is any hex adjacent to a mountain hexside.

Once all such hexes have been used up, other volcanoes may be placed freely.

Volcanic Hexes: In addition to major volcanoes, 1D-1 other volcanic hexes may optionally be placed anywhere on the world, ignoring plate boundaries but still following other preferences. A volcanic hex contains many smaller volcanoes of various sizes and conditions.

Volcanoes may influence the presence of certain resource types in specific areas.

Rivers: Rivers are optional, as they have little effect at this scale. They may be included for local "color", however.

On each continent (or within each map triangle containing at least 10 all-land hexes if there is only a single continent on the world) there will be 1D-1 major rivers. Major rivers are 1D hexes in length.

Placement of rivers varies. They generally originate in mountains, rugged areas, lakes, or small seas, and flow toward larger bodies of water. If rivers are available for a continent, and the continent includes jungle (determined below), at least one river should flow through that jungle. Rivers can be drawn to conform to hexsides, or they may be drawn within hexes instead, whichever you prefer.

Life Influenced Terrain: If no life is present on the world, all hexes are immediately considered desert. If life is present, follow the guidelines below in developing various terrain types.

Deserts: Deserts can occur in three different ways.

Continental deserts are placed on any continent where ten or more contiguous, non-rugged, non-tundra land hexes are present, and a dice throw greater than or equal to the world's UPP hydrographic digit is made. If a desert result occurs, roll 2D-1 for the number of desert hexes to be placed. Actual placement is left to the referee; except when necessary, deserts of this type do not occur in coastal hexes, but this is the only general limit. Where only one continent is present, check once per map triangle containing 10+ continguous open hexes, instead.

Windshadow deserts occur because of mountain barriers that block movement of air containing moisture. There will be H-1D such desert hexes, where H is the UPP hydrographic digit. Place them in any hex adjacent to rugged hexes or mountain hexsides, but never adjacent to water hexes. There are no other requirements, and the available hexes are divided as the referee desires.

Coastal deserts occur in coastal hexes. There will be H-2D coastal desert hexes, where H is the UPP hydrographic digit. They may be placed on any coastal hex within four hexes of the polar caps. Exact locations are up to you.

Jungles and Rain Forests: Jungle and Rainforest hexes are generally placed in regions where temperatures are between 20°C and 40°C. If a group of 10 contiguous, non-desert, non-rugged hexes exists on a continent within this temperature range (or a map triangle, where only one continent exists), and a throw less than or equal to the UPP hydrographic digit is made on 2D, a jungle will be present.

Contiguous hexes can also, for jungles only, include adjacent islands and archipelagoes. When a jungle exists, roll

2D-1 for the number of jungle hexes to be placed.

Jungle and Rainforest hexes must be within 3 hexes of an ocean or sea, and may not be placed adjacent to desert hexes or outside the appropriate temperature range. Islands and archipelagoes may be included in the jungle placement process. Exact placement, within these guidelines, is up to you.

Open/Forest: All remaining hexes immediately become Open/Forest hexes. In the absence of civilization, these hexes will be heavily wooded, in some cases comparable to jungle.

Civilization Influenced Terrain: If there is intelligent life present on a world, additional terrain features may be present.

Cities: Placement of cities is largely a matter of personal choice, but a few general guidelines are noted.

At tech levels 0-3, cities of larger than population digit 5 should be placed only in open terrain (not jungles, deserts, oceans, ice caps, rugged, etc.).

Tech levels 4-6 permit placement of population digit 5+ cities in rugged or desert terrain, in addition to open terrain.

Tech levels 7-9 permit population digit 5+ cities to be placed in jungles, in addition to previous terrain types.

Tech levels 10+ allow placement of population digit 5+ cities in oceans or on ice caps. Thus, from tech level 10 and beyond, there are no barriers to settlement. At tech level 10+, it is also conceivable that each hex may hold a number of cities equal to the tech level, regardless of size.

Special Cases: In some cases, technological limitations may make city placement impossible. When this happens, place the city anyway, but note the discrepancy. This should be explained in some reasonable fashion, to suit conditions on the world and personal taste in backgrounds. One good example might be an undersea city on a world with declining technology; the inhabitants are no longer capable of repairing problems, and hence are at the mercy of the first natural disaster that strikes.

Roads: Significant roads may be mapped if the tech level is between 5 and 10. Beyond tech level 10, the popularity of grav technology typically makes roads obsolete.

"Settled" Hexes: Open hexes adjacent to cities will be settled. At tech level 11+, any hex adjacent to a city is automatically considered settled, including ocean hexes. Settled terrain is generally inhabited lightly, and given over to agriculture or occupied by small communities.

If the atmosphere is not between 4 and 9, there are no "settled" hexes regardless of technology.

Starports/SpacePorts: Starports may be placed in or adjacent to the city hexes they belong to. Spaceports are always placed in the city hex.

Resources: The presence of specific resources or production facilities in specific hexes can be determined by rolling the basic resource presence number or less, including the modifier for the terrain type of the hex. Modifiers for terrain types are included on the resource location chart. If the throw is made, that resource is present or produced in that area.

The throw can also be made for smaller areas if the resource is indeed present in the hex. (And, of course, a throw to locate the resource in a given hex is only allowed if the resource is available on the planet as a whole).

Terraforming: If a world has conducted terrain terraforming, one or more hexes have had their terrain type modified. The most common type of terrain terraforming is to improve desert terrain into arable land (clear or settled) for agricultural use. The types of terrain terraforming include; from desert to prairie; from prairie to clear; from clear to wooded; from wooded to forest; from forest to rainforest; from rainforest to forest; from forest to wooded; from wooded to clear; from clear to prairie (accidental); and from prairie to desert (accidental).

Given sufficient time, the terraforming can include more than one level of transformation. An extreme (and rare) example of this would be to terraform desert into rainforest over a period of time.

The extent of the terraforming (how many hexes it includes) is up to the one mapping the world. Higher tech level terraforming (tech level 12+) tends to be more extensive.

ALIEN WORLDS

This material assumes roughly Terran conditions. This is a deliberate bias, but should not restrict you from creating otherworldly conditions. It is impossible to write rules for every eventuality and still to have a manageable book, so implementing rare and unusual conditions is left up to the individual referee and players.

For example, you may wish to have a jungle-type terrain that flourishes in different temperature ranges than given here. If so, extend the jungle rules to permit these alien jungles in appropriate areas. In another instance, a world known to hold the remnants of a post-nuclear holocaust culture might have a whole new type of desert ("radioactive") placed at various points.

Use these rules as a foundation: modifications can be (and, in fact, should be) logically created and consistently applied. For an example of a world where local conditions influence terrain placement, see *Tarsus* (GDW). (*Tarsus* was developed prior to and independently of these rules).

TIDALLY LOCKED WORLDS

A tidally locked world is a world that has an infinite rotation period with its primary star.

For such worlds, it is sometimes more convenient to treat the map projection differently than described above.

Tidally locked worlds keep the same hemisphere toward the star at all times and the other in perpetual darkness. There are great extremes of temperature from one side to the other, with the "twilight" band—the rim where the sun is always near the horizon—being the area usually (but not always) closest to livable temperatures.

Since the area of greatest interest in terms of population and habitation is the twilight band, rather than the world's equator, a world map can be drawn in an alternate projection which more conveniently displays the twilight band.

The top of the grid is designated as the sunward side, the bottom as the nightside. The "equator" on the map becomes the twilight zone band. Along the center band, the north and south poles of the world may be located (17.5 hexes apart); half-way between them, an up-and-down line marking the equator may be inserted.

Keep in mind the unfamiliar orientation, however. This projection variant is very useful for twilight zone mapping, with the hot and cold regions to sunward and nightward slightly distorted, but also less frequently visited.

Rules for temperature variation must then be changed slightly to use these mapping conventions for dayside and nightside. The temperature is hottest at the top of the map, and coldest at the bottom. The base mean surface temperature occurs in the twilight band.

Temperatures increase and decrease from that point in accordance with normal rules for latitude, world size, axial tilt, rotation, and so forth. All other rules and effects remain the same.

For purposes of the rotation effects on temperature, a tidally locked world is assumed be at the maximum limit of daytime plus on the bright side, and nighttime minus on the dark side.

Such a world will be one of climatic extremes: only in a relatively thin band of constant twilight will life generally be able to flourish (though this depends on the base temperature). Mapping should reflect these surface conditions—ice sheets covering the cold regions, sunbaked deserts on the hot side.

USING WORLD DATA

Local temperature, climate, weather, quakes, volcanoes, and availability of resources all add color to an adventure. This section tells how to use world data to determine conditions and to generate unusual events. Information is also given on the weather effects of movement rates, and the placement of orbital cities. Guidelines are also given for using a world's size and gravity, atmosphere, magnetic field, and star system details in an adventure.

LOCAL TEMPERATURE DETERMINATION

The basics of temperature determination (latitude, axial tilt, eccentricity, rotation, and stellar movements) have already been established. To combine these factors, get a sheet of paper and make a temperature worksheet. Once it is filled out, you can determine temperatures for any hex, including modifications for time, season, altitude, and bodies of water.

Filling Out a Temperature Worksheet: Take a sheet of lined paper and label eight columns as hex row, modifier, base, seasonal, summer, daytime, winter, and nighttime. (An example with Regina is shown below. Referring to the example will clarify the procedure.) Filling out the worksheet is greatly simplified if you use whole numbers (round all fractions up).

Hex Row: Number down the hex row column from 1 to 11.

Modifier: Look at the Latitude Temperature Modifiers Table (Table 44). Find the column for the world's size, and copy the values into the modifier column of your worksheet.

Base: You have previously determined the base mean temperature for the world; jot down the value above this column for easy reference, then for each row add that value to the value from the modifier column.

Seasonal: Look at the Seasonal Latitudes Table (Table 45). Find the axial tilt for your world in the first column. Reading across the row, find which hex rows have which percentages, and enter the appropriate values down the column.

Summer: You have previously determined the axial tilt modifiers for the world. Jot down the summer value above this column for easy reference. Then in each row, add the seasonal percentage of this value to the value from the base column. For example, in hex row 1 of Regina, there is no seasonal percentage, so the base value is entered into the summer column with no change. For hex row 4, we add 8 (50% of +16°) to the base value (9) to get 17 for the summer value.

Daytime: You have previously determined the rotation modifiers for the world. Jot down the daytime value above this column for easy reference. Then in each row, add that value to the value from the summer column, giving the summer daytime high temperature.

Winter: The winter column is done like the summer column. You have previously determined the axial tilt modifiers for the world. Jot down the winter value above this column for easy reference. Then in each row, add the seasonal percentage of this value to the value from the base column. For example, in hex row 1 of Regina, there is no seasonal percentage, so the base value is entered into the winter column with no change. For hex row 4, we subtract 13 (50% of -26°) to the base value (9) to get -4 for the winter value.

Nighttime: The nighttime column is done like the daytime column. You have previously determined the rotation modifiers for the world. Jot down the nighttime value above this column for easy reference. Then in each row, add that value to the value from the winter column, giving the winter nighttime low temperature.

TEMPERATURE WORKSHEET: REGINA, axial tilt 26°

Hex Row	Modifier	Base: 9°	Seasonal	Summer: +16°	Daytime: +5	Winter: -26	Nighttime: -7
1	+21	30	—	30	35	30	23
2	+14	23	—	23	28	23	16
3	+7	16	25%	20	25	9	2
4	0	9	50%	17	22	-4	-11
5	-7	2	75%	14	19	-17	-24
6	-14	-5	100%	11	16	-31	-38
7	-21	-12	100%	4	9	-38	-45
8	-28	-19	100%	-3	2	-45	-52
9	-35	-26	100%	-10	-5	-52	-59
10	-42	-33	100%	-17	-12	-59	-66
11	-49	-40	100%	-24	-19	-66	-73

Permanent ice cap starting at hex row 9.

Using the Temperature Worksheet: Once the worksheet is filled out, it gives you summer daytime highs and winter nighttime lows for each hex row. Spring mornings, fall evenings, and other combinations can be interpolated from these values.

The temperature worksheet also shows the permanent freezing line at a glance. Look for the first row with all negative values in the four righthand columns. Permanent ice caps start at that row.

Altitude: Mountains or plateaus have cooler temperatures than low-lying regions. As elevation increases, temperature declines. The standard "lapse rate" is -1°C per 200 meters elevation above surface level. Conversely, temperatures in depressions increase at the same rate.

Bodies of Water: The presence of a significant body of water moderates temperature extremes. A large body of water within 5km of a given point reduces summer temperatures by 1D degrees, and raises winter temperatures by 1D degrees. The roll should be made at the start of a given season, and be fairly constant through that season.

Also, each day, temperatures are reduced 1D degrees near water, and raised 1D degrees at night. This is determined each day and each night.

Other Variations: These rules, in combination, should be considered only as general guidelines. It is up to the referee to create essentially random variations, unseasonal conditions, and so forth (but always within reason).

OVERCAST & PRECIPATATION

Hydrographics Factor	*Cloudiness Percentage*				*Overcast Factor*				*Precipitation Factor*			
	Atm 0-3	*Atm 4-9*	*Atm A-D,F*	*Atm E*	*Atm 0-3*	*Atm 4-9*	*Atm A-D,F*	*Atm E*	*Atm 0-3*	*Atm 4-9*	*Atm A-D,F*	*Atm E*
0	0	0	40	0	0	0	4	0	0	0	4	0
1	0	0	40	0	1	1	5	0	1	1	5	0
2	10	10	50	5	2	2	6	1	2	2	6	1
3	10	10	50	5	3	3	7	1	4	4	8	2
4	20	20	60	10	4	4	8	2	5	5	9	2
5	20	30	70	15	4	5	9	2	5	6	10	3
6	20	40	80	20	4	6	10	3	5	7	11	3
7	20	50	90	25	4	7	11	3	5	8	12	4
8	20	60	100	30	4	8	12	4	5	9	13	4
9	20	70	110	35	4	9	13	4	5	10	14	5
A	20	70	120	35	4	10	14	5	5	11	15	5

Modifications to Overcast and Precipitation Factors:
+2 if full ocean hex
+1 if winter season
+1 if costal, jungle/rainforest hex
-1 if tundra, ice sheet hex
-3 if desert hex

CLIMATE AND WEATHER

Other effects of climate and weather can be developed from the basic data on temperatures, although some abstraction is necessary to keep weather rules manageable.

Seasons: The world's axial tilt is usually the main determinant of seasonal variations. It should be remembered, first, that only the seasonal latitudes experience seasonal variations, and, second, that the northern hemisphere's winter corresponds to the southern hemisphere's summer, and vice versa. (Seasons caused strictly by orbit or by a multiple star system's celestial mechanics will affect the world uniformly, however).

Seasons cause the temperature effects given in item 20, "Axial Tilt Modifiers" on the World Profile form. In addition, the onset of winter and the beginning of summer will both be periods of increased storminess. Average temperatures can be determined for summer and winter, and interpolated for seasons in between, for locations at various latitudes.

Precipitation and Cloudiness: Precipitation and cloudiness are based on a world's hydrographic percentage and atmosphere. Refer to the Overcast and Precipitation Table. The cloudiness percentage tells how much of the world appears covered by clouds when viewed from space. The overcast factor and the precipitation factor give the basic chance that a particular hex is overcast or is experiencing precipitation.

Each day, cloud cover or precipitation will occur in a given hex on a roll of less than the appropriate factor. The precipitation modifiers table gives the DMs for season and terrain. Precipitation will be rain or snow, depending on the temperature. If precipitation is occurring, clouds are automatically present. The intensity and duration of precipitation is given on the Weather Intensity and Duration Table. Feel free to develop specific tables for specific worlds.

WEATHER INTENSITY AND DURATION

Die	*Storm Intensity*	*Die*	*Storm Duration*
2–	Light, intermittent (duration DM +3)	2–	1D hours
3	Light, intermittent (duration DM +3)	3	1D hours
4	Light, steady (duration DM +2)	4	1D hours
5	Light, steady (duration DM +2)	5	1D x 2 hours
6	Moderate, intermittent (duration D M +1)	6	1D x 3 hours
7	Moderate, intermittent (duration D M +1)	7	1D x 3 hours
8	Moderate, steady (no duration DM)	8	1D x 3 hours
9	Moderate, steady (no duration DM)	9	1D x 6 hours
10	Violent, intermittent (duration DM -1)	10	1D x 6 hours
11	Violent, steady (duration DM -3)	11	1D x 12 hours
12+	Cyclonic (DM -5)	12+	1D days

Roll first for storm intensity, and then for storm duration, applying the duration DM.

GEOLOGIC ACTIVITY

Quakes and volcanoes can't be ignored when they occur. But when is that, and what are the effects?

Seismic Quakes: Seismic quakes of enough intensity to be noteworthy are not common, but do happen from time to time.

The basic chance of having a quake occur in any particular hex during a 24-hour period is determined as follows. A roll of 4D is made once each standard day, with the planetary stress factor added to the number. Additional modifiers are applied to rolls made in specific hexes. A DM+2 is added if the hex is on a transverse plate boundary; DM+2 is added if the hex is volcanic. If the final result is 32+, there will be a seismic quake in that hex during that day.

The quake is a major one if a roll of less than or equal to the planet's stress factor is then made; otherwise the quake is considered minor.

A major quake has a magnitude of 2D-2; a minor quake has a magnitude of 1D-1. The magnitude of a quake determines the danger it represents to characters caught in it.

Quake Effects: Each character is "hit" by the quake if a roll on 2D of less than or equal to the quake magnitude is made against that character. A saving throw of dexterity or less is permitted to enable the character to avoid the hit; if the throw is failed, he will suffer damage. Quakes cause 2D damage.

Characters in structures or vehicles when a quake occurs must check for hits three times, rather than once. If they are undertaking some hazardous activity, the occurrence of a quake may be cause for even more danger (more rolls) at the referee's discretion.

Timing and Aftershocks: The referee is responsible for timing quakes. A random timing system might divide a day into six equal intervals, randomly chosen by 1D, and then go on to further subdivisions as needed.

A major quake will be followed by a number of "aftershocks" equal to the quake's magnitude, over a period of 2D hours following the initial quake. Again, timing is up to the referee. Minor quakes do not produce aftershocks.

Volcanic Eruptions: A volcano may be active or dormant. Roll 3D once per standard year; the volcano is active on a roll of the planetary stress factor or less.

An active volcano will be in an eruption period if a throw of 4D plus the world's stress factor is 32+. This roll needs to be made only if a party is specifically visiting an area around a volcano. Notice also that if the stress factor is 7-, volcanoes may be active yet never erupt. In this case, implement 1D-1 minor quakes per day.

For each volcano in an eruption period, determine magnitude (2D-2) and duration (2D-2 x magnitude in standard days). In actual fact, the volcano will not be erupting constantly, but rather displaying intermittent activity. Every 24 hours, roll 2D; a result less than or equal to the magnitude of the eruption indicates that the referee should consult the Eruption Activity Table, which yields results such as quakes, gas, ash and cinders, and lava flows. If the roll is greater than the magnitude, 1D-1 minor quakes occur instead.

ERUPTION TABLE

Die	*Eruption Activity*
2-3	Lava flow, cinders & ash, 1D minor quakes
4-5	Gas cloud, 1D minor quakes
6-8	Cinders & Ash, 1D minor quakes
9-10	Cinders & Ash, gas cloud, 1D minor quakes
11-12	Lava flow, gas cloud, 1D minor quakes

Eruption Effects: Seismic quakes are handled as discussed above. Gas clouds taint the atmosphere for 2D + magnitude kilometers away from the volcano (the referee may designate a "downwind" direction); persons without filter masks will suffer 2D damage per hour in such gas clouds. Cinders and ash will rain down over a radius in kilometers equal to the eruption's magnitude. Over the course of several hours, cinders may accumulate to a depth of 1D x .3 meters. Unprotected individuals suffer 1 point of damage per combat round from exposure to this rain of hot ash.

Molten lava will flow from the mountainside at a steady, relentless speed of 5 kph (S1 in Traveller terms), for a period of hours equal to the magnitude of the eruption. Lava does 3D damage per round to anyone caught in it. Protective gear may block or lessen such damage. Wheeled vehicles cannot maneuver on molten or recently hardened lava because of the heat effects on tires.

Predicting or Controlling Seismic Activity: Reliable quake prediction appears at tech level 8; warnings of imminent quake activity or volcanic eruptions may be available. At tech level 8 and above, whenever a quake is rolled, roll less than tech level on 2D to predict the quake. If the roll succeeds, delay implementation of the quake, and warn the characters that it will occur.

At tech level 10, controlling quakes is often possible. On a 3D roll for technology or less, the magnitude of a quake can be reduced by an amount equal to the tech level divided by 2 (round fractions down). The roll must be made individually for various quakes. A DM-1 is allowed if the population of a city in the quake hex is 6+.

RESOURCES

When a party of characters arrives at a world, they will often want to buy or sell various commodities. The information generated on resources is used for these exchanges.

How Resources Are Used: Resources which are present on a world can be rolled up on the Trade and Speculation Table with a purchase price DM of -2; the resale price DM is also -2 for commodities from that world (in addition to normal modifiers). Resources indicated as being unavailable on a world have purchase and resale price DMs of +4 each.

The referee should compile a list of available and unavailable resources for each world if trade and commerce is to be a major facet of the campaign. Resource presence can be freely ignored, however, by those who don't want to take the time.

Fully detailing all resource locations is a task of enormous magnitude. Only the most avid will even consider a hex-by-hex (or even a triangle-by-triangle or continent-by-continent) breakdown of resources. The investment of time and effort is far beyond the possible profits of such a move. However, the ability to determine presence of resources on a case by case basis can be useful in setting up prospecting ventures or judging the nature of local industry.

CITIES AND SPACE FACILITIES

Many worlds have more than one starport, and there can be many reasons why a party of characters will prefer one over another.

Landing at World Starports and Spaceports: It is usually possible to land at ports other than the main starport on a world. However, throw higher than the law level on 2D to obtain permission to do this, to represent quarantine restrictions or other special cases.

SURFACE MOVEMENT RATES

The Transportation Movement Rates Table shows basic movement rates for various forms of transport. If the mode of transportation is affected by terrain, multiply the basic rate by the multiplier shown on the Terrain Effects on Movement Table. The Weather Effects on Movement Table shows speed effects and suggested UTP rolls to succeed at safely maneuvering under various weather conditions.

TERRAIN EFFECTS ON MOVEMENT

Terrain Type	*Multiplier*
Jungle/rainforest	0.8
Desert	0.8
Tundra	0.8
Ice Sheet	0.6
Rugged/mountain	0.6
River	as other terrain in hex
Ocean/sea	water vehicle only
All other	1.0

TRANSPORATION MOVEMENT RATES

Mode of Transportation	*Hourly(km)*	*Daily(km)**	*Weekly(km)*	*Affected by Terrain*
Foot/Beast of burden/Cart	5	40	280	Yes
Raft/Sailing vessel (water only)	0-10	40	420	—
Steamship (water only)	30	240	2500	—
Motorboat (water only)	60	480	5000	—
Submersible (water only)	40	320	3350	—
Destroyer (water only)	40	320	3350	—
Ground Car (road)	100	800	8400	Yes
Ground Car (off-road)	10	80	840	Yes
ATV/AFV (wheeled, road)	60	480	5000	Yes
ATV/AFV (wheeled, off-road)	20	160	1700	Yes
ATV/AFV (tracked)	35	280	2900	Yes
Hovercraft	60	480	5000	Yes†
Grav Vehicles	100	800	8400	No
Grav Speeder	1000	8000	unlimited	No
Fixed-wing Aircraft	600	4800	unlimited	No
Helicopter	200	1600	17,000	No
Space Vessel	1000	8000	unlimited	No

*Daily Rate is based on 8-hour days. All modes of transportation (except Foot/Beast of burden/Cart) can have shifts which operate the vehicle for up to 24 hours, allowing a distance of up to 3 times the daily rate to be traversed.

Weekly Rate is an average figure; actual distance can be up to twice as far.

†The Hovercraft is a special case for terrain movement modifiers; in rugged terrain the movement modifier is 0.1, and mountains are prohibited entirely. All other terrain modifiers apply as normal.

OTHER EFFECTS OF WORLD DATA ON PLAY

Referees should use this section to give their players the feeling of adventuring on a truly different planet. How do surface gravity, atmosphere, and hydrosphere affect players?

Gravity: Most regular ship runs adjust their gravity gradually in jump space to accustom their passengers to the gravity of the destination world. An unplanned stop will have no such preparation. Correct response to new gravity takes two weeks to develop at minimum. Marksmanship requires 1D-skill weeks (minimum 2) of daily practice to restore full proficiency. Scouts and Marines in active service may waive this rule.

Lower gravity than characters are used to will cause them to aim high and lose footing easily (-1 to -3 on dexterity depending on percentage difference of gravities). Lower gravity increases projectile weapon range dramatically. It also reduces potential damage from falls and increases payload capacity on air/rafts and muscles

Higher gravity also reduces dexterity. Endurance is reduced in proportion to the gravity difference. Aim will be too low until players adjust. Damage from falls increases proportionately to gravity. Payloads of grav vehicles decrease.

Trace gravity rules can be found in *Belter* (GDW Boxed Module). Tiny bodies may actually allow a bullet to achieve orbit or escape velocity. (Don't shoot yourself in the back.)

Atmosphere: Adjustments to atmosphere of the destination planet are limited. Thin atmospheres are breathable, but very thin atmospheres require using a compressor and dense atmospheres may require using a reducer. Native life on thin atmosphere worlds will have means of preventing moisture loss through the outer surfaces. Radiation is stronger through a thinner atmosphere and mutation is more likely.

Dense atmospheres have much more powerful winds than standard atmospheres have, with 3 to 10 times more kinetic energy. Operation of air vehicles is more hazardous in dense atmospheres. Storms are more devastating and dangerous. Dense atmospheres also cause distortion of light, which may affect the aiming of weapons. In dense atmospheres, divide by the atmospheric pressure to get the maximum laser range.

Magnetic Fields: Molten-core bodies and gas giants have magnetic fields which divert radiation from their surfaces and allow the use of compasses. Rocky and icy bodies have no magnetic fields, so they have higher background radiation. See equipment section for data on self-precessing gyrocompasses.

Multiple Star Systems: Binaries rarely create the dramatic effects pictured in fiction. A distant binary companion will supply no more light than a large moon and look like no more than a bright star. Closer binaries are treated as gravitational points for purposes of planetary orbit, so both will usually be in the sky at the same time.

WEATHER EFFECTS ON MOVEMENT

Intensity of Storm	*Foot*	*Ground Vehicle*	*Water Vehicle*	*Air & Grav Vehicle*
Light, intermittent	none	none	none	none
Light, steady	none	none	none	none
Moderate, intermittent	none	none	a1	1
Moderate, steady	a1	a1	a2	2
Violent, intermittent	b4	a2	a5	5
Violent, steady	b5	b2	b6	6
Cyclonic	c6	c3	d7	7

Speed Effects:

a Speed reduced to 75% of normal
b Speed reduced to 50% of normal
c Speed reduced to 25% of normal
d Speed reduced to 0; move with storm

Suggested Tasks:

1 ROUTINE, [vehicle skill], dex, 10 min.
2 DIFFICULT, [vehicle skill], dex, 10 min.
3 FORMIDABLE, [vehicle skill], dex, 10 min.
4 ROUTINE, [vehicle skill], dex, 10 min. (hazardous)
5 DIFFICULT, [vehicle skill], dex, 10 min. (hazardous)
6 FORMIDABLE, [vehicle skill], dex, 10 min. (hazardous)
7 FORMIDABLE, [vehicle skill], dex, 10 min. (hazardous)
REFEREE: Any failure is an automatic mishap.

WORLD PROFILE

1. Date of Preparation
195-1112

2. World Name
Regina

3. Location
Spinward Marches 1910

4. UPP
A | 7 | 8 | 8 | 8 | 9 | 9 | C

PHYSICAL DATA Data describing the world's basic physical attributes in more detail.

5. Diameter
11,960 km

6. Density
1.06 standard

7. Mass
0.71 standard

8. Mean Surface Gravity
0.93 g

9. Rotation Period
25 hrs 31 min 37 sec

10. Orbital Period
423.28 std days (GG —star)
160.08 std days (Regina—GG)

11. Seasons (list)
Winter, Summer (80 days each)

12. Axial Tilt
26° 27' 32"

13. Orbital Eccentricity
0.0

14. Satellites
none

15. Surface Atmospheric Pressure
1.8 atm

16. Atmospheric Composition
Standard oxygen-nitrogen mix

16a. Atmospheric Terraforming? ☐ Yes ☒ No

17. Hydrographic Percentage
82%

18. Hydrographic Composition
Water

18a. Hydrographic Terraforming? ☐ Yes ☒ No

TEMPERATURE Data concerning world surface temperature and various modifiers.

19. Base Mean Surface Temperature
8.7°C

20. Axial Tilt Modifiers
+15.6°C, -26°C

21. Rotation Modifiers
+5.2°C, -6.5°C

22. Latitude Modifiers
±7 per hex row

23. Orbital Eccentricity Modifiers
0.0

24a. Weather Control? ☒ Yes ☐ No
24b. Greenhouse Effect Terraforming? ☐ Yes ☒ No
24c. Albedo Terraforming? ☐ Yes ☒ No

25. Other Modifiers
none

MAPPING DATA Data describing the details of a world's makeup which affect world mapping.

26. Num. of Tectonic Plates
3

27a. Native Life? ☒ Yes ☐ No
27b. Terrain Terraforming? ☐ Yes ☒ No

28. Major Continents
4

29. Minor Continents
3 7 major islands
7 archipelagoes

30. Major Oceans
world

31. Minor Oceans
world

---

32. World Name
Regina

SEISMIC DATA Data indicating the relative likelihood of seismic activity.

33. Stress Factor
5

34. Notable Volcanoes
6

RESOURCES Data indicating the presence of resources of various kinds.

35. Natural Resources (list)
Agricultural, Ores, Gems, Petrochemicals

36. Processed Resources (list)
Agricultural, Agroproducts, Alloys

37. Manufactured Products (list)
Mechanical, Gravitics, Heavy Equipment, Electronics

POPULATION & PORTS Describe the world's population centers and space facilities in detail.

38. World Population
725,000,000

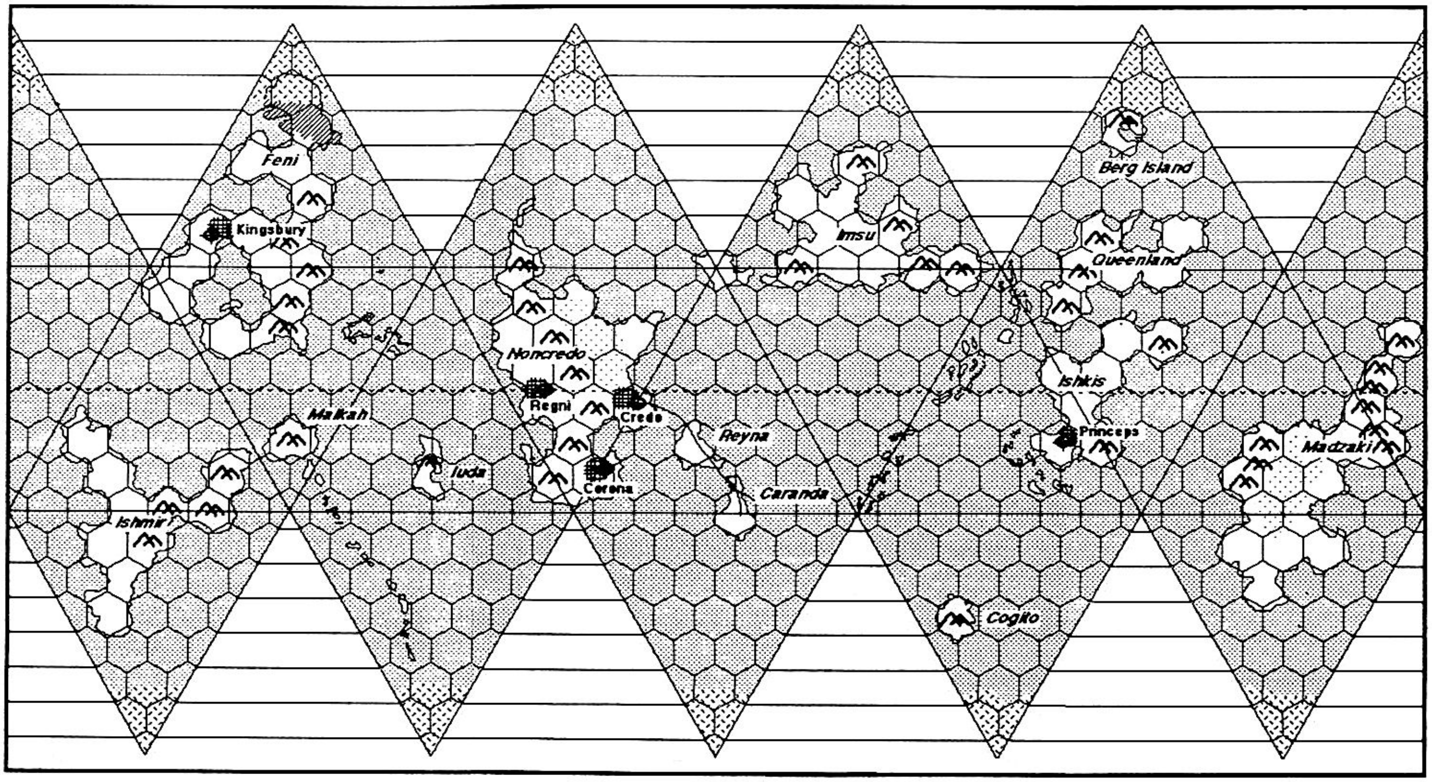
39. Primary Cities (list name, population, and starport type)

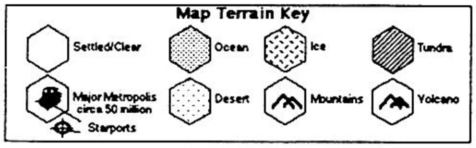
Credo	90,000,000	A
Princeps	70,000,000	A
Regni	50,000,000	A
Kingsbury	80,000,000	B
Corona	60,000,000	B

40. Secondary Cities (list number of cities, their population level, and their typical spaceport type)
53 cities, circa 5 million, class F spaceport

41. Tertiary Cities (list number of cities, their population level, and their typical spaceport type)
85 cities, circa 500 thousand, class H spaceport

3 orbital complexes, circa 5,000 (Class A starport); 1 orbital station, circa 500 (class B&F)





Regina A-788899-C 1 hex=1074 km

✻ *Table 6.1*

GENERAL WORLD TYPE

(non-Gas Giant)

Die Roll	*WorldType*
2-10	Molten Core
11-14	Rocky Body
15+	Icy Body

Modifiers:

If size 4-, DM+1
If size 6+, DM-2

If atm 0-3, DM+1
If atm 6+, DM-2

When using Scouts:
If outer zone, DM+6

✻ *Table 6.2*

MEAN WORLD DENSITY (K)

Die Roll (3D)	*World Type*			
	Molten Core	*Rocky Body*	*Icy Body*	*Gas Giant*
3	.82	.50	.18	.10
4	.84	.52	.20	.11
5	.86	.54	.22	.12
6	.88	.56	.24	.13
7	.90	.58	.26	.14
8	.92	.60	.28	.16
9	.94	.62	.30	.18
10	.96	.64	.32	.20
11	.98	.66	.34	.22
12	1.00	.68	.36	.23
13	1.02	.70	.38	.24
14	1.04	.72	.40	.26
15	1.06	.74	.42	.27
16	1.08	.76	.44	.28
17	1.10	.78	.46	.29
18	1.12	.80	.48	.30

Molten Core: World has a metallic molten core surrounded by a cooler crust.
Rocky Body: World has a cool, rocky core and crust.
Icy Body: World is composed of ices, with few or no rocky components.
Gas Giant: A large planet (20,000 to 120,000 km diameter) composed primarily of hydrogen and hydrogen compounds. May or may not have a core of solid matter.

Table 9

ROTATION PERIOD

Special Cases

Die Roll	*Rotation*
2	1Dx10 days (retrograde)
3	1Dx20 days
4	1Dx10 days
5	use basic rotation
6	tidal lock
7	tidal lock
8	tidal lock
9	use basic rotation
10	1Dx10 days
11	1Dx50 days
12	1Dx50 days (retrograde)

Table 12

AXIAL TILT

Die Roll	*Basic Axial Tilt*
2 - 3	0° + (2D-2)°
4 - 5	10° + (2D-2)°
6 - 7	20° + (2D-2)°
8 - 9	30° + (2D-2)°
10-11	40° + (2D-2)°
12	roll 1D below...
	1-2 50° + (2D-2)°
	3 60° + (2D-2)°
	4 70° + (2D-2)°
	5 80° + (2D-2)°
	6 90°

Table 13

ORBITAL ECCENTRICITY

Die Roll	*Eccentricity*
2-7	0.000
8	0.005
9	0.010
10	0.015
11	0.020
12	roll 1D below...
	1 0.025
	2 0.050
	3 0.100
	4 0.200
	5 0.250
	6 extreme: referee's choice

Table 42

USEFUL MAPPING FORMULAS & DATA

Circumference of a Sphere: Diameter x 3.14159
Hex Scale in Miles: Circumference divided by 35
Converting Miles to Kilometers: Multiply by 1.6
Converting Kilometers to Miles: Divide by 1.6
Total Number of World Map Hexes: 500
Total Number of Hexes Per Triangle: 25

Table 43

SIZE OF TECTONIC PLATES

Die	*Size in Hexes*
1	2D x 5
2	2D x 10
3	2D x 15
4	2D x 20
5	2D x 25
6	2D x 30

Table 15

SURFACE ATMOSPHERIC PRESSURE (in atm)

	----------Atmosphere Type----------					
Die Roll	*Trace (1)*	*Very Thin (2-3)*	*Thin (4-5)*	*Standard (6-7)*	*Dense (8-9)*	*Very Dense (*see note)*
2	0.01	0.10	0.43	0.76	1.50	2.50
3	0.05	0.12	0.45	0.80	1.60	5.00
4	0.05	0.14	0.48	0.85	1.70	10.00
5	0.06	0.16	0.50	0.90	1.80	25.00
6	0.06	0.18	0.50	0.95	1.90	50.00
7	0.07	0.20	0.50	1.00	2.00	100.00
8	0.07	0.23	0.55	1.00	2.00	150.00
9	0.07	0.25	0.60	1.10	2.20	200.00
10	0.08	0.30	0.65	1.20	2.20	250.00
11	0.08	0.35	0.70	1.30	2.40	500.00
12	0.09	0.40	0.75	1.40	2.40	750.00

*Very Dense atmospheres occur in the Atmospheric Composition table or in atmosphere types D and E.

Table 16

ATMOSPHERIC COMPOSITION

	----------Atmosphere Type----------			
Die Roll	*Tainted (2,4,7,9)*	*Exotic (A)*	*Corrosive (B)*	*Insidious (C)*
2	Disease	Very Thin, Irritant	Below -100°C	Gas Mix
3	Gas Mix	Very Thin	Very Thin,-100°C to -25°C	Gas Mix
4	High Oxygen	Thin	Very Thin,-25°C to 50°C	Radiation
5	Pollutants	Thin, Irritant	Very Thin, 50°C to 100°C	Temperature
6	Sulfur Compounds	Standard	Normal,-200°C to -25°C	Pressure
7	Pollutants	Standard, Irritant	Normal,-25°C to 50°C	Gas MIx
8	Sulfur Compounds	Dense	Normal, 50°C to 100°C	Pressure
9	Pollutants	Dense, Irritant	Very Dense,-200°C to -25°C	Temperature
10	Low Oxygen	Very Dense	Very Dense,-25°C to 50°C	Radiation
11	Gas Mix	Very Dense, Irritant	Very Dense, 50°C to 100°C	Gas Mix
12	Disease	Occasional Corrosive	Over 100°C	Gas Mix

Table 19

TEMPERATURE EFFECTS

2300° C	Upper limit for solid planets (planet vaporized).
1535° C	Melting point of iron.
327° C	Melting point of lead.
100° C	Water boils.
50° C	Upper limit of human habitability.
37° C	Physical strain on human body.
30° C	Upper limit of human comfort.
25° C	Upper limit of optimum human "room temperature".
18° C	Lower limit of optimum human "room temperature".
15° C	Base Mean Surface Temperature for Terra.
6° C	Minimum for crop growing season on most worlds.
0° C	Lower limit of human comfort.
-5° C	Crop "killing frost" temperature on most worlds.
-20° C	Lower limit of human habitablity.
-36° C	Hardy plants killed on most worlds.
-78° C	Carbon dioxide solidifies to form dry ice.
-183° C	Liquid oxygen boils.
-196° C	Liquid nitrogen boils.
-273° C	Absolute Zero.

Table 45

SEASONAL LATITUDES (HEX ROWS)

Axial Tilt	*100%*	*75%*	*50%*	*25%*
0°	—	—	—	11
1°	—	—	11	10
2°–3°	—	11	10	9
4°–5°	11	10	9	8
6°–8°	10,11	9	8	7
9°–12°	9–11	8	7	6
13°–16°	8–11	7	6	5
17°–22°	7–11	6	5	4
23°–28°	6–11	5	4	3
29°–34°	5–11	4	3	2
35°–44°	4–11	3	2	1
45°–59°	3–11	2	1	—
60°–84°	2–11	1	—	—
85°+	1–11	—	—	—

Table 35

NATURAL RESOURCES

	Density			Atmosphere		Population		Technology				Native Life		Terrain				
Resource	*Molten Core*	*Rocky Body*	*Icy Body*	*Atm 4-9*	*Atm 0-3,A+*	*Pop 0-4*	*Pop 5+*	*Tech 0-3*	*Tech 4-6*	*Tech 7-11*	*Tech 12+*	*Life**	*No Life**	*Desert*	*Volcanic*	*Settled*	*City*	*Other*
Agricultural	+4	+4	-4	+1	- 3	0	0	+1	0	- 1	- 2	+5	0	-10	0	0	-5	-3
Ores	+7	+3	0	0	+1	0	0	+1	0	- 1	- 2	0	0	0	+1	0	0	0
Radioactives	+5	+3	0	0	+1	0	0	+1	0	- 1	- 2	0	0	0	0	0	0	0
Gems & Crystals	+5	+2	0	0	0	0	0	+1	0	- 1	- 2	0	0	0	+5	0	0	0
Petrochemicals	+4	+1	-4	0	- 3	0	0	+1	0	- 2	- 2	+5	- 5	0	0	0	0	0

**Life, No life:* "Life" refers to life native to the world

Natural Agricultural:	Wood, Meat, Spices, Fruit
Natural Ores:	Copper, Tin, Silver, Aluminum
Natural Radioactives:	Radioactives
Natural Gems & Crystals:	Crystals, Gems
Natural Petrochemicals:	Petrochemicals

Table 36

PROCESSED RESOURCES

	Density			Atmosphere		Population		Technology				Native Life		Terrain				
Resource	*Molten Core*	*Rocky Body*	*Icy Body*	*Atm 4-9*	*Atm 0-3,A+*	*Pop 0-4*	*Pop 5+*	*Tech 0-3*	*Tech 4-6*	*Tech 7-11*	*Tech 12+*	*Life**	*No Life**	*Desert*	*Volcanic*	*Settled*	*City*	*Other*
Agricultural	+5	+5	0	+5	-5	+1	+2	-1	0	+1	+1	+5	0	-10	0	0	-5	-10
Alloys	+4	+4	-1	0	-5	-1	+1	-2	-1	0	+1	0	0	-3	+1	-5	0	-3
Agroproducts	+4	+4	-1	+3	-5	0	+1	-1	0	+1	+2	+5	0	-10	0	0	-5	-10

**Life, No life:* "Life" refers to life native to the world

Processed Agricultural:	Liquor, Grain
Processed Alloys:	Steel, Special Alloys
Processed Agroproducts:	Textiles, Polymers, Pharmaceuticals

Table 37

MANUFACTURED RESOURCES

	Density			Atmosphere		Population		Technology				Native Life		Terrain				
Resource	*Molten Core*	*Rocky Body*	*Icy Body*	*Atm 4-9*	*Atm 0-3,A+*	*Pop 0-4*	*Pop 5+*	*Tech 0-3*	*Tech 4-6*	*Tech 7-11*	*Tech 12+*	*Life**	*No Life**	*Desert*	*Volcanic*	*Settled*	*City*	*Other*
Weapons	+4	+4	-1	0	0	-1	+1	0	+1	+3	+5	0	0	-10	0	-5	0	-10
Mechanical Parts	+4	+4	-1	0	0	-1	+1	0	+1	+2	+3	0	0	-10	0	-5	0	-10
Heavy Equipment	+4	+4	-1	0	0	-1	+2	0	+1	+2	+3	0	0	-10	0	-5	0	-10
Electronics	+4	+4	-1	0	0	-1	+1	-10	-10	+2	+4	0	0	-10	0	-5	0	-10
Gravitics	+4	+4	-1	0	0	-1	+1	-10	-10	+1	+2	0	0	-10	0	-5	0	-10

**Life, No life:* "Life" refers to life native to the world

Manufactured Weapons:	Firearms, Ammunition, Blades, Body Armor
Manufactured Mechanical Parts:	Tools, Mechanical Parts, Vacc Suits
Manufactured Heavy Equipment:	Aircraft, ATV, AFV, Machine Tools, Farm Machinery
Manufactured Electronics:	Computers, Electronic Parts, Cybernetic Parts, Computer Parts
Manufactured Gravitics:	Air/Rafts

Table 27

WIDE SCALE TERRAFORMING†

	Size					Atmosphere		Hydrosphere				Population			Technology				Native Life	
Forming Type	*Size 1,2*	*Size 3,4*	*Size 5,6*	*Size 7,8*	*Size 9+*	*Atm 0*	*Atm C*	*Hyd 0*	*Hyd 1-4*	*Hyd 5-9*	*Hyd A*	*Pop 0-4*	*Pop 5-7*	*Pop 8+*	*Tech 0-4*	*Tech 5-8*	*Tech 9-11*	*Tech 12+*	*Life**	*No Life**
Terrain	+4	+3	+2	+1	0	-4	0	+1	0	0	0	-2	0	+3	-10	+1	+3	+4	0	+3
Hydrosphere	+2	+1	0	-1	-2	-4	0	0	+1	+1	0	-2	0	+2	-10	+1	+2	+3	0	+3
Albedo	+2	+1	0	-1	-2	-5	0	+2	0	0	+1	-2	0	+2	-10	+1	+2	+3	-2	+2
Greenhouse	+2	+1	0	-1	-2	-5	-5	+1	0	+1	+2	-2	0	+2	-10	+1	+2	+2	-2	+2
Atmosphere	+2	+1	0	-1	-2	-5	-5	-1	0	0	+1	-3	0	+1	-10	-1	+1	+2	-4	+2

**Life, No life:* "Life" refers to life native to the world

† At least one hex on the world map has been affected by massive terraforming efforts

Table 28

CONTINENTS TABLE

(use when hydrographic percentage is 50% to 99%)

Die	*Major Continents*	*Minor Continents*	*Mapping Details*
16	2D+1	1D-1	3D-3 Major islands, 2D archipelagoes
17	2D+1	2D-2	3D-3 Major islands, 2D archipelagoes
18	2D+1	3D-3	3D-3 Major islands, 2D archipelagoes
19	2D	1D-1	3D-3 Major islands, 2D archipelagoes
20	2D	2D-2	3D-3 Major islands, 2D archipelagoes
21	2D	3D-3	3D-3 Major islands, 2D archipelagoes
22	1D	1D-1	3D-3 Major islands, 2D archipelagoes
23	1D	2D-2	3D-3 Major islands, 2D archipelagoes
24	1D	3D-3	3D-3 Major islands, 2D archipelagoes
25	1D-1	1D	3D-3 Major islands, 2D archipelagoes
26	1D-1	2D	3D-3 Major islands, 2D archipelagoes
27	1D-1	3D	3D-3 Major islands, 2D archipelagoes
28	1D-2	1D-1	3D-3 Major islands, 2D archipelagoes
29	1D-3	1D-2	3D-3 Major islands, 2D archipelagoes
30	1D-4	1D-3	2D Major islands, 2D archipelagoes
31	0	0	1D-3 Major islands, 2D archipelagoes
32	0	0	Archipelagoes
33	0	0	Archipelagoes
34	0	0	Archipelagoes
35	0	0	No significant land surface
36	0	0	No significant land surface

Roll 1D + (UPP hydrographic code x 3)

Table 30

OCEANS TABLE

(use when hydrographic percentage is 1% to 49%)

Die	*Major Oceans*	*Minor Oceans*	*Mapping Details*
1	0	0	No significant water surface
2	0	0	No significant water surface
3	0	0	Scattered lakes
4	0	0	Scattered lakes
5	0	0	Scattered lakes
6	0	0	1D-3 Small seas, 2D scattered lakes
7	1D-4	1D-3	2D-3 Small seas, 2D scattered lakes
8	1D-4	1D-2	3D-3 Small seas, 2D scattered lakes
9	1D-3	1D-1	3D-3 Small seas, 2D scattered lakes
10	1D-3	1D-1	3D-3 Small seas, 2D scattered lakes
11	1D-2	1D-1	3D-3 Small seas, 2D scattered lakes
12	1D-2	2D-2	3D-3 Small seas, 2D scattered lakes
13	1D-1	1D-1	3D-3 Small seas, 2D scattered lakes
14	1D-1	2D-2	3D-3 Small seas, 2D scattered lakes
15	1D-1	3D-3	3D-3 Small seas, 2D scattered lakes
16	1D	1D-1	3D-3 Small seas, 2D scattered lakes
17	1D	2D-2	3D-3 Small seas, 2D scattered lakes
18	1D	3D-3	3D-3 Small seas, 2D scattered lakes
19	1	1D-1	3D-3 Small seas, 2D scattered lakes
20	1	2D-2	3D-3 Small seas, 2D scattered lakes
21	1	3D-3	3D-3 Small seas, 2D scattered lakes

Roll 1D + (UPP hydrographic code x 3)

Table 21

ROTATION TEMPERATURE EFFECTS

	----------Daytime----------		----------Nighttime----------	
Atm Pressure	*+ per hour*	*absolute limit*	*- per hour*	*absolute limit*
None (0)	1.0° C	(Base+273) x 0.1	20.0° C	(Base+273) x 0.80
Trace (1)	0.9° C	(Base+273) x 0.3	15.0° C	(Base+273) x 0.70
Very Thin (2,3)	0.8° C	(Base+273) x 0.8	8.0° C	(Base+273) x 0.50
Thin (4,5)	0.6° C	(Base+273) x 1.5	3.0° C	(Base+273) x 0.30
Standard (6,7)	0.5° C	(Base+273) x 2.5	1.0° C	(Base+273) x 0.15
Dense (8,9)	0.4° C	(Base+273) x 4.0	0.5° C	(Base+273) x 0.10
Very Dense*	0.2° C	(Base+273) x 5.0	0.2° C	(Base+273) x 0.05

Notes:
Base: Base Mean Surface Temperature

Table 44

LATITUDE TEMPERATURE MODIFIERS

Hex Row	*Sise A*	*Size 8,9*	*Size 6,7*	*Size 4,5*	*Size 3,2*	*Size 1*
1	+24	+21	+18	+15	+12	+9
2	+16	+14	+12	+10	+8	+6
3	+8	+7	+6	+5	+4	+3
4	0	0	0	0	0	0
5	-8	-7	-6	-5	-4	-3
6	-16	-14	-12	-10	-8	-6
7	-24	-21	-18	-15	-12	-9
8	-32	-28	-24	-20	-16	-12
9	-40	-35	-30	-25	-20	-15
10	-48	-42	-36	-30	-24	-18
11	-56	-49	-42	-35	-28	-21

Table 39

STARPORTS AND SPACEPORTS

	----------World Starport/Spaceport Class----------									
Die	*A*	*B*	*C*	*D*	*E*	*X*	*F*	*G*	*H*	*Y*
1	D	F	H	H	Y	Y	H	Y	Y	Y
2	C	D	G	H	Y	Y	G	H	Y	Y
3	C	D	F	G	H	Y	G	H	H	Y
4	B	C	F	G	H	H	G	G	H	Y
5	B	C	E	G	H	H	F	G	H	Y
6	B	B	D	E	H	H	F	G	H	Y
7	B	B	C	E	E	H	F	G	H	Y
8	A	B	C	D	E	H	F	G	H	Y

Modifiers:

If city population 6+, DM +1
If city population 8+, DM +2

Table 14

SATELLITE ORBITS

Die	*Close*	*Far*	*Extreme*
2	3	15	75
3	4	20	100
4	5	25	125
5	6	30	150
6	7	35	175
7	8	40	200
8	9	45	225
9	10	50	250
10	11	55	275
11	12	60	300
12	13	65	325

Throw 2D for orbit type (7- is close, 8+ is far; if gas giant, 12+ is extreme). Then throw for orbit distance (in central planet diameters).

INDEX

WORLD MAP GRID

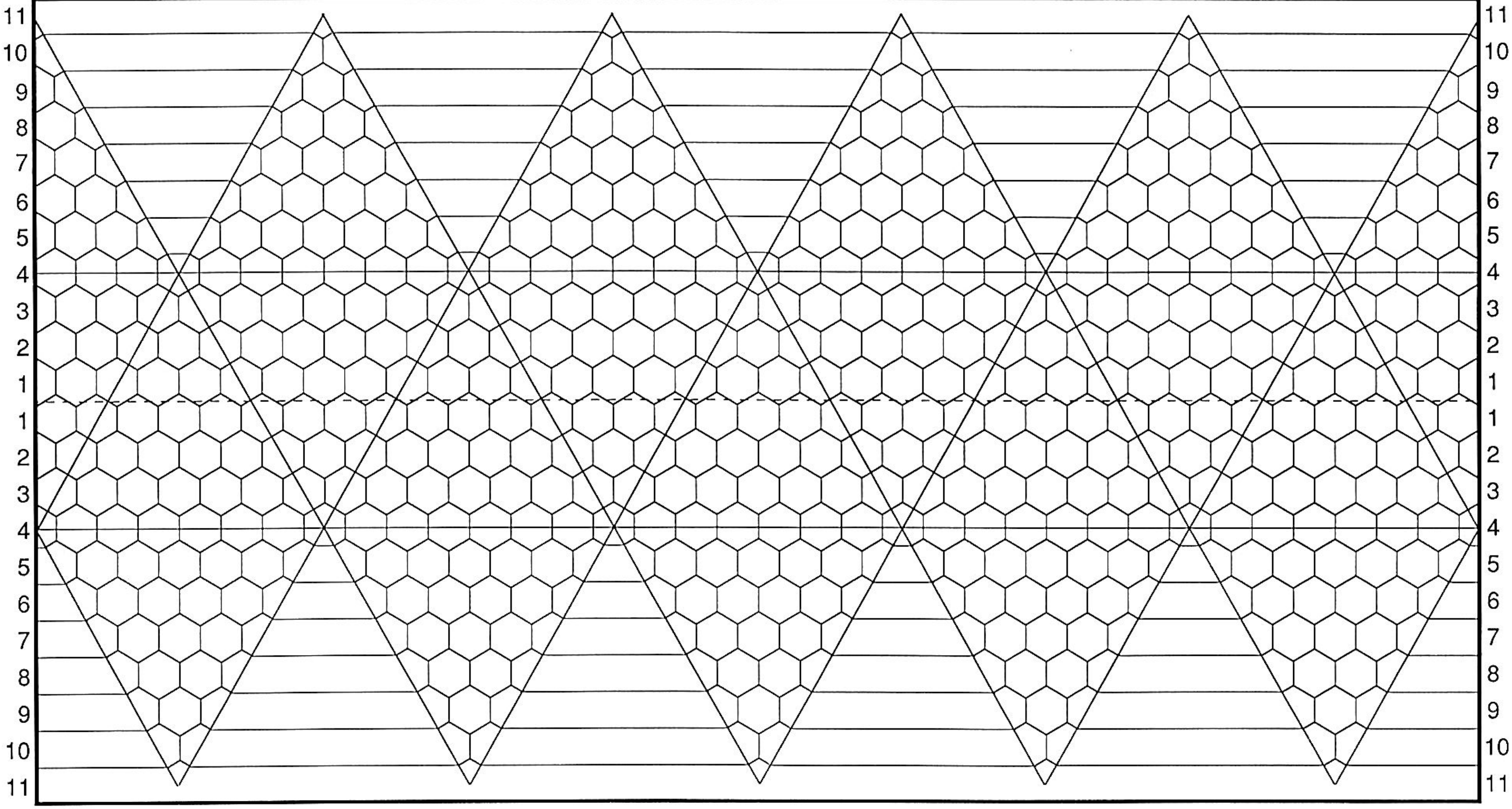
This geodesic map grid divides the spherical surface of any globe into twenty triangles, each of which is further divided into hexagons. Note terrain identities and other planetographic features of the world in these hexagons. Total number of map hexes per triangle: 25. Total number of map hexes: 500.

1. Date of Preparation

2. World Name *(and UPP)* ☐☐☐☐☐☐☐☐

3. Hexagon Scale in Kilometers (circumference divided by 35)

4. Subsector and Sector Location of World



IS Form 21

World Map Grid (Large)

Grand Survey

A State-of-the-Art Supplement Approved for Use With *TRAVELLER*

In the years 420 and 1065, the Imperial Interstellar Scout Service published the First and Second Grand Surveys. Some of their methods, and some of the results of their surveys, have been published before. But now, with the brand-new state-of-the-art material in this book, you can have all the detail you ever wanted.

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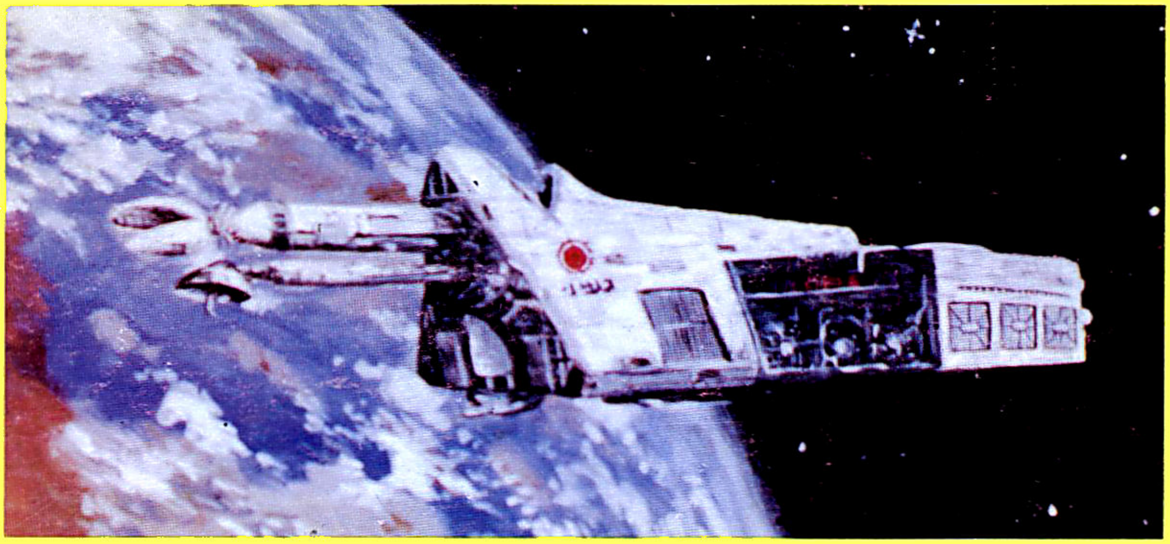
This module is intended for use with ***Traveller.*** It requires that you have a copy of the Traveller rules. You also need at least two six-sided dice, paper, and pencil.



Villemina Donosev held the post of Master Chief Surveyor of the Imperial Grand Survey when the First Survey was published in 420. Her unstinting devotion was instrumental in bringing the hundred-year project to a successful close. When a new class of ship was commissioned for the Second Survey, it was decided to name the *Donosev* Class for her.

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