

**GURPS**

Fourth Edition

# UNDERGROUND ADVENTURES™



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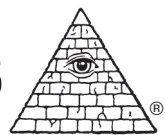
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## About GURPS

Steve Jackson Games is committed to full support of *GURPS* players. Our address is SJ Games, P.O. Box 18957, Austin, TX 78760. Please include a self-addressed, stamped envelope (SASE) any time you write us! We can also be reached by e-mail: [info@sjgames.com](mailto:info@sjgames.com). Resources include:

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*Bibliographies.* Many of our books have extensive bibliographies, and we're putting them online – with links to let you buy the resources that interest you! Go to each book's web page and look for the "Bibliography" link.

*Errata.* Everyone makes mistakes, including us – but we do our best to fix our errors. Up-to-date errata pages for all *GURPS* releases, including this book, are available on our website – see above.

Rules and statistics in this book are specifically for the *GURPS Basic Set, Fourth Edition*. Page references that begin with B refer to that book, not this one.

# INTRODUCTION

*“Here is the cavern, Father.” Antonius Laurens was a tribune in his legion, but he spoke with deference, using his companion’s religious title, as fitted their business.*

*Centurion Mauritius Scipio glanced around with a tactician’s eye and saw no sign of human passage in the undergrowth. This might be private enough for a mithraeum, he thought. Now to see the mystery that young Laurens had hinted at.*

*“Light your lamp, Bridegroom,” he said, “and let’s enter the chamber.”*

*The entryway was steep, and Scipio walked carefully, wishing he had the staff he was named for, to steady his feet. At first, there was nothing to be seen. Then, the lamp’s flicker fell upon the further walls, and what was painted there.*

*Bulls! Marvelously depicted bulls, painted in two colors, like images on a Greek vase – but painted as big as life, or bigger. That one on the far wall might be the very bull that Mithras slew. He gestured for Laurens to follow, and it seemed almost to breathe in the shifting light as they approached it.*

*Might it have already been sanctified to Mithras, long ago? But he saw none of the other images that went with Mithras. Animals other than bulls were there, but not the right ones, and nowhere was Mithras himself. Yet he knew what sort of place this was, and he shivered.*

*“Can we use this place, Father?”*

*Scipio gathered his thoughts. “I know not if it be lawful,” he said. “This place is sanctified, and not sanctified to the Bullslayer. And it is old, for no one has been here in many years. Before we may use it, there must be an offering, to whatever god or goddess dwells here, and we must seek an omen. And if it is not favorable, I think we must leave the place undisturbed.”*

From Paleolithic caves to Parisian sewers, from asteroid mines to the hollow earth, underground locations make perfect settings for adventure. Roleplaying games were born there. Why not go back for a visit?

The realities of underground environments present special challenges, whether you go there in natural caverns, artificial tunnels, or huge subterranean vehicles. **GURPS Underground Adventures** offers information and gaming suggestions on both the facts and the fantasies.

The *facts* include realistic details on subterranean dangers, from narrow passages to poison gases to cave-ins; on technologies for coping with them; and on skills needed to use those technologies. As a larger context for these facts,

there’s a survey of current scientific knowledge of the earth’s interior.

The *fantasy* begins with guidelines for inventing underground adventures and campaigns, and for creating characters who can undertake them. For larger-scale fantasies, there’s a survey of myths, legends, and scientific speculations about the interior of the planet Earth, with suggestions about turning them into campaign settings. Several campaign seeds provide starting points for underground ventures.

Whether you want to design a campaign specifically around an underground setting, include an underground episode in an ongoing campaign, or make the hazards of your dungeon fantasy more vivid and detailed, **Underground Adventures** gives you the resources you need.

For details on specific items of equipment, refer to **GURPS Low-Tech**, **GURPS High-Tech**, or **GURPS Ultra-Tech**. In certain settings, **GURPS Magic** is useful for specifics on spells.

## PUBLICATION HISTORY

A shorter version of **GURPS Underground Adventures** made up one chapter in **GURPS All-Star Jam 2004**, a supplement for **GURPS Third Edition**. This version has been updated to the Fourth Edition and to reflect current geology and technology. It was expanded to provide more skills, more tools, and more speculative ideas. Its new material builds on **GURPS Low-Tech**, **GURPS High-Tech**, **GURPS Ultra-Tech**, **GURPS Magic**, and **GURPS Powers**.

## ABOUT THE AUTHOR

William H. Stoddard is a professional copy editor, specializing in scientific and scholarly books in fields ranging from aerospace technology to archaeology. Fortunately, he likes reading nonfiction; his research library is threatening to take over his apartment, and he regularly visits the nearest university library for supplemental reading. His other pleasures include cooking, reading science fiction and alternate history, and running and playing in roleplaying games, which he has been doing since 1975, when he first encountered **Dungeons & Dragons**. His previous work for Steve Jackson Games includes writing the latest editions of **GURPS Supers** and **GURPS Low-Tech**. He lives in San Diego with his cohabitant Carol, two cats, two computers, and far too many books!

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# CHAPTER ONE

# THE

# FOUNDATIONS

# OF THE EARTH

Real-world explorers can only go a few miles down, into natural caves or artificial tunnels. In a fantasy or weird-science setting, survivable conditions may extend far deeper, into vast caverns or a hollow world, perhaps inhabited by exotic creatures

or civilizations – and intrepid adventurers may explore those realms. Alternatively, superscience or superpowers may grant human beings access to Earth’s interior, as present-day science knows it.

## LEGENDS

Before the birth of science, or even philosophical speculation, human ideas about Earth and the universe took the form of legends. In a mythic-fantasy campaign – or a humorous one – such legends may be real.

*But on what does the tortoise stand? “On another tortoise.”*

*– Rev. J.F. Berg,  
Great Discussion  
on the Origin,  
Authority, and  
Tendency of the Bible*

## THE FLAT EARTH

When a person stands on the ground, the world looks flat; many early civilizations thought it was. On a flat world, what happens if someone keeps traveling in a straight line? Here are three possibilities.

- He reaches the edge and falls off. The world is a huge planar surface – a disc, square, triangle . . .
- He keeps going forever. The world is an endless plane.

- He bumps into walls and has to stop. The world is a house built by the gods; the sky is its roof and walls.

In most flat-earth theories, up and down are the same throughout the cosmos. An infinite-plane world or a houselike world might have an infinitely thick floor. Other flat worlds are relatively thin; ambitious miners might tunnel through! What supports such a flat world is a subject for fanciful stories, such as elephants and turtles holding up the world (like Terry Pratchett’s Discworld).

## CHTHONIAN REALMS

Many cultures have legends about gods of the underworld, or magical beings who live beneath the world’s surface (see *Speleid*, p. 27). These aren’t the same as gods of the earth! The earth is often a goddess, such as the Greek Ge (or Gaia; see *The Gaia Hypothesis*, p. 9) or the Germanic Hertha, and may be associated with fertility; underworld gods, such as the Greek Hades or the Germanic Hel, have different concerns.

In myths where the earth is seen as a house, the underworld is considered its cellar. It may serve as a vault, storing gems and precious metals, or as a dungeon, imprisoning the souls of the dead, as in legends going back to the Mesopotamian *Tale of Gilgamesh*. Underworld gods may be jealous guardians of either – or both, like Pluto, the Roman god of the underworld. Or they may be prisoners themselves, like the evil god Loki in Norse tales, who caused earthquakes when he writhed in agony at his torture. They may even be both: In Greek myth, Hades kidnapped Persephone to his dark realm, but she then became his queen. Other versions are more optimistic: Welsh legends portray Annwn, the underground realm of the dead, as a paradise.

Folk legend often includes smaller underground realms. In Irish myth, for example, many mounds – distinctly rounded artificial or natural hills – are inhabited by faeries or are gateways to their realms. Chinese Buddhism has legends of vast caverns that conceal paradise realms where any inhabitant can become enlightened.

## MURDERED GIANTS

One of the oldest ideas about the world was the myth of a slain giant whose corpse was shaped into the world. The first recorded version of this tale comes from Babylonian tablets – the *Enuma Elish* describes how the god Marduk killed the monstrous Tiamat and made the heavens and the earth from her remains. Adam Kadmon in Jewish legend, Purusha in Hinduism, and Ymir (see below) in Norse myth suffered similar fates.

The Norse version offers a twist: Maggots within the corpse became the races of elves. Some, the alfar, came out into the light. Others, the svartalfar, remained an underground race – apparently also called “dwarves,” and described as amazing craftsmen, creators of Thor’s hammer Mjollnir and other treasures.

## Ymir (106,009,960 points)

The primordial giant of Norse myth can serve as a model for *Murdered Giants* (see above). Ymir isn’t actually as big as the entire Earth; the Vikings didn’t know the size of the world, and their legends aren’t specific about Ymir’s size. This version of him is SM +40 (nine million yards tall, or about 5,000 miles).

**ST** 50,000,000 (Size, -80%) [99,999,980]; **DX** 8 [-40]; **IQ** 8 [-40]; **HT** 12 [20].  
 Damage 5,000,001d/5,000,003d; BL 250,000,000,000 tons; HP 50,000,000 [0];  
 Will 12 [20]; Per 8 [0]; FP 12 [0].  
 Basic Speed 5.00 [0]; Basic Move 2,000 [9,975]; Dodge 8.  
 SM +40; height 5,000 miles.

### Social Background

*TL*: 2 [0].  
*CF*: Norse [0].  
*Languages*: Norse (Native) [0].

### Advantages

Damage Resistance 2,000,000 (Tough Skin, -40%) [6,000,000]; Night Vision 5 [5]; Temperature Tolerance (Cold) 10 [10].

### Disadvantages

Appearance (Monstrous) [-20].

### Skills

Animal Handling (Bovines) (A) IQ+4 [16]-12; Brawling (E) DX+5 [16]-13;  
 Intimidation (A) Will [2]-12; Survival (Arctic) (A) Per+4 [16]-12.

# NATURAL PHILOSOPHY

Civilized societies began to speculate about purely natural explanations for things, moving away from ancient legends. Greek philosophers such as Thales of Miletus developed this approach, and Romans such as the poet Lucretius adopted it. Aristotle discussed the slowness of geological changes. Aristotle’s successor Theophrastus and the Roman writer Pliny the Elder studied and classified minerals. The Taoists in China and the Carvakists in India also favored naturalistic explanations.

*At the round earth’s  
 imagined corners, blow  
 Your trumpets, angels . . .  
 – John Donne,  
 “Holy Sonnet 7”*

## THE GEOCENTRIC COSMOS

The first Greek natural philosophers still thought the world was flat (which is actually a workable approximation for local mapping and surveying). Thales of Miletus proposed that the world floated on water – a finite land area (which might need to be hollow for buoyancy) drifting on an infinite ocean. In a game setting, hollow continents might be sinkable, in a natural catastrophe or through a military attack. (Perhaps the sinking of Atlantis was the work of enemy miners!)

Thales’ student Anaximander envisioned a drum-shaped planet with two habitable surfaces, placed at the center of the universe. Each side’s “down” was the other’s “up.”

With the development of mathematical thought, later Greeks worked out the spherical world. At the Library of Alexandria, Eratosthenes calculated Earth’s circumference, based on the sun’s angular height above the horizon at two cities.

Most ancient astronomers favored Ptolemy’s *geocentric astronomy*, in which celestial bodies, including the sun, follow circular orbits around Earth. Earth is heavy and impure, but celestial bodies are light and pure. On a spherical Earth, “down” is toward the center, and “up” is toward the sky and Heaven. A minority, such as Hipparchos, believed in the *heliocentric* theory, in which Earth revolves around the sun.

## The Inferno

The greatest work of fiction based on geocentric astronomy is Dante's *Divine Comedy*. In the *Inferno*, Dante and Virgil explore Hell, located inside the world. Dante included many details of Hell from Roman myths. He also considered physics, as in the scene where Dante and Virgil descend to the lowest circle of Hell, where Satan is imprisoned. Once they pass Satan's midsection, they are climbing *up* Mount Purgatory. At the sphere's center, up and down interchange.

## The Hollow Earth

In 1692, the astronomer Edmund Halley proposed that Earth was not a solid sphere, but five concentric shells. In 1818, a retired American army officer, John Cleves Symmes, added large holes at the North and South Poles through which explorers might enter the interior. This led to a privately funded Antarctic expedition in 1824, and may have inspired Edgar Allan Poe's *The Narrative of Arthur Gordon Pym*. In 1920, Marshall Gardner published a new version, adding an internal sun.

Realistically, a hollow earth wouldn't last long: the spheres would collide, or the outer shell would collapse under its own weight. By the end of the 19th century, geologists abandoned the theory. Even so, modern pseudoscientific and occultist groups, including the Thulegesellschaft in Nazi Germany, often found it appealing.

A different "hollow earth" theory has vast caves running through the world's crust. The Theosophical Society claimed that a cave complex inhabited by demons existed under Tibet, known as Agarthi.

## CONTESTED GROUND

After the Middle Ages, explorers and natural philosophers began pursuing what eventually turned into modern geology. For several centuries, basic theoretical questions were inconclusively debated. Scripture, classical philosophy, practical observations, and speculation all contributed to the discussion.

### The Origin of Landmasses

Early geologists developed conflicting theories on the origins of rock. One group, *neptunists*, thought rock originally crystallized out of seawater, supplemented later by sedimentary rock strata. They believed burning veins of coal heated volcanoes, and regarded Earth's interior as mostly cold – an idea Jules Verne used in *A Journey to the Center of the Earth*.

Another group, *vulcanists*, argued that basalt formed from cooled lava ejected from a *hot* interior. The later *plutonists* applied the same idea to granite, and emphasized the volcanic origins of mountain ranges.

### The Origin of Fossils

Early naturalists found buried objects that looked like creatures' remains, but were made entirely out of stone. The ancient Greeks and Romans explained these as monsters killed by gods or heroes; many temples proudly displayed huge skeletons.

In one naturalistic theory, these remains were originally organisms buried in sediments. As the sediments turned to rock, minerals replaced the once-living tissues. This theory of

"solids naturally contained within solids" became the basis of modern paleontology.

A rival theory proposed that minerals could spontaneously take on the shapes of living creatures; the mineral kingdom was imitating the vegetable and animal ones. Before Louis Pasteur disproved spontaneous generation (formation of lower organisms in dead matter) in the 19th century, this didn't seem quite as implausible as it does now.

### Noah's Flood

Another anomaly was fossilized seashells in strata far above sea level. In Christian Europe, people thought these were from the Noachian flood. The 18th-century catastrophists, mostly neptunists, believed that the flood was only the latest in a series of global disasters, each of which wiped out most of the species of its time. Frozen mammoths were viewed as evidence for one catastrophe. The uniformitarians, mostly vulcanists and plutonists, rejected catastrophism, claiming that geological structures were formed by the same slow forces that operate in the present landscape – a view that later inspired Darwin's theory of evolution.

## GEOLOGICAL TIME

In the 19th century, uniformitarian geologists realized Earth had to be hundreds of millions years old for natural processes to have created the visible landscape. In 1859, Charles Darwin calculated an age of 300 million years. Exposed areas such as the Grand Canyon showed layers of rock strata formed from marine sediments, which contained fossilized organisms, many of extinct species. Strata from across the world contained fossils of similar species, always in the same sequence (see *Geological Ages*, p. 7). Museums began competing to produce dramatic exhibits of extinct life forms, especially the big ones.

This new geological history became the basis for fantastic fiction about prehistoric tribes or entire lost civilizations – as in Robert E. Howard's stories of Conan's Hyboria. In the early 20th century, H.P. Lovecraft developed a new kind of cosmic horror, filling the geological record with forgotten inhuman civilizations, making human history a mere episode, likely to be swept aside if the ancient races ever revived. Occultist groups such as the Theosophical Society sometimes claimed to have actual records of these antiquated times.

*Geologists formerly would have brought into play the violent action of some overwhelming debacle . . .*

– Charles Darwin,  
*A Naturalist's Voyage  
Round the World  
(The Voyage of the Beagle)*

## Land Bridges and Lost Continents

Similarities between the fossil records of different locations puzzled many paleontologists. Related species were found on widely separated continents. The distribution of living species was also odd; why could opossums be found in Australia and the Americas, but not on Asia or the Pacific islands?

The common answer was land bridges. The seas had risen and fallen in the past, and low levels might turn shallow seas into land. More-daring speculators envisioned large expanses of land linking, say, Africa to India, which had not just been submerged by rising seas, but broken up by huge catastrophes.

Most 19th-century geologists believed the world was cooling and shrinking. In the process, its crust cracked and wrinkled, and parts sank into the interior, turning continents into oceans. Oceans could also turn into continents, as regions of seafloor failed to sink or were pushed upward. With serious geologists proposing such ideas, speculations about lost continents such as Atlantis and Lemuria seemed plausible.

## The Age of the Earth

The Scottish physicist Lord Kelvin rejected uniformitarian timelines. Assuming the sun's heat derived from its initial gravitational collapse, he computed that it could not be older than 100 million years, and could not shine many million years longer, prompting Darwin to describe him as an "odious spectre" in a letter. This prediction inspired H.G. Wells' portrayal of a dying future Earth in *The Time Machine*.

Not long after the discovery of radioactivity, in 1904, Ernest Rutherford pointed out that radioactive decay was a new energy source that could prolong the lives of celestial bodies. Between 1908 and 1910, R.J. Strutt developed radioactive dating, which determined the actual ages of geological strata (*Geological Ages*, below).

## Geological Ages

Geological Age	MYA (millions of years ago)
Priscoan Eon	4,600
Archean Eon	4,000
Proterozoic Eon	2,500
Phanerozoic Eon	590
Paleozoic Era	590
Cambrian Period	590
Ordovician Period	505
Silurian Period	438
Devonian Period	408
Mississippian (Lower Carboniferous) Period	360
Pennsylvanian (Upper Carboniferous) Period	320
Permian Period	286
Mesozoic Era	248
Triassic Period	248
Jurassic Period	213
Cretaceous Period	145
Cenozoic Era	65
Tertiary Period	65
Paleocene Epoch	65
Eocene Epoch	55
Oligocene Epoch	38
Miocene Epoch	25
Pliocene Epoch	5
Quaternary Period	2
Pleistocene Epoch	2
Holocene (Recent) Epoch	0.01

*It is not surprising that when this mighty nation sank beneath the waves, in the midst of terrible convulsions, with all its millions of people, the event left an everlasting impression upon the imagination of mankind.*

– Ignatius Donnelly, *The Antediluvian World*

# MODERN GEOLOGY

At the start of the 21st century, geologists have a detailed picture of Earth's interior, and some ideas about other planets' and satellites' interiors. If adventurers in a realistic setting go underground, this is what they'll find. Present-day campaigns with more fantastic themes need to explain away what geologists have observed.

Key to modern geology is *plate tectonics*. This started out with the *continental drift theory*, first proposed in 1915. Back then, geologists rejected it because they couldn't see how the continents could move – plate tectonics is the explanation (see *The Crust*, pp. 8-9).

## BELOW THE SURFACE

Earth's chemical elements fall into three main groups. *Lithophiles* (such as aluminum, potassium, sodium, and silicon) combine with oxygen, forming rocky materials. *Chalcophiles* (such as lead, silver, and mercury) react with sulfur, forming ores that can be broken down by heat. Iron reacts with both oxygen and sulfur, but there's lots of excess iron; unreactive *siderophiles* like gold and platinum go into solution in the iron, along with cobalt and nickel.

# Physics of Earth's Interior

Here are the numerical details for the physical state of the planet at the boundaries of its major interior zones.

Boundary Between	Diameter (miles)	Gravity	Pressure (atmospheres)	Temperature (°F)
Outer/inner core	1,500	0.45	3,300,000	9,000
Lower mantle/outer core	4,300	1.09	1,400,000	6,700
Upper/lower mantle	7,100	1.02	240,000	2,900
Crust/upper mantle	7,890	1.00	6,000	1,200

Within Earth's hot interior, these materials sort themselves into layers. The *core* is mostly iron and nickel, with about 20% nonmetallic, likely sulfur. The outer core is liquid; the inner core is solid. As the core cools, crystals grow on the inner core, releasing heat as they freeze – about 40% of the heat released in the interior.

Above the core is the *mantle*, made mostly of rocky materials. The main radioactive elements in the interior are mantle lithophiles: potassium-40, thorium-232, uranium-235, and uranium-238. Their decay provides about 60% of the Earth's internal heat. The mantle has several layers with different properties, including the upper, fairly rigid *lithosphere*, and the more yielding *asthenosphere* just beneath it.

Heat release within the planet gives rise to heat flow called *convection*. As in a pot of broth on a stove, hot liquid on the bottom rises to the surface, where it moves sideways from the hot spot, cools, and eventually sinks somewhere else. Sometimes scum accumulates on the surface of the liquid. Convection within the earth provides the tectonic energy for nearly

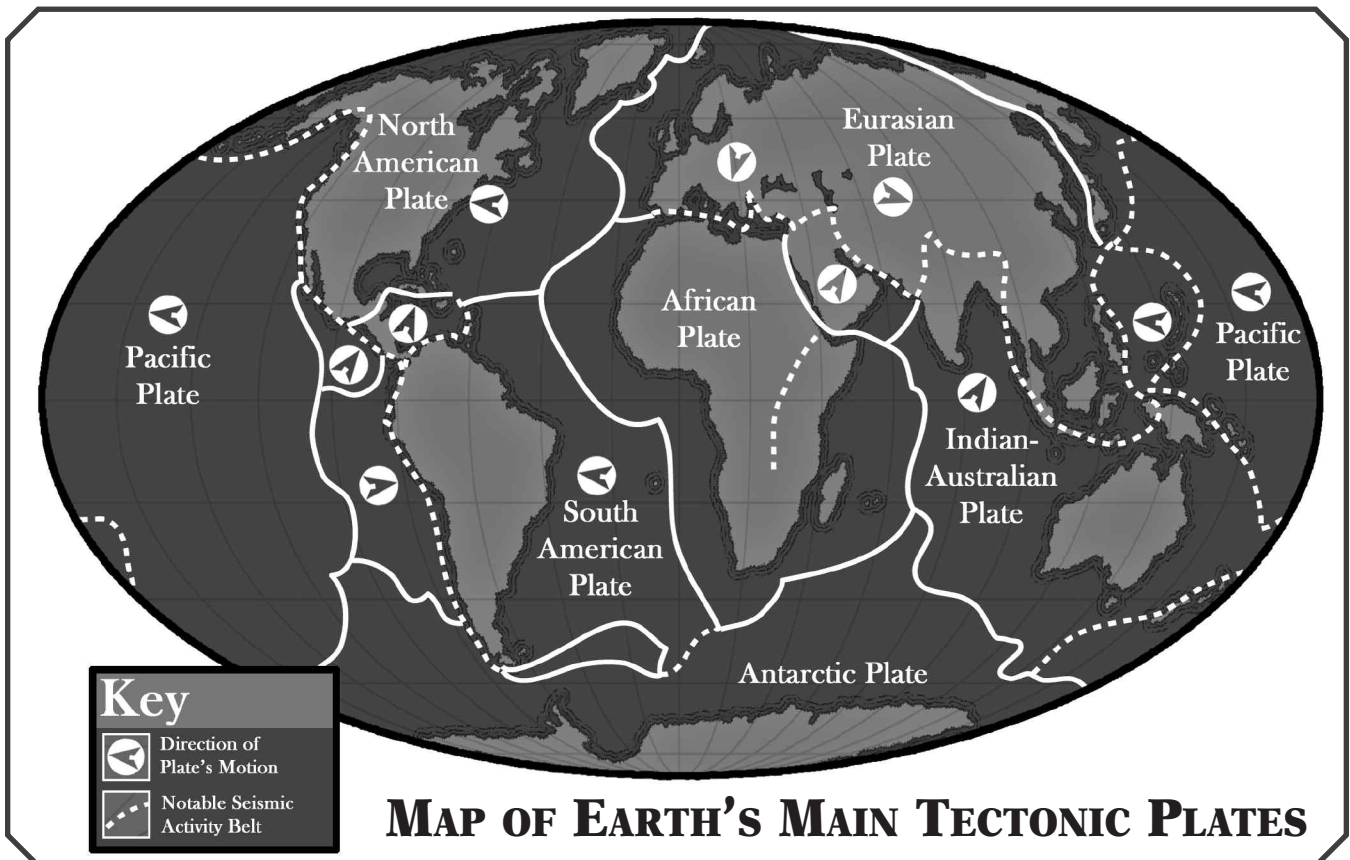
all geological processes. Geothermal heat flow is about 44 billion kilowatts; about 44 million kilowatts are released in earthquakes.

## THE CRUST

The “scum” on top of the mantle is the *crust*. Its thickness ranges from 4.5 to 27 miles – a short distance, but no human being has ever made the descent or could survive it.

The oceanic crust is basalt, with a surface of sedimentary rocks such as sandstone and limestone. The continents have a bottom layer of basalt, a thick middle layer of granite, and an upper sedimentary layer. Granite is lighter than basalt and rises above it as icebergs rise above ocean water. As with icebergs, the granite also thrusts downward, so the continental crust is thicker than oceanic crust.

Lines of convective heat produce divergent plate boundaries: continental-rift valleys as in East Africa, narrow seas like the Red Sea, or oceanic ridges such as the Mid-Atlantic Ridge.





New crust forms in ridges and pushes plates apart. Elsewhere, plates come together; oceanic crust is pushed down into the mantle and melted, rising to form volcanic island chains. Continental crust stays on top; a single continent develops volcanic mountain ranges along its margin, such as the Andes, while two continents colliding produce compressional mountain ranges, such as the Himalayas (see the map on p. 8). Volcanoes and earthquakes occur mostly along plate boundaries, such as the Pacific “ring of fire,” but hot spots develop in the middle of plates – worldwide, there are about 100, including Yellowstone and the Hawaiian Islands.

Crust recycling in the upper mantle produces concentrated deposits of metals and their ores. Water heated by geothermal energy can also concentrate ores. Geothermal energy can be economically valuable in its own right; geologists estimate that it exceeds the available energy in fossil fuels.

*If the crust is of sufficient thickness we shall come to a final stop between six and seven hundred miles beneath the earth's surface; but during the last hundred and fifty miles of our journey we shall be corpses.*

– Edgar Rice Burroughs,  
*At the Earth's Core*

## RECENT SPECULATIONS

Modern geology still has room for speculation. Some recent examples could supply premises for science-fiction or fantasy campaigns.

### *The Gaia Hypothesis*

In the 1960s, a Jet Propulsion Laboratory consultant, James Lovelock, proposed an unusual method for detecting life on Mars – look at the atmosphere. Oxygen reacts with many other substances; after a million years, the air would be 98% carbon dioxide, except that photosynthesis puts new oxygen into the air. In addition, Earth's soil contains organic substances, in contrast to the inorganic regolith of other terrestrial worlds.

Lovelock formulated the Gaia Hypothesis, which says Earth is habitable because life itself keeps it so. For example, its surface temperature has been stable for several billion years, despite changes in solar radiation. Recent studies suggest that water acts as a lubricant for plate tectonics; without life, the crust might fuse into a solid shell. The Gaia Hypothesis found supporters among environmentalists, but was heatedly debated by scientists, and by religious thinkers reacting to its allusion to a mythical goddess.

## *The Deep Hot Biosphere*

After genetic analysis identified the Archaea and Bacteria as distinct biological groups in 1977, microbiologists recognized that many Archaea were *extremophiles*: organisms able to survive extreme conditions such as high temperatures. At the same time, oceanographers discovered deep-sea *hydrothermal vents* and found organisms there that could live at high temperatures – sometimes in water hotter than 212°F, kept from boiling only by extreme pressures. In the recently investigated Cayman vents, water that may be hotter than 700°F supports not only bacteria but also multicellular animals.

In 1992, Thomas Gold proposed that similar organisms could exist deep within the Earth's crust, in the pores of rocks. Gold calculated that the weight of this *deep hot biosphere* might be greater than that of all life on the Earth's surface. Like hydrothermal-vent communities, it would be supported by high-temperature chemical reactions, not by sunlight.

## EXTRATERRESTRIAL GEOLOGY

When a star system comes into being, gravity forms its original gas and dust into *planetesimals*, small celestial bodies similar to present-day asteroids. These collide, releasing heat and fusing into larger bodies. Bodies with diameters above 280-440 miles have gravity high enough to exceed the structural strength of their materials. They collapse into roughly spherical shapes, like planets, satellites, and large asteroids. Smaller bodies remain irregular.

Radioactive materials inside a planet add to its internal heat. If this is great enough to melt the planet's material, it forms layers (see *Below the Surface*, pp. 7-8).

## Planetary Destruction

What would it take to literally destroy a planet – in particular, to destroy Earth?

Earth as a whole is inanimate, and has no complex internal mechanical parts; it can be taken as homogenous. It masses approximately 13 septillion ( $13 \times 10^{24}$ ) lbs. (“weighs” isn't quite the right word). Taking the cube root, and multiplying by 8, gives 1,880,000,000 HP; on a planetary scale, rounding to two billion is close enough.

The Earth's crust averages roughly 10 miles thick. Rock has a minimum DR of 8/inch; that makes the Earth's DR about 5,000,000. Nothing that can inflict a major wound on the planet, let alone smash it, will even notice that amount of DR!

Inflicting a major wound on the Earth takes about 286,000,000d. Round that up to 300 million dice, which could come from a weapon or Innate Attack, or a blow with ST 3 billion. For a single blow, this can be achieved with ST 55 with the Super-Effort modifier (*GURPS Supers*), at a cost of 2,200 points.

Luis Alvarez estimated that an asteroid six miles in diameter with an impact energy of 100,000,000 megatons caused the extinction of the dinosaurs. This would cause roughly the same damage, based on weight and collision speed, as above. Thus, a “major wound” to a planet with life amounts to an extinction event.

# CHAPTER TWO

# TIGHT PLACES

Caves present explorers with a variety of obstacles. In the first place, they're often completely dark. Their passages aren't always level and may even be vertical, requiring climbing; they may also be narrow (see *Narrow Passages*, p. 12). Cave floors may have gaps or breaks (p. 11).

Certain underground experiences warrant Fright Checks (pp. B360-361), such as having the lights go out suddenly or being stuck. Hostile creatures are more fearful than above the ground, because they may appear without warning out of shadows or around bends. Floods, cave-ins, or rock bursts require Fright Checks at -1 to -5, depending on the disaster's scale and suddenness.

## PERCEPTION

Except near their entrances, most caves are lightless, making Vision rolls impossible (-10 to visually guided actions, if at all possible). Fantasy or science-fictional caves may have phosphorescent lichen or luminous minerals. If they exist, treat them as comparable to starlight, allowing Vision rolls at -7 to -9.

Cave explorers normally carry whatever sort of lights their TL allows (see *Lighting*, p. 23). Some of these illuminate a radius; others project a beam. Either form eliminates or reduces Vision penalties in the area it illuminates, but leaves the explorer blinded to anything outside that region. Treat the light as *in plain sight* to distant observers who have a clear view of it: +10 to Vision rolls to see it (p. B358). However, they're at -7 to see anything outside its radius.

The ability to see infrared, whether with thermal-imaging gear (**GURPS High-Tech**) or Infravision, provides visibility in lightless environments. Most underground environments are in thermal equilibrium, so seeing most inanimate objects is at -2 because of low contrast. Human beings and other heat sources often stand out: +10 to Vision rolls to detect them.

An explorer with no light source can find his way by touch, either keeping one hand on a cave wall (full Move) or crawling (1/3 Move). Either requires a roll vs. DX-6 for each stretch of cave traveled; failure means encountering a hazard. Spending extra time by moving slowly (see p. B346) provides bonuses that offset the penalty. The Cane Travel technique (p. 21) furnishes similar bonuses that take the place of extra time. Dark Vision allows normal vision with no light source, and with no penalty for looking into or out of an illuminated area.

Hearing sometimes works differently in underground environments. Caves are often almost completely silent; any sound stands out, giving +4 to Hearing rolls to *notice* a sound. Additionally, sound carries farther in narrow tunnels or tunnel-like caves. On the *Hearing Distance Table* (p. B358), once the range in yards exceeds the width of the tunnel, the penalty to Hearing rolls is -1 for each *two* steps.

*Example:* A party of Saxon warriors ventures into the mines of a colony of zwerger (p. 28), lured by stories of treasure. They keep their voices down to a quiet conversation level (range one yard). The Hearing penalty is -1 at two yards. However, the tunnel is only two yards wide! The penalty is -2 at eight yards, -3 at 32 yards, -4 at 128 yards, and -5 at 512 yards. The zwerger have a chance to hear them a long way off.

Eventually, they come on a place where the tunnel opens out to four yards, and find a pile of metal there. One of them, Gottfried, points at it and shouts (range eight yards). There is no Hearing penalty at four yards (the width of the tunnel) or at eight yards. The penalty is -1 at 32 yards, -2 at 128 yards, and -3 at 512 yards.

Stone surfaces reflect sound efficiently, creating echoes. Hearing rolls to *locate* the source of a sound, or to perceive and analyze its details, are at -2.

## NAVIGATION

Journeying underground presents special challenges. The sky is hidden, which makes celestial navigation impossible; global positioning systems don't work, because the ground blocks signals (but see *Local Positioning System*, p. 24). Underground navigation normally goes by dead reckoning. Travel without at least a compass, or travel at a pace that doesn't allow time for careful measurements, depends on landmark recognition, at -5 to effective skill. Area Knowledge of a cave can substitute for Navigation based on landmark recognition.

The simplest navigation task is figuring out where you are in relation to a known starting point. Navigation (Land) will tell you where you are in a two-dimensional network, and where you encountered slopes or vertical shafts. Navigation (Underground) (p. 21) will also tell you how deep you are, and give you a sense of three-dimensional spatial relations.

The same roll will find the way to a known location: your point of entry, a place on the way to where you are, or a point on a map or chart. Roll at +2 to decide which way to go in an unbranched passage or to choose between two branches; roll at +1 if there are three to five branches – there is no bonus for more. If you are digging a new tunnel, which could aim in any direction, the roll is unmodified.

Trying to find an unknown location is a further -4 to skill. This could be the entry, if you've gotten lost; a possible second exit somewhere else; or the deepest point in a complex, or some other desirable destination.

If you're on the surface, and have time for surveying, you can determine a precise destination – either an identified second exit from a cave, or a planned end for a tunnel. Treat such a point as known. Surveying requires a Navigation (Land) roll and takes a day; see also *Navigation* (p. 24).

Tunneling from two surface sites to a planned meeting point requires a roll for each site. Without previous surveying, *both* rolls are at -4.

## MOVEMENT

Movement in caves and tunnels uses the same basic capabilities as land movement, but often with special complications.

### Moving Quietly

The sound of movement, like other sounds, carries abnormally far in a tunnel or cave (p. 10). Treat walking at half Move or less as equivalent to quiet conversation on the *Hearing Distance Table* (p. B358). Faster movement corresponds to normal conversation. Combat in which blows are struck is analogous to loud conversation – or louder, for blows struck against metal armor! Use of the Cane Travel technique (p. 21) is equivalent to normal conversation.

If you are attempting to move silently, this can be treated as a Quick Contest of your Stealth skill against a Hearing roll for the person you're trying to sneak past (or an Observation roll with hearing modifiers, if he's actively listening). Combat where blows are struck, or the tapping noise of Cane Travel, makes a Stealth roll impossible. Grappling does not, but both Stealth and the combat skill are at -2.

### Poor Terrain

Caves may confront hikers with a variety of unstable terrain: rubble underfoot (left by small cave-ins) or wet or icy surfaces. In tactical combat (pp. B386-387), any of these counts as bad terrain, costing +1 movement point per hex. Attack rolls are at -2, and defense rolls at -1 on all these surfaces. The GM may also apply -2 to DX-based skills for whole-body movement, such as Acrobatics, Dancing, and Jumping. For long-distance travel, these surfaces modify hiking speed (see p. B351). Treat rubble as broken ground, wet surfaces as rain, or icy ones as a coating of ice, giving  $\times 0.50$  daily move for each condition.

### Climbing

Cave explorers often have to climb. Treat a sloping passage as an ordinary mountain, or, in tactical combat, as the equivalent of stairs up or down (+1 movement point per hex). A vertical passage is analogous to a vertical stone wall. Cavers often rely on ropes; consider this as rope-up or rope-down. A wet or icy surface, or a sloping pile of rubble, gives an additional -2 to Climbing. See p. B349 for details on climbing.

If cavers are roped together, and one of them falls, divide his weight (and that of his gear) among the number of other climbers. Each climber then must make a Climbing roll at an encumbrance penalty based on the fallen climber's weight, or be pulled loose. A second climber being pulled loose requires a second set of Climbing rolls based on the fallen climbers' *combined* weight. An enemy can deliberately grab a rope and try to yank a group of climbers loose; treat this as a Quick Contest of combined

ST (equal to the ST of the strongest person on each side, plus (total of other climbers' ST)/5).

The high-speed form of roping down is *rappelling*. Basic equipment for this is a harness, a rope, and a carabiner to connect them; this allows roping down at 12'/sec. at -1 to Climbing skill. See *Climbing Gear* (p. 23).

Caves may present an additional option: *chimneying*, or climbing a vertical passage by bracing against its opposite walls, with an arm and leg on each side (for narrow passages) or with back and feet against opposite sides (for wider passages). This is easier and faster than climbing a vertical wall.

Type of Climb	Modifier	Short Climb	Long Climb
Narrow chimney (1-2')	-1	1 1/2 sec.	10'/min.
Wide chimney (2-3')	-2	1 1/4 sec.	5'/min.

*Note:* The widths given are for *human* (or human-sized) climbers. For larger or smaller climbers, the widths should be proportional to the longest dimension for their SM. For example, for a race with SM -4 (18"), from 1/6 to 1/3 of 18" (that is, from 3" to 6") would count as a narrow chimney; from 1/3 to 1/2 (that is, from 6" to 9") as a wide chimney.

### Gaps and Chasms

Explorers in natural caves or ruins may need to cross an opening in the floor. The simplest way to do this is by jumping (p. B352). Explorers who expect to make repeated trips may prefer to set up one or more ropes, or a rope bridge with planks. Getting the first rope across can be done by jumping while holding a rope, by throwing or firing a grapnel (see *Low-Tech*, p. 125), or by using the Climbing Line perk (p. 19). Spotting a suitable attachment point calls for a Per-based Climbing roll. For rules on the strength of ropes and rope bridges, see *GURPS Low-Tech Companion 1* (p. 39).

To cross a single rope hand over hand, roll vs. Climbing at -2 (Brachiator gives +2, cancelling the penalty); travel is at Move 1 (half Basic Move with Brachiator). To walk on a single rope, roll vs. Acrobatics, at a penalty based on encumbrance, and at +1 with a balance pole such as a quarterstaff; no roll is required for those who have Perfect Balance.

## Crossbows and Grapnels

*GURPS Low-Tech* (p. 125) provides a general rule for using a crossbow to fire a weighted rope or a grappling hook. For a weighted rope, divide Maximum Range by two for horizontal fire or four for vertical. For a grappling hook, divide by 10 for horizontal fire or 20 for vertical.

Realistically, the length of the rope needed to bridge a gap is going to affect this! A GM who wants the added detail may use the following alternate rule: Determine the width of the gap in yards. Multiply this value by the weight of the rope per yard, based on its material and thickness. Divide by two. Add the weight of the grappling hook, if any. Divide the crossbow's Range by  $10 \times$  (combined weight, in pounds) for horizontal fire, or by  $20 \times$  (combined weight, in pounds) for vertical fire.

For hand-thrown grapnels, use the same (combined weight) in the throwing rules (p. B355).

## Narrow Passages

Caves often contain very narrow passages. To get through them, a traveler can use Escape skill to squeeze through a passage only slightly wider than his body. Body weight affects this: Skinny gives +2 to Escape, Overweight gives -1, Fat -2, and Very Fat -3. Encumbrance penalties also apply.

Total exhalation (p. 22) can help get through tight passages – but getting stuck leaves you unable to inhale! This results in being out of air *immediately*. You have only the oxygen in your blood, as if you were breathing vacuum (p. B437).

Getting out unaided requires a ST-6 roll; companions can yank a trapped caver out with a ST roll. Either process inflicts 1d-2 crushing damage on the torso, if successful (partly squeezing and partly superficial scraping). Repeated attempts are possible, but each failed attempt inflicts 1 point of damage. Flexible armor protects against this damage, and the damage has an armor divisor of (0.5). Rigid armor thwarts use of total exhalation in the first place; the wearer's chest may get smaller but the armor doesn't. It doesn't prevent rolls vs. Escape skill, but the usual encumbrance penalties apply.

*Journeying underground presents special challenges.*

## Fighting in Confined Spaces

Even fairly wide caves or tunnels limit a combatant's freedom of movement. A party of combatants standing side by side can completely occupy a passage with a width of up to one yard per combatant; attackers can only come at them from in front. A successful slam (p. B371) or evasion (p. B368) will let someone get behind a party.

Narrow passages limit the strikes a combatant can perform. Thrusting attacks require a distance equal to the weapon's longest Reach in the *direction of the thrust*. Swinging attacks need that much clearance in *at least two directions*. With insufficient clearance, use of a weapon is subject to close combat penalties: -4× the weapon's longest Reach to attack, -2× longest Reach to parry, and -1 swing damage per yard of longest Reach (thrust damage is unaffected). See *GURPS Martial Arts* (p. 117) for more on this topic.

## WATER HAZARDS

Caves often contain pools or streams, especially if they formed in eroded limestone areas (see *Types of Caves*, p. 31). Explorers may have to wade, crawl, or swim in underground waterways; some even need scuba gear.

## Underwater Passages

Part of a cave may be entirely below the underground water level. It's possibly, but risky, to swim into such a body of water: The swimmer can't reach air by surfacing, but needs to swim back out (or find another place to surface). Misjudging how long he can hold his breath, or getting lost, can be fatal. Sediment in a body of water can reduce visibility, for an additional -1 to -9 to Vision rolls.

Cave diving with scuba gear is a specialized and hazardous activity, classified as a form of *penetration diving* (p. 22). Even with suitable training and equipment, the risks of nitrogen narcosis (*The Bends*, p. B435) are greater; all HT rolls for decompression are at -3.

## Hot and Cold Water

Cave water is often dangerously cold, but water in some caves may be incredibly hot; see *Types of Caves* (p. 31). Water conducts heat much better than air; the human comfort zone in water is only 75-85°F.

In water at a temperature outside this narrower comfort zone, but inside the normal comfort zone, roll vs. HT once per minute. On a failure, the affected person loses 1 FP. In hot water, on a critical failure, he suffers heat stroke and loses 1d FP.

At temperatures colder than the normal comfort zone, or colder than normal freezing temperature, he may suffer thermal shock (p. B430).

At temperatures hotter than the normal comfort zone, he suffers the usual effects (p. B434) in addition to losing FP from failed rolls vs. HT. Normally, FP aren't lost from dehydration during immersion.

## Flooding

Caves are subject to flooding, either because the water level outside the cave is high (from heavy rain, river floods, or intense storms outside sea caves), or by an underground stream breaking through into a cave. Miners breaking into an aquifer or an underground stream or lake may flood mines. In the confined environment of a cave or mine, flooding is exceptionally dangerous.

In a minor flood, the water rises several feet, damaging or sweeping away many possessions. A Hearing roll – or a roll vs. Per-based Engineer (Mining), Per-based Prospecting, or Survival (Underground) (p. 21), applying all Hearing modifiers – gives enough warning to run or climb for higher levels, if any are accessible. Failure requires Swimming rolls at -2. In a major flood, the water fills the cave, requiring Swimming rolls at -4.

A critically failed Swimming roll results in slamming into the cave or mine wall at Move 10. This causes collision damage (pp. B430-431) to a randomly determined hit location. The resulting injury may further impair the swimmer's ability to survive the flood.

## HOSTILE ENVIRONMENTS

Most caves have even temperatures, equal to the average surface temperature – cool in summer and warm in winter. The air in many caves is completely still and can feel warmer than it is; roll vs. Per (at +1 per 10°F below zero) to perceive freezing cold. Temperature rises 1°F per 82.5' of depth, or 64°F per mile, on the average. Deep mines need massive cooling systems to keep the temperature endurable. Some underground spaces are abnormally hot. For example, a cave 980' deep discovered by miners at Naica, Mexico (and filled with spectacular selenite crystals up to 11' long), is at 122°F, because of a nearby magma chamber. For effects of heat or cold, see pp. B430 and B434.

In extremely humid caves, such as that at Naica (90% relative humidity), lack of evaporative cooling magnifies temperature effects. Roll to withstand heat every 10 minutes rather than every 30.

Air pressure also rises with depth below the ground – each 3.75 miles of depth doubles atmospheric pressure (see *Atmospheric Pressure*, pp. B429-430). Rapid ascent from extreme depths risks a case of the bends (p. B435). See the table for approximate depths at which various pressures are reached.

Pressure (atmospheres)	Depth (miles)	Notes
1.2	1.0	Dense below this depth
1.5	2.2	Very Dense below this depth
2.0	3.75	
2.5	5.0	
4.0	7.5	
5.5	9.0	
10.0	12.5	Superdense below this depth
100.00	25.0	

Atmospheric composition underground can also be a threat. Several hazardous atmospheres (see pp. B429-430) are common (traditionally called *damps*).

*Black-damp* (or *choke-damp*) is simply air with too little oxygen. It's common in coal mines, but can occur in any poorly ventilated space. Cavers or miners cut off from external air by a cave-in (*Structural Integrity*, below) experience similar effects. Moderately bad conditions have the effects of a "thin" atmosphere (p. B429) from low oxygen pressure. Extreme conditions act as a suffocating atmosphere.

*Coal-damp* (or *fire-damp*) contains methane and other hydrocarbon gases. It's found in coal mines. Treat it as a suffocating atmosphere, but with an added risk of fire and explosion.

*Stink-damp* contains hydrogen sulfide, a weak corrosive. People and objects must successfully roll HT every minute or take 1 point of corrosion damage. On initial exposure, it has a characteristic "rotten egg" smell – hence the name. Continued exposure shuts down the olfactory sense after the first minute. Roll vs. Per+4 to smell it; either a critical success or a critical failure means that the person is nauseated (p. 428). Hydrogen sulfide is also inflammable, like methane.

*White-damp* contains carbon monoxide. This is found in coal mines after a coal-damp explosion, or may form there gradually. Molten rock can also release carbon dioxide and carbon monoxide. Treat it as a toxic atmosphere requiring a HT-2 roll every minute to avoid 1 point of toxic damage. It cannot be detected by smell.

Hydrogen sulfide and methane can be considered highly inflammable (*Making Things Burn*, p. B433). If set on fire, they inflict 1d-1 burning damage per second on anyone trapped in them. In a confined space, they also act as explosives! Explosive force varies with concentration; at a minimum inflammable concentration, each cubic yard of either gas does 5d explosive crushing damage.

## MINES AND TUNNELS

Sometimes it's necessary to go underground where there are no natural caves, for reasons such as construction, mining, or scientific exploration. Artificial tunnels raise two important questions: how long it takes to create them and how likely they are to collapse.

## Tunneling

**GURPS** calculates digging in cubic feet per hour (*Tunneling*, p. B90). However, in tunneling, the critical question is often length. To convert cubic feet/hour to yards/hour for a crawl space, divide by 25; for a man-high tunnel, divide by 50; for a circular bore, divide by (20 × square of tunnel diameter in yards). All work done in a crawl space is at 1/3 speed.

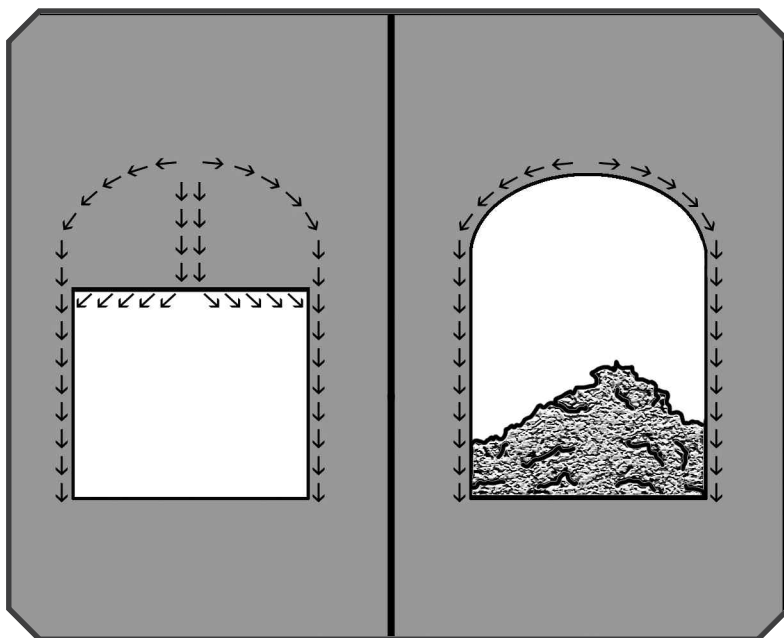
In addition to breaking up soil or rock and shoveling it out, tunneling requires hauling out broken rock or loose soil. An average wheelbarrow load is 0.1 cubic yard; the round trip to the dumping site takes two minutes per 100 yards. Hauling broken rock, soil, or ore up a vertical shaft normally requires some sort of hoist. Various technologies can speed up tunneling, including explosives, jackhammers, and mining machinery (*Equipment*, pp. 23-27).

## Structural Integrity

Like the roofs and walls of a building, the earth or stone that surrounds a tunnel needs to be load-bearing. The load can be tremendous; on the average, the weight on a square yard of tunnel roof is 1,500 lbs./ft. of depth. Fortunately, rock is tremendously strong. It can withstand a compressive load from 1,000 tons per square yard for sandstone up to 20,000 tons per square yard for basalt and quartzite – the weight of five miles of crust! The deepest mine on Earth, TauTona in South Africa, goes just under half that far down (2.4 miles). Many minerals gain even greater strength from being compressed on all sides.

Most natural caves have vaulted or domed roofs, which transmit weight sideways to the walls; the entire structure is under compressive stress. The rock outside the cave acts as a buttress against motion to the side. Flat roofs experience tensile stress, which rock resists much less well; its tensile strength is roughly 1/10 its compressive strength. The rock above a flat roof in a mine or tunnel is in danger of caving in, up to the natural arch. The wider the tunnel, the greater the danger.

Digging a simple pit or burrow requires a roll vs. Survival for the terrain type. Large or elaborate structures require Engineer (Mining), Architecture at -2, or Prospecting at -4.



Use Geology, Geography (Physical)-4, Prospecting-5, or Naturalist-6 to conduct a preliminary survey for such a structure; the primary skill is at +3 on a critical success, unmodified on a normal success, at -2 on a normal failure, and at -5 on a critical failure, or at -2 if no survey is attempted. (Don't base *both* the survey and the design on Prospecting!) For a working mine or other underground structure that changes over time, one roll is required per week.

For a success, treat the resulting underground structure as being in good repair, with HT 12. For a failure, reduce HT to 10; alternatively, in a working mine, *each* failure provides a cumulative -1 to HT. Roll vs. HT in an earthquake, an internal explosion, or a surface explosion powerful enough to have seismic effects at the structure's depth. (Casting the spell Earthquake underground, at Severe intensity, can have the same effect; see *GURPS Magic*, p. 54.) A critical success produces a structure that requires HT rolls only in major catastrophes such as a surface explosion whose crater reaches the structure's depth. A critical failure produces a dangerously unstable structure that requires a HT roll every week.

The basic cost of underground construction is \$900 per 1,000 square feet for simple horizontal excavation. Construction that is more rugged costs more (see *High-Tech* or *Low-Tech* for an explanation of CF or "cost factor").

- A vaulted or domed roof, stone pillars left in place, or wooden bracing gives +2 to HT and +1 CF (x2 cost).
- Steel bracing and/or solid lining for the walls gives +4 to HT and +4 CF (x5 cost).

Either option can be retrofitted into a poorly designed complex, but at higher cost: +2 CF (x3 cost) instead of +1, or +8 CF (x9 cost) instead of +4. Construction at the bottom of a shaft (five yards deep or more) adds an extra +1 CF for hoisting.

A vertical shaft has a base cost of \$3,600 per 1,000 square feet of *vertical* area (that is, multiply the shaft's width in feet by its depth in feet). Apply modifiers for more rugged construction as described for horizontal excavation.

A tunnel in clay or soil *requires* bracing – digging one without bracing counts as an automatic failure in construction. A tunnel in loose soil or sand necessitates solid lining; digging an unlined tunnel counts as an automatic critical failure in construction. Regardless of success or failure, HT is at an added -2 for a tunnel in clay, -4 in soil, and -6 in loose soil or sand.

A failed HT roll means a cave-in or collapse. Anyone in the structure who fails a Dodge roll suffers 2d+3 crushing damage. On a critical failure, Dodge is at -1 and damage is 3d+3.

A cave-in may completely block the flow of air. If so, the people trapped by it are in danger of suffocation. Estimate the volume in cubic feet as length x width x height (in feet); multiply by the pressure in atmospheres; divide the result by the number trapped in it to find how many minutes of air they have. After half this time, they experience the effects of "thin" atmosphere (p. B429). After the full time, they begin to suffocate, as discussed for black-damp (p. 13). This assumes no more than moderate physical activity; for strenuous activity such as trying to dig out, divide their survival times by 5.

## ROCK BURSTS

Another underground hazard is rock bursts, in which brittle compressed rocks suddenly shatter, releasing flying fragments. Treat this as fragmentation damage (pp. B414-415) averaging [2d] x depth in miles, rounded to the next higher number of dice. A rock burst can occur on a critical failure on a miner's monthly job success roll, or on a Geology or Prospecting roll to collect mineral specimens.

It's possible to prevent rock bursts by using explosives to release the elastic energy stored in rock. Roll vs. Engineer (Mining) to do this. On a normal failure, unreleased energy remains in the rock. On a critical failure, the mine suffers a large-scale rock burst along the entire length of a wall. In a large-scale burst, the range modifier for distance from the wall has no effect on the chance of being hit.

## Using Magic Underground

Caves have been favored for magical and religious ceremonies since the Paleolithic Age. They conceal secret activities, and their darkness and silence invite perceptual illusions and may help induce trances. In a setting with mana-based magic, caves may have higher mana than the surrounding environment: high mana in a normal-mana world, normal mana in a low-mana world, or low mana in a no-mana world. In addition to its effects on spell casting, the flow of mana may create naturally magical rocks, metals, or gems. Gems, in particular, are often believed to have inherent magical powers or affinities (see *Gemstones* on p. 99 of *GURPS Thaumatology*).

It's plausible for underground mana to be *aspected* – favorable to some spells and unfavorable to others. In a normal-mana setting, negative aspecting can be treated as low mana, for -5 to effective skill; positive aspecting can be +5 to effective skill. Partial aspecting (+1 to +4 or -1 to -4) may allow a more nuanced approach, at the GM's discretion. An obvious positive aspect for the underground is to

earth and metal spells. Among the classical elements, air is considered opposite to earth, so air spells could have negative aspect. Light spells might have negative aspect, and darkness spells positive. If the underground is the realm of the dead, necromantic spells could be positively aspected there. (See also *Spirits of the Underworld*, p. 27.)

Some ancient religions (such as Greek and Roman polytheism) divide the gods into celestial gods, who receive sacrifices on altars open to the sky, and chthonian gods, who receive sacrifices in pits sunk into the earth. Places below the ground may be high sanctity to chthonian gods and low sanctity to celestial gods. In a dualistic faith such as Zoroastrianism, the interior of the world may even have no sanctity for the heavenly god.

The Pythia (the oracle at Delphi) habitually prophesied while breathing volcanic fumes that induced a state of trance. In a fantasy setting, such vapors may carry high mana or sanctity. Breathing them may be an Accessibility limitation on such advantages as Blessed or Channeling.

# CHAPTER THREE

# EXPLORERS

A campaign inspired by the ideas in the first chapters won't get very far without adventurers! The following templates,

traits, and equipment can be used to create underground adventurers in *GURPS*.

## TEMPLATES

Characters of many standard types may venture beneath the earth, from mighty-thewed barbarian warriors to search-and-rescue workers. The following templates are for adventurers specifically designed for such settings.

Like aquatic supers, underground adventurers are very useful in their special setting but less interesting elsewhere. For well-rounded personae, allow extra points to pay for skills or advantages that are useful above ground.

### CAVER

75 points

Some people go underground for fun. Traditionally, they're called spelunkers; many now prefer the name "cavers." Serious enthusiasts have long believed in preserving the underground environment; standards are now more rigorous.

**Attributes:** ST 10 [0]; DX 11 [20]; IQ 11 [20]; HT 11 [10].

**Secondary Characteristics:** Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 11 [0]; Per 11 [0]; FP 11 [0]; Basic Speed 5.50 [0]; Basic Move 5 [0].

**Advantages:** Fit [5]. • 15 points chosen from among Absolute Direction (p. 18) [5] or 3D Spatial Sense [10], Claim to Hospitality (Other Cavers) [4], Daredevil [15], Fearlessness [2/level], Flexibility [5] or Double-Jointed [15], Gizmos [5/gizmo], Night Vision [1/level], Perfect Balance [15], Resistant to Respiratory Poison (+3) [3] or (+8) [5], Survivor (p. 19) [5/level], Temperature Tolerance [1/level], or increase Fit [5] to Very Fit [15].

**Disadvantages:** -10 points chosen from among Code of Honor (Caver's; p. 20) [-1], Curious [-5\*], Overconfidence [-5\*], Phobia (Open Spaces) [-10\*], or Sense of Duty (Fellow cavers) [-5] or (Anyone in danger underground) [-10].

**Primary Skills:** Climbing (A) DX+1 [4]-12 and Navigation (Underground; p. 21) IQ+1 [4]-12.

**Secondary Skills:** Survival (Underground; p. 21) (A) Per [2]-11.  
• One of Escape (H) DX [4]-11; Hiking (A) HT+1 [4]-12; or Swimming (E) HT+1 [2]-12 and Scuba (A) IQ [2]-11.

**Background Skills:** One of Knot-Tying (E) DX [1]-11; Area Knowledge (Specific Cave Complex) or First Aid, both (E) IQ [1]-11; Leadership or Photography, both (A) IQ-1 [1]-10; or Scrounging (E) Per [1]-11.

\* Multiplied for self-control number; see p. B120.

### Customization Notes

This template represents a fairly capable and experienced caver. For a less experienced one, lower IQ to 10 and drop 5 points' worth of advantages (but keep Fit – cavers get regular physical exercise). For a more experienced one, raise skill levels and consider the technique of Penetration Diving (p. 22) or Total Exhalation (p. 22).

### CHTHONOMANCER

125 points

Some wizards specialize in going underground, whether as adventurers or as workers. Many spells are useful for underground activities, including several specifically developed for such environments (*Spells*, pp. 22-23).

**Attributes:** ST 10 [0]; DX 11 [20]; IQ 13 [60]; HT 10 [0].

**Secondary Characteristics:** Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 13 [0]; Per 13 [0]; FP 10 [0]; Basic Speed 5.25 [0]; Basic Move 5 [0].

**Advantages:** Magery 1 [15]. • 15 points chosen from among FP +1 to +3 [3/level]; Absolute Direction (p. 18) [5] or 3D Spatial Sense [10], Acute Hearing [2/level], Danger Sense [15], Fearlessness [2/level], Night Vision [1/level], Unfazeable [15], or additional Magery [10/level].

**Disadvantages:** -20 points chosen from among Greed [-15\*], Hunchback [-10], Loner [-5\*], Obsession [-5\* or -10\*], Odious Personal Habits [-5, -10, or -15], Phobia (Open Spaces) [-10\*], Supernatural Features [Varies], Workaholic [-5], or Xenophilia [-10\*].

**Primary Skills:** Hidden Lore (Chthonian Lore; p. 21) (A) IQ [2]-13. • One of Geology (Speleology, p. 21) (A) IQ+1 [4]-14 or Naturalist (H) IQ [4]-13.

**Secondary Skills:** Navigation (Underground; p. 21) (A) IQ-1 [1]-12; Stealth (A) DX+1 [4]-12; and Thaumatology (VH) IQ-1 [2]-12†.

**Background Skills:** One of Knife (E) DX+1 [2]-12; or Cloak, Shortsword, or Staff, all (A) DX [2]-11. • A total of 5 points in Climbing (DX/A), First Aid/TL (IQ/E), Hobby Skill (Rock Collecting; p. 21) (IQ/E), Intimidation (Will/A), Leadership (IQ/A), Masonry (IQ/E), Occultism (IQ/A), Prospecting/TL (IQ/A), Survival (Underground; p. 21) (Per/A), or a second combat skill.

**Spells†:** Break Rock (p. 23), Climbing, Ignite Fire, Light, Purify Air, Predict Earth Movement, Seek Earth, Seek Landform (p. 22), Seek Water, Shape Earth, Test Air, and Walk Through Earth, all (H) IQ-1 [1]-12. • One of the following spell packages:

1. *The Way of the Bat:* Keen Hearing, Keen Scanning Sense (Sonar) (p. 18), and Sound Vision, all (H) IQ-1 [1]-12.
2. *The Way of the Mole:* Identify Metal, Seek Fuel, and Test Fuel, all (H) IQ-1 [1]-12.
3. *The Way of the Owl:* Dark Vision, Keen Vision, and Night Vision, all (H) IQ-1 [1]-12.
4. *The Way of the Spider:* Find Direction, Pathfinder, and Trace Labyrinth (pp. 22-23), all (H) IQ-1 [1]-12.

\* Multiplied for self-control number; see p. B120.

† Thaumatology and all spells include +1 from Magery 1.

### Customization Notes

If the realm of the dead lies beneath the ground, a chthonomancer may choose a different option: *The Way of the Scarab*, encompassing Death Vision, Sense Spirit, and Summon Spirit. This requires taking Magery 2 as an advantage, which raises the level of *all* spells to 13 for the same point cost. Replace Hidden Lore (Chthonian Lore)-13 with Expert Skill (Thanatology)-12.

For a lower-powered chthonomancer, drop DX to 10 and reduce total advantages by 5 points. For a higher-powered one, look at some of the high-end underground spells, and raise IQ to 14, for higher ability with *all* spells and many skills. A specialized high-powered template could include Breath Adaptation, Resist Fire, and their prerequisites, for ventures deep into a hollow planet.

A more radical redesign would make the chthonomancer into a priest of the underworld gods. Replace Magery with Power Investiture and Clerical Investment, and treat the listed spells as those granted by the gods (possibly with adjustments; they may not approve of Ignite Fire or Light).

## GEOLOGIST

75 points

From ancient Greek natural historians to high-tech 21st century scientists, people studying the earth often go out into the field. The geologist has basic survival and technical skills and mastery of the scientific knowledge of his age.

**Attributes:** ST 10 [0]; DX 10 [0]; IQ 12 [40]; HT 11 [10].

**Secondary Characteristics:** Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 12 [0]; Per 12 [0]; FP 11 [0]; Basic Speed 5.25 [0]; Basic Move 5 [0].

**Advantages:** Fit [5]. • 15 points chosen from among Administrative Rank [5/level], High Manual Dexterity [5/level], Natural Scientist 1 (p. 19) [10], Single-Minded [5], Status [5/level], Tenure [5], or Wealth (Comfortable) [10].

**Disadvantages:** -15 points chosen from among Absent-Mindedness [-15], Bad Temper [-10\*], Code of Honor (Professional) [-5], Jealousy [-10], Secret (Plagiarism or Scientific fraud) [-10], Shyness (Mild) [-5] or (Severe) [-10], Wealth (Struggling) [-10], or Workaholic [-5].

**Primary Skills:** *Either* Naturalist (H) IQ+1 [8]-13 (at TL0-4) or Geology (H) IQ+1 [8]-13 (at TL5-12). • One of Cartography, Electronics Operation (Scientific), Photography, or

Prospecting, all (A) IQ+1 [4]-13; or Mathematics (Surveying) (H) IQ [4]-12.

**Secondary Skills:** Expert Skill (Natural Philosophy) (H) IQ [4]-12 (at TL0-4) or one of Astronomy, Chemistry, or Physics (Geophysics), all (H) IQ [4]-12; or Physics (VH) IQ-1 [4]-11.

**Background Skills:** Survival (any land specialty) (A) Per-1 [1]-11 and Writing (A) IQ-1 [1]-11. • 2 points in Climbing (DX/A), Computer Operation/TL (IQ/E), Current Affairs/TL (Science & Technology) (IQ/E), First Aid/TL (IQ/E), Hiking (HT/A), Leadership (IQ/A), Mathematics/TL (Applied) (IQ/H), Research/TL (IQ/A), Teaching (IQ/A), or additional skills from the primary skills list.

\* Multiplied for self-control number; see p. B120.

### Customization Notes

Administrative Rank represents employment in a governmental scientific agency. Tenure suits professors at research universities. Wealth (Comfortable) is appropriate to gentlemen (or ladies) with scientific interests.

A variant on this template can represent a paleontologist. Replace Geology with Paleontology (any specialty) as a primary skill. Choose a secondary skill from Anthropology, Biology (Botany, Ecology, Microbiology, or Zoology), Expert Skill (Natural Philosophy), or Geology. Biology without an optional specialty is possible, but less likely, as nearly all paleontologists specialize.

The simplest way to create a lower-cost template is to lower IQ to 11 and either reduce elective advantages to 10 points or increase disadvantages to -20 points. For a higher-cost template, divide added points between raising the scientific skills, including additional scientific skills, and adding classic “adventurer” skills useful in field surveys.

*All I can do at dowsing is find  
water, oil, coal, and gas. I'm no good  
at all on metals – I couldn't feel gold  
if I were perched right on the roof  
of Fort Knox; I couldn't feel radium  
if it were frying me to a crisp.*

– E.E. Smith,

*Subspace Explorers*

## LURKER

125 points

In a world with extensive underground settlements, or haunted underground ruins, some people may specialize in ventures beneath the surface. They may be freelance treasure seekers, or hire out to larger organizations as guides or spies.



**Attributes:** ST 10 [0]; DX 12 [40]; IQ 11 [20]; HT 12 [20].

**Secondary Characteristics:** Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 11 [0]; Per 12 [5]; FP 12 [0]; Basic Speed 6.00 [0]; Basic Move 6 [0].

**Advantages:** 20 points chosen from among Acute Hearing [2/level], Combat Reflexes [15], Danger Sense [15], Eidetic Memory [5], Fearlessness [2/level], Fit [5] or Very Fit [15], Flexibility [5] or Double-Jointed [15], Night Vision [1/level], or Strangler (p. 19) [5/level].

**Disadvantages:** -15 points chosen from among Code of Honor (Pirate's or Professional) [-5], Delusions (Minor) [-5], Greed [-15\*], Loner [-5\*], No Sense of Humor [-10], Phobia (Open Spaces) [-10\*], Social Stigma (Criminal Record or Uneducated) [-5], or Xenophilia [-10\*].

**Primary Skills:** Navigation (Underground; p. 21) (A) IQ+2 [8]-13 and Stealth (A) DX+2 [8]-14. • Two of Garrote, Knife, or Shield (Buckler), all (E) DX+2 [4]-14; Axe/Mace, Cloak, Shortsword, or Wrestling, all (A) DX+1 [4]-13; or Net (H) DX [4]-12.

**Secondary Skills:** Climbing (A) DX [2]-12; Escape (H) DX [4]-12; and Survival (Underground; p. 21) (A) Per [2]-12.

**Background Skills:** 3 points in Breath Control (HT/H), Cartography/TL (IQ/A), First Aid/TL (IQ/E), Fishing (Per/E), Forced Entry (DX/E), Leadership (IQ/A), Naturalist (IQ/H), Scrounging (Per/E), Tactics (IQ/H), or Traps/TL (IQ/A).

\* Multiplied for self-control number; see p. B120.

### Customization Notes

This is a high-cost "adventurer" template. For a less expensive version, cut back the combat skills, and reduce HT and/or total advantages. For a more expensive one, add the advantage Trained by a Master, spend fewer points on other advantages, and add Blind Fighting and perhaps other cinematic skills to the choices of primary skills.

## MINER

50 points

You're skilled in the craft of excavation and underground construction. Your abilities can be useful in escaping from prison, bypassing or undermining fortress walls, or extracting valuable minerals from the earth.

With advancing technology, miners use different methods and need different skills. This template has distinct skill options for different TLs. Some overlap exists, both because some technologies become available midway through a TL, and because large projects can adopt advanced methods while small ones struggle along with older ones.

**Attributes:** ST 11 [10]; DX 10 [0]; IQ 11 [20]; HT 10 [0].

**Secondary Characteristics:** Damage 1d-1/1d+1; BL 24 lbs.; HP 11 [0]; Will 11 [0]; Per 11 [0]; FP 10 [0]; Basic Speed 5.00 [0]; Basic Move 5 [0].

**Advantages:** Fit [5]. • 15 points chosen from among Absolute Direction (p. 18) [5] or 3D Spatial Sense [10], Fearlessness [2/level], Night Vision [1/level], Resistant to Respiratory Poison (+3) [3] or (+8) [5], Single-Minded [5], or increase Fit [5] to Very Fit [15].

**Disadvantages:** -25 points chosen from among Bad Sight (Nearsighted) [-25] or (Nearsighted; Mitigator, -60%) [-10], Bad Temper [-10\*], Bully [-10], Code of Honor

(Professional) [-5], Flashbacks [Varies], Overconfidence [-5\*], Sense of Duty (Workmates) [-5], Stubbornness [-5], or Workaholic [-5].

**Primary Skills:** Masonry (E) IQ+1 [2]-12. • One of the following options (chosen based on campaign tech level):

1. TL0-3: Forced Entry (E) DX+2 [4]-12 and Lifting (A) HT+2 [8]-12.
2. TL3-8: Explosives (Demolition) (A) IQ+2 [8]-13 and Forced Entry (E) DX+1 [2]-11. • One of Driving (Locomotive) (A) DX [2]-10, Teamster (Equines or Oxen) (A) IQ [2]-11, or Lifting (A) HT [2]-10.
3. TL7-9: Driving (Construction Equipment) (A) DX+2 [8]-12 and Mechanic (Construction Equipment) (A) IQ [2]-11. • One of Driving (Automobile, Heavy Wheeled, Locomotive, or Tracked) (A) DX [2]-10 or Mechanic (Conveyors) (A) IQ [2]-11.
4. TL9-12: Electronics Operation (Sensors) (A) IQ+1 [4]-12 and Mechanic (Nanomachines or Robotics) (A) IQ+2 [8]-13.

**Secondary Skills:** Navigation (Underground; p. 21) (A) IQ [1]-11. • One of Prospecting (A) IQ+1 [4]-12 or Engineer (Civil or Combat) IQ [4]-11.

**Background Skills:** 3 points in Brawling (DX/E), Carousing (HT/E), Intimidation (Will/A), Mathematics/TL (Applied) (IQ/H), Mathematics/TL (Surveying) (IQ/H), Mechanic/TL (Power Tools or Pumping Equipment) (IQ/A), or Soldier/TL (IQ/A).

**Technique:** 3 points in Bracing and/or Scaffolding (see *Masonry Techniques*, p. 21).

\* Multiplied for self-control number; see p. B120.

### Customization Notes

A simple way to create a miner with lower point cost is to drop IQ to 10 and remove the techniques (getting by on the Masonry-3 default). A higher-cost template might go in one of two directions: Either raise IQ to 12, drop the technique, and invest in Engineer (Mining) and one of Administration or Leadership; or raise ST to 13 and enhance some physical skills.

## Subterranean Supers

Purely subterranean supers are much less common than aquatic ones, and many of them are villains (such as the Fantastic Four's first adversary, the Mole Man). Often they depend on digging vehicles (*Vehicles*, p. 26).

The inherent ability to travel through the ground can be represented as Tunneling or, less straightforwardly, as high ST with the Burrower perk (p. 19). With this combination, ST 950 grants the ability to dig through 180,500 cubic feet per hour of soil, sufficient to create a man-high tunnel 3,610 yards long, which amounts to Move 1. (This costs far more than Tunneling, but extreme strength has many other uses!)

Other powers can usefully accompany underground movement: high levels of Pressure and Temperature Tolerance; Doesn't Breathe and Sealed; Damage Resistance and Nictitating Membrane; and sensory abilities able to work through rock, such as Sensitive Touch or a suitable Scanning Sense (p. 18).

# ADVANTAGES, DISADVANTAGES, AND SKILLS

For underground adventurers or races, a variety of modified or new traits are suitable.

## ADVANTAGES

The following advantages have special applications in an underground campaign.

### *Absolute Direction*

see p. B34

Absolute Direction gives +3 to Navigation (Land). This applies to finding your way along twisting or branching tunnels, but doesn't give a sense of relative depth. 3D Spatial Sense gives +2 to Navigation (Underground) (p. 21). In addition to the benefits of Absolute Direction, it lets you keep track of your depth, or judge the direction and distance to the nearest other tunnel – for example, in digging out after a cave-in.

### *Dark Vision*

see p. B47

Supernatural races or creatures that live underground may have this ability. Natural races or animals generally should not.

### *Detect*

see p. B48

Substances that might be detected beneath the ground include the following options.

*Rare:* Any specific gemstone or rare mineral; geodes; gold; meteoritic iron; native copper; silver.

*Occasional:* Any specific common mineral (basalt, feldspar, marble, quartz, etc.); ferrous ores; gemstones; precious metals.

*Common:* Clay; igneous rock; metal; metamorphic rock; petroleum; sand; sedimentary rock; water.

*Very common:* All minerals.

### *Filter Lungs*

see p. B55

This advantage can protect against the effects of dust in an underground environment, both short-term (coughing or choking) and long-term (black lung, silicosis, and the like).



### *Flexibility*

see p. B56

Flexibility and Double-Jointed add their bonuses to Climbing and Escape rolls to maneuver in caves (see *Movement*, pp. 11-12, and *Narrow Passages*, p. 12). They are not cumulative with bonuses from Total Exhalation (p. 22).

### *Infravision*

see p. B60

The ability to see heat sources has special effects in underground environments; see *Perception*, p. 10.

### *Night Vision*

see p. B71

The standard cost for Night Vision improves vision in partial darkness, but lets you see *just as well* in full daylight. A race can instead have a different native light level, giving it unmodified vision at that light level, but -1 for each level brighter or darker its surroundings are. This version of Night Vision is a feature costing 0 points.

### *Pressure Support*

see pp. B77-78

Air pressure underground becomes 10 times greater with each 12.5 miles of depth (see *Hostile Environments*, pp. 12-13). At great depths, Pressure Support is needed for survival.

### *Resistant*

see pp. B80-81

Respiratory poisons, an Occasional condition, include the various “damps” that cave explorers or miners may encounter (see *Hostile Environments*, pp. 12-13).

### *Scanning Sense*

see p. B81

Underground races and creatures (such as bats) often have Sonar. Races and creatures that burrow through soil, tunnel through rock, or swim in magma can have other senses.

*Ground-Penetrating Radar* has a base range of 200 yards. Like standard radar, it can only detect large, dense objects; it cannot distinguish objects smaller than 10” (SM -5) or determine details of shape. However, it penetrates dense solid matter, such as soil and rock, to a depth of 10 yards. Increased Range may be applied separately to either the base range or the penetration depth. It works better in actual contact with the ground, which avoids distortion at the earth/air interface: +2 to Per rolls. Cost is 20 points.

*Sonar* can be adapted to represent the active use of seismic vibrations to probe the underground environment. The low frequencies can travel through solid rock as well as magma, but give poor resolution; treat it as having both Penetrating (+50%) and Vague (-50%). Increase base range to 7,000 yards. Cost is 20 points.

Sonar right out of the *Basic Set*, at its usual cost and without modifications, can represent the use of ultrasound in molten magma. Sound travels faster in magma, because of its higher density; increase base range to 5,000 yards.

## Sensitive Touch

see p. B83

Some burrowing creatures have Sensitive Touch. For example, the star-nosed mole has 25,000-30,000 specialized tactile receptors on its nose, which give it bonuses to identify food (Survival) and detect seismic vibrations (such as footsteps, explosions, and earthquakes).

## Slippery

see p. B85

This advantage enhances Escape skill for squeezing through narrow openings (see *Narrow Passages*, p. 12). It is cumulative with bonuses from Total Exhalation (p. 22).

## Subsonic Hearing

see p. B89

This includes perception of seismic vibrations (such as footsteps, explosions, and earthquakes).

## Talent

see p. B89

For general rules governing Talents, see the *Basic Set*. These new Talents are useful in *GURPS Underground Adventures*.

*Natural Scientist:* Astronomy, Biology, Chemistry, Expert Skill (Hydrology and Natural Philosophy), Geology, Mathematics (Applied, Statistics, and Surveying), Metallurgy, Meteorology, Paleontology, Physics, and Physiology. *Reaction bonus:* Other scientists and anybody impressed by "smart people." 10 points/level.

*Strangler:* Brawling, Stealth, Tracking, and Wrestling. *Reaction bonus:* None – the whole point is sneaking up on and throttling your prey! 5 points/level.

*Survivor:* First Aid, Knot-Tying, Naturalist, Scrounging, and Survival. *Reaction bonus:* Boy Scouts, campers, and survivalists. 5 points/level.

## Temperature Tolerance

see p. B93

Each level of this advantage adds only HT/5 degrees to your "comfort zone" in water (see *Hot and Cold Water*, p. 12).

## Tunneling

see p. B94

The speeds attained with this advantage are much higher than real organisms can manage. Use it to represent subterranean supers, superscience vehicles, and mythical or cinematic monsters. To create a biologically plausible burrower, see *Burrower* (below).

## PERKS

The following perks are useful to cavers or miners. Perks with a \* after the name are racial/super perks not available to normal humans.

## Burrower\*

Part of your body (often your hands) can function as a shovel, letting you burrow through loose or ordinary soil (see *Digging*, p. B350). This is slower than Tunneling (above).

## Climbing Line\*

You can create a climbing line at will, in the form of a silk thread, spider web, or the like. This gives you improved climbing ability (p. B349; *Movement*, pp. 11-12). Buy Binding (p. B40) if you want to entangle foes.

## Horizontal Jackhammering

A jackhammer (p. 25) is normally used only in a vertical or near-vertical position, as it's too awkward to support at an angle. However, two operators can team up to wield one horizontally against a rock face. One holds the hammer on his shoulders, one operates it, and both lean into it to press it to the work surface. Both must have this perk.

## Illumination\*

You can emit light from your own body or part of it, or from the space immediately around your body. This is equivalent to a flashlight (a narrow 10-yard beam) or a torch (lights a two-yard radius). When in use, it lets you see in the deepest caves – but it also let others see you. See *Perception* (p. 10) for more details.

## Pressure-Tolerant Lungs\*

Your lungs and other organs can handle higher atmospheric pressures than an ordinary human's. Add dense atmospheres to the range of pressures you can breathe without penalty, and shift the penalties for denser atmospheres, respectively, by one class; see *Atmospheric Pressure* (p. B429).

## Standard Operating Procedure

Standard Operating Procedure exempts the player from having to tell the GM that that PC is doing something that should be second nature for him.

You always get the benefit of the doubt. You *must* specialize; each procedure is a separate perk. Here are two examples relevant to cave exploration.

*Piton Testing:* When climbing with the aid of pitons (p. 23), you always remember to drive them in securely, and to test how firmly they are seated.

*Safe Diver:* You check your scuba gear obsessively. If you take at least the minimum four minutes to prepare for a dive, you automatically succeed at spotting any problems before you put it on. If you have any points invested in Penetration Diving (p. 22), this extends to checking that you have the necessary additional gear and that it works; otherwise, you still have to roll.

## DISADVANTAGES

The following disadvantages have special applications in an underground campaign.

## Blindness

see p. B124

Races and creatures that live permanently in caves commonly have this disadvantage.



## Disciplines of Faith

see p. B132

Caves are a classic place for the practice of Asceticism.

## Invertebrate

see p. B140

This trait's "side benefit" is especially useful underground. If you use Escape to get through narrow passages (p. 12), you are at +3 to skill, cumulative with modifiers from body weight. If you practice total exhalation (p. 22), being stuck does not prevent you from inhaling!

## Phobia

see pp. B148-150

Underground adventurers should not fear darkness or enclosed spaces. Actual cave dwellers often fear *open* spaces. In a campaign set entirely underground, reduce the value of agoraphobia to -5\* points.

*Take nothing except pictures;  
leave nothing except footprints.*

## QUIRKS

Some quirks are especially relevant to underground campaigns.

### Code of Honor

see p. B163

*Caver's*: Take nothing except pictures; leave nothing except footprints; protect the caves you explore from damage; help other cavers who get into trouble.

### Distinctive Features

see p. B165

It's common for full-time cave creatures to be albinos.

### Likes

see p. B164

Being underground is an appropriate subject for this quirk. So are things that can be found there, from gems to the rubbish heaps of dead civilizations.

## SKILLS

The following skills work a bit differently, or have added benefits, in an underground campaign.

### Blind Fighting

see p. B180

The same skill that lets you sense targets when fighting in total darkness lets you avoid obstacles. Rock formations don't

move or make noise, so you depend partly on echoes of your own footfalls and breathing, and partly on senses other than hearing, for -5 to effective skill. At speeds greater than your Basic Move, this skill only works on a critical success.

## Driving

see p. B188

Use the Construction Equipment specialty to operate realistic digging vehicles. For futuristic or weird-science vehicles that mimic living organisms, use the Mecha specialty.

## Electronics Operation and Electronics Repair

see pp. B189-190

Field equipment used in geology and seismology falls under Scientific. Remote sensing, including satellite mapping technologies, falls under Sensors.

Electronics Operation covers many complex devices that had non-electronic (usually mechanical) equivalents before the emergence of electronics at TL6. At TL5 and below, the rules for this skill still apply, but it's less jarring to call it "Machine Operation." Electronics Repair (p. B190) doesn't exist at these TLs; the related repair skill is Mechanic (p. B207).

## Engineer

see p. B190

The main specialty for excavation, mining, and underground construction is Mining, but either Civil or Combat can be used for suitable types of construction. Subterranean vehicles can count as a vehicle type.

## Escape

see p. B192

This skill can be used to crawl through narrow openings in caves; see *Narrow Passages* (p. 12) and *Total Exhalation* (p. 22).

## Expert Skill

see pp. B192-193

The skill of Natural Philosophy includes early geological observations and speculations, up to the end of the 18th century and the first geological timelines.

## Forced Entry

see p. B196

This skill can be applied to the use of man-powered tools in mining and tunneling. If you have Forced Entry at a level that grants +1 or +2 to damage to inanimate objects, apply the same bonus to ST in estimating the rate at which you can break up soil, clay, or rock with a pick or penetrate it with a drill. The bonus doesn't apply to shoveling.

*Example*: Mjothvitnir, a dwarf miner, has ST 11, DX 10, and Forced Entry-12. For purposes of breaking hard soil or rock, his ST is treated as 13 and his BL as 34. He can break 34 cubic feet/hour of hard rock, rather than 24 cubic feet/hour.

## Geology

see p. B198

Starting at mid-TL5, Geology can be used to answer questions about the interior of the planet. Optional specialties within geology include speleology, the study of caves.

## Hidden Lore

see p. B200

In worlds inhabited by spirits or supernatural beings, this includes a specialty relevant to underground ventures.

*Chthonian Lore:* You are knowledgeable about underground spirits, including those that are found in caves and in mines.

## Hobby Skill

see p. B200

Rock collecting (also called amateur geology or rockhounding) is mainly IQ-based. It can substitute for Geology or Prospecting to identify mineral specimens, but not to answer broader scientific questions about them, or judge the economic value of mineral deposits. A Per-based roll can spot interesting minerals in the field.

## Masonry

see p. B207

This skill applies to tunnels as well as to aboveground buildings. Both types of construction require judging the stability of stone walls and roofs under loads. See *Structural Integrity* (pp. 13-14).

## Mechanic

see p. B207

The following important specialty emerges at TL3.

*Machine Type:* Pumping equipment. Includes pumps for water and other fluids, and ventilators for air.

## Navigation

see p. B211

Navigation (Land) is partially usable in caves and tunnels. It can keep track of which passages you've chosen and which turns you've taken. However, in a multilevel cave complex or mine, it won't keep track of what level you're on or of the spatial relations between levels. That requires the following new specialty.

*Underground:* Underground navigation in three dimensions, usable in multilevel complexes or in subterranean vehicles. *Modifiers:* -3 without a compass. +2 for 3D Spatial Sense (p. B34). *Defaults:* Mathematics (Surveying)-4. Land and Underground default to each other at -2.

## Scuba

see p. B219

Putting on scuba gear quickly, for an unmodified roll, takes four minutes. A trained diver will usually take 30-35 minutes, gaining +3 for extra time (p. B3460). Having room to lay out

diving gear, and freedom from distractions, provides an extra +1. Both bonuses apply throughout a dive, reflecting having your gear *just so*. Unmodified rolls reflect diving in a hurry, under stressful conditions.

Diving in caves (*Penetration Diving*, p. 22) demands extra preparation; the initial roll to set up and check equipment is at -2.

## Survival

see pp. B223-224

For underground campaigns, Survival has an additional terrain type, Underground. This version applies primarily to survival tasks in natural caves, but can also be used with abandoned mines that wildlife has colonized. Underground and land specialties default to each other at -4. Each type of cave (p. 31) is a familiarity within this skill; abandoned mines are another familiarity.

## TECHNIQUES

Several new techniques are useful in caves or tunnels.

### Cane Travel

Hard

*Default:* DX-6; cannot exceed DX-1.

Primarily, those who are blind use this technique, but it can also be applied in lightless environments, such as many caves. Feeling your way with a cane or staff can detect hazards without walking into them (see *Perception*, p. 10). Cane Travel can offset much of the penalty for movement in total darkness. Its use *substitutes* for taking extra time (p. B346); the combination of Cane Travel with extra time cannot allow a better roll than DX-1 to move without vision.

Alternatively, Cane Travel may default to Blind Fighting-5, with a maximum of Blind Fighting, if the GM allows this skill.

### Masonry Techniques

Average

*Default:* Masonry-3.

*Prerequisite:* Masonry; cannot exceed Masonry.

The Masonry skill covers dozens of specialized tasks. Many of these are done at a penalty – typically -3, although the GM is free to assess anything from -1 to -10, depending on difficulty. Those who specialize in these tasks may buy off the penalty as an Average technique. If you intend to learn more than a couple of techniques, it makes more sense to raise Masonry! Examples of techniques include the following.

*Bracing:* Setting up props to hold up the ceiling of a tunnel, or to support the construction of an arch.

*Hoisting:* Building a crane to raise a massive load.

*Scaffolding:* Building a framework for masons or miners working above the ground or the floor of a mine.

At the GM's discretion, some of these techniques may default to other occupational skills. For example, Hoisting could logically default to Seamanship-3 and have Seamanship as a prerequisite.

## Penetration Diving

Average

*Default:* Scuba-2.

*Prerequisite:* Scuba; cannot exceed Scuba.

This is a technically specialized form of diving, practiced when direct ascent to breathable air is impossible, as in cave diving (p. 12) or exploring wrecks or submerged structures. Preparations include carrying extra air for emergencies, multiple light sources, and guidelines to help you navigate. If you roll above your Penetration Diving, but not above your Scuba skill, you get lost and must roll vs. Navigation (Underground) (p. 21) to find your way out before your air runs out.

## Total Exhalation

Hard

*Default:* Escape+1.

*Prerequisite:* Escape; cannot exceed Escape+3.

This is exhaling as completely as possible before squeezing through a tight passage. It raises the caver's chances of getting through, but at a risk: A critical failure means being stuck. See *Narrow Passages* (p. 12) for the effects.

A successful roll against Breath Control gives +1 to Total Exhalation, or +2 on a critical success. This *can* exceed Escape+3.

# SPELLS

New spells especially suited to underground activities are available in several colleges.

## AIR SPELLS

Underground atmospheres can present special hazards (see *Hostile Environments*, pp. 12-13), against which these spells warn or protect.

### Test Air

**Area; Information**

Determines if the atmosphere within the spell's radius is safe to breathe. The spell detects toxic substances such as "damps" and injurious dust particles. It also reveals unbreathably low oxygen levels (or a fantasy-world equivalent, such as phlogiston saturation). It does not check for magic in the air.

*Base cost:* 1/3; minimum cost 1.

#### Item

Staff, wand, or jewelry. *Energy cost to create:* 100.

### Monitor Air

**Area; Information**

Keeps track of the atmosphere's breathability on a continuing basis. Warns against the same harmful substances as Test Air, but also against low oxygen content or other forms of devitalized air.

*Duration:* 8 hours.

*Base cost:* 2 to cast. 1 to maintain.

*Prerequisite:* Magery 1 and Test Air.

#### Item

Jewelry. Monitors the air around the wearer as long as it is worn. *Energy cost to create:* 600.

### Breath Adaptation

Regular

The subject's lungs can adapt to great pressure, permitting him to breathe unhindered (and avoid the bends) at up to 10 atmospheres. This allows him to travel as deep as 12.5 miles

underground (see *Hostile Environments*, pp. 12-13). He gains Pressure Support 1 (Accessibility, Not under water) for the duration of the spell; see p. B77 for details.

For higher levels of Pressure Support, or to dive to great depths, use Resist Pressure (*GURPS Magic*, p. 169).

This is also a Body Control spell.

*Duration:* 1 hour.

*Cost:* 4 to cast. 2 to maintain.

*Prerequisites:* Resist Poison and Shape Air.

#### Item

Jewelry or face mask. Grants the ability to survive high pressure as long as it is worn. *Energy cost to create:* 900.

## EARTH SPELLS

Earth is obviously the primary source of underground spells. The following spells can be considered a specialized side branch of the college of Earth.

### Seek Landform

**Information**

Identical in application and mechanics to Seek Pass (*Magic*, p. 51), this spell can be applied to terrain features of any specified kind. In particular, the caster can use it to find the mouths of caves.

### Trace Labyrinth

**Regular**

Must be cast underground, normally immediately on entry to an underground space. As long as the spell is active, it will create a magical trace of the caster's movement, which the caster can see as a faintly glowing line. After the spell lapses, the trace extends no further, but remains visible as long as the caster is underground, and vanishes immediately when he leaves.

This is also a Knowledge spell.

*Duration:* 1 hour.

*Cost:* 3 to cast. 1 to maintain.

*Time to Cast:* 10 seconds.

*Prerequisites:* Magery 1 and Seek Landform.

## Item

A spindle or spool of thread. The user does not actually reel out the thread, but he must hold the item for it to be active. *Energy cost to create:* 500.

## Break Rock

### Regular

Reduces a volume of rock to smaller pieces. Can be applied either to part of the wall of a cave or mine, or to a freestanding boulder. The result can be smaller boulders (averaging one cubic foot and 150 lbs.), rubble suitable for construction, or gravel; only gravel can be shoveled out. The mass of rock will collapse naturally after it breaks.

*Cost:* 2 per cubic yard for smaller boulders; 3 per cubic yard for rubble; 4 per cubic yard for gravel. Minimum is one cubic yard.

*Prerequisite:* Shape Earth.

## Item

Staff, wand, or digging tool. *Energy cost to create:* 250.

## KNOWLEDGE SPELLS

An additional form of the spell Divination is often applied to buried things.

*Rhabdomancy* is divination with rods, such as dowsing rods (p. 25). A rod is held in the hand, or a forked stick in both hands; hazel twigs are traditionally used. The diviner walks over the site where the desired object or substance might be found. If the subject of the divination is present, the stick points downward or twitches when the caster passes over it. This is best for finding caves, underground water, veins of metal or mineral, buried treasure, grave sites, or archaeological ruins. Its use to locate things that are not buried in natural earth is at -5. *Prerequisites:* Seek spells for the four classical elements.

# EQUIPMENT

The *Basic Set* and several supplements list a variety of gear that's useful on ventures underground. This section provides page references for previously explained gear, rather than descriptions (other than weight and cost). It explains new gear in detail. Gear is listed alphabetically rather than by TL.

## CLIMBING GEAR

Explorers can use this gear to climb slopes, walls, or chimneys in caves.

*Ascender:* **High-Tech**, p. 55. \$50, 1 lb. TL6.

*Descender:* **High-Tech**, p. 55. \$50, 0.75 lb. TL6.

*Gecko Gear:* **Ultra-Tech**, p. 96. Set of four pads: \$2,000, 0.4 lbs. TL10.

*Grappling Hook:* **Low-Tech**, p. 125; **High-Tech**, p. 55. Unpadded, \$20, 2 lbs.; padded, \$30, 3 lbs. TL1.

*Gripboots:* **Ultra-Tech**, p. 75. \$500, 2 lbs. TL9.

*Harness:* **High-Tech**, p. 55. \$75, 3 lbs. TL5.

*Harpoon:* A projectile for a heavy crossbow or a scorpion, with an attached rope; see **Low-Tech**, p. 125. \$30, 2 lbs. TL3.

*Mini-Rappel Kit:* **High-Tech**, p. 55. \$150, 3 lbs. TL8.

*Personal Lifting Device:* **High-Tech**, p. 56. \$8,000, 7 lbs.; fuel cartridge \$100, 2 lbs. TL8.

*Pitons and Hammer:* **Low-Tech**, p. 125. Hammer: \$10, 1 lb. Two pitons: \$8, 1.5 lbs. TL2.

*Rope:* **Low-Tech**, pp. 23-24; **High-Tech**, p. 56; **Ultra-Tech**, p. 81. Rope should be checked for mechanical, thermal, or chemical damage before each use; make a Per-based roll vs. Climbing or Knot-Tying to detect faults. If the roll fails, or if the climber skips this step, a natural 18 indicates breakage; any other critical failure, or any critical failure on a checked rope, indicates that a knot has come untied or an attachment has pulled out (see p. B349). Weight and cost vary with material and thickness. TL0.

*Smart Pitons:* **Ultra-Tech**, p. 76. Two pitons: \$20, 0.2 lb. TL9.

## EXPLOSIVES

Explosives are useful for fragmenting rock. Breaking up one cubic yard of rock requires 7.2 lbs. of black powder or ammonium-nitrate-fuel-oil (ANFO) mixture (\$2/lb.), 3.6 lbs. of 80% dynamite (\$2/lb.), 2.9 lbs. of TNT (\$10/lb.), 1.9 lbs. of nitroglycerine (\$15/lb.), 2.1 lbs. of C4 (\$10/lb.), 0.9 lbs. of octanitrocubane (\$20/lb.), or 0.6 lbs. of stabilized metallic hydrogen (\$40/lb.) (all listed on p. B415). This is placed in one or more holes drilled in the rock and tamped, or surrounded by clay or dirt, and packed in (roll vs. Demolition or Engineer). On a failed roll, or if the explosives are simply placed on the rock surface, multiply the required weight by 10.

Drilling and blasting is a slow method of tunneling, averaging 0.5 yards/hour with high explosives, and half that, or less, with black powder. At TL3-5, blasting is an adjunct to hand digging, not a substitute.

## LIGHTING

This gear supplies light in underground environments.

*Carbide Lamp:* **High-Tech**, p. 51. Worn in a helmet mount. Invented in 1897, and used through most of the 20th century. \$50, 3 lbs.; calcium carbide for 5 hours, \$0.30, 0.25 lb. TL6.

*Electric Lamp:* A high-intensity electric lamp that projects a 120' beam. Worn in a helmet mount. Power comes from a belt-mounted wet-cell battery good for 12 hours per recharge. Invented after World War I. \$225, lamp and cord 1.5 lbs., battery 4 lbs. TL6.

*Sealed Oil Lamp:* A small pottery lamp holding 1/3 pint of oil, sealed except for a spout for a wick and a small hole for ventilation; can be strapped onto a miner's head. Gives dim light that reduces darkness penalties to -4. Burns for eight hours when full; used to time a miner's shift. \$10, 1 lb. (when filled). TL2.

*Torch:* **Basic Set**, p. 288; **Low-Tech**, p. 33. \$3, 1 lb.; if dipped in pitch, \$7, 1 lb. TL0.

## NAVIGATION

The following gear can be used for guidance underground.

*Local Positioning System (LPS):* Global positioning systems (GPS) don't work underground, because the signals they rely on are blocked. However, an underground space can be equipped with radio-frequency identification devices (RFIDs), whose relative locations are mapped and programmed into them. Anyone with a suitable radio transceiver and map display can use them to gain +2 to Navigation (Underground) (p. 21). \$100, 0.5 lb. TL9.

*Surveyor's Kit:* **Low-Tech**, p. 43; **High-Tech**, p. 53. Used to keep a tunnel level and straight when excavating the space. \$245, 40 lbs. TL2. More advanced equipment gives +2 to Navigation. \$1,000, 300 lbs. TL5.

## PROTECTIVE CLOTHING

People who work underground wear specialized clothing for their own safety and comfort.

*Cooling System:* **High-Tech**, p. 74. \$200, 5 lbs. TL8.

*Helmet:* Essentially the same as a hard hat (**High-Tech**, p. 70), but with a lamp mount in the front. 1 lb., \$60. TL5.

*Heavy Clothing:* Clothing made of thick fabric with limited water retention (wool or synthetics), plus a durable belt. Protects torso, arms, legs, and vitals: DR 1. \$90, 12 lbs. Worn with gloves and boots that protect hands and feet: DR 2. 3 lbs., \$110. TL3.

*Leather Apron:* **Low-Tech**, p. 99. \$60, 3 lbs. TL1.

## SCIENTIFIC APPARATUS

Geologists have developed a variety of observational and field methods for studying underground structures. Operation calls for a roll vs. Electronics Operation (Scientific) at TL6 or above; at TL5 and earlier, the skill is called "Machine Operation" (see *Electronics Operation and Electronics Repair*, p. 20). Roll vs. Geology to interpret the results, unless otherwise noted.

### Seismic Instruments

Many geological events – including earthquakes, landslides, and eruptions – produce seismic activity, or ground vibrations. Tremors and landslides can be detected within several miles; major earthquakes can be detected *anywhere* on Earth. No roll is needed to *notice* large events; roll vs. skill to detect smaller events and how far away they are. Three readings from different locations are enough to locate an event with a roll vs. Cartography. Seismic-wave analysis also provides information about the mantle and core (pp. 8-9).

During World War I, seismographs were used to locate enemy artillery. Underground nuclear explosions can be detected anywhere on Earth; nuclear arms control largely relies on networks of seismographs. In the 1920s, oil companies started using seismic waves created with buried explosives to map subsurface oil deposits – in effect, this is very-low-frequency sonar. In 1953, reusable "thumper" units came on the market.

Seismic vibrations can be created with any of several methods.

- Drill a hole down to bedrock (at least 30') and roll vs. Explosives (Demolition) to set up a buried charge of dynamite; 2 lbs. is typical.

- Roll vs. Explosives (Demolition) to set up 10 charges of dynamite on 10' poles for simultaneous detonation; 5 lbs. per charge is typical.

- Drop a two-ton weight from 10' up; roll vs. Driving (Construction Equipment), Engineer (Civil, Combat, or Mining), or Hoisting (*Masonry Techniques*, p. 21) to set this up.

- Use a seismic source (below).

### Seismic Source

This mechanical device is used for creating ground vibrations. The earliest units weighed over a ton and were carried on specially built "thumper trucks." Modern units are much smaller, powered by a lead-acid battery, and can be mounted on a small cart or any vehicle with a hitch. \$10,500, 220 lbs. Battery: \$35, 6 lbs., provides 1,500 uses. TL8.

The following equipment can be used for seismic measurements.

*Earthquake Detector (Didong Yi):* This ancient Chinese device, invented by Zhang Heng in 132 A.D., was a copper urn enclosing a pendulum that could be set in motion by seismic vibrations; its swing would release one of eight copper balls in holders spaced around the outside, pointing in the eight cardinal directions, dropping it into a receptacle beneath. Which ball dropped showed the direction of the earthquake. It can't measure intensity or distance, but is sensitive enough to respond to earthquakes several hundred miles away. \$5,000; 240 lbs. TL2.

*Geophone:* A small ground-vibration detection device, used in strings placed 20' apart, which typically consist of six or 12 units. Each unit has a spike that can be driven into the ground for proper sensitivity. Can also be used as improvised intruder-detection systems; 12 geophones will enclose a square 60' on a side or a circle 75' in diameter. Roll vs. Electronics Operation (Security) to set up; roll vs. Camouflage to conceal. \$80, 0.2 lb. Wire, per 20': 2 lbs., \$5. TL7.

*Seismograph:* Detects vibrations from earthquakes, other geological disturbances, and explosions. Must be stationary and in good contact with the ground. Roll vs. Geology or Prospecting to interpret data. Mechanical seismograph (available 1880): \$10,000, 250 lbs. TL6. Electromechanical seismograph (available 1910): \$20,000, 50 lbs. TL6.

### Drills and Samples

A drill rig able to bore through solid rock can collect material from deep within the earth's crust. (These are "core samples," but they do not come from the core!) Geologists and paleontologists can analyze their composition, estimate their age from the radioactive elements they contain, and find fossils or even living microorganisms in them (see *Life Under Pressure*, pp. 29-30). Roll vs. Driving (Construction Equipment) to collect a usable sample. Core sampling is a TL6 technique; H.P. Lovecraft refers to it in *At the Mountains of Madness*.

A nominally backpack-portable drill rig can make a 2"-diameter hole at 4.25"/minute in hard rock. This is suitable for taking rock cores near the surface; it can also make holes for dynamite or other explosive charges for blasting. \$4,000, 90 lbs. TL6.



## Dowsing Rods

Dowsing is a form of divination (see *Rhabdomancy*, p. 23), first recorded in 1518, when Martin Luther condemned it as a violation of the First Commandment (against idolatry and worship of false gods). Mages learn this form as a spell.

In a TL8 setting, various devices are sold as high-tech equivalents of dowsing rods.

*Remote Substance Detector*: An electronic device with a handgrip and an antenna, capable of being set to detect various substances (explosives are a common choice). In the real world, these devices have no actual function; for their fraudulent use, roll vs. Fortune-Telling (p. B196). In a fantasy campaign, they can be a focus for rhabdomancy (p. 24), with four technological spells as an alternate prerequisite. In a weird-science campaign, they can be a focus for psionic powers, or provide a technological substitute

for them, operated with Electronics Operation (Psychotronic) or Electronics Operation (Sensors) (p. B189). Use long-distance modifiers for range. \$6,000, 6 lbs.

In some settings, nonmages may learn rhabdomancy with the aid of the following perk.

### Unusual Training

You can learn and use the skill of rhabdomancy under specific, limited conditions, without learning its prerequisite spells and without having Magery. In a mundane setting, the condition may be the presence of environmental cues that you recognize subconsciously. In a fantasy setting, it can be initiation into a mining guild, the friendship of earth spirits, devotion to a suitable saint, or the like; you may be called a doodlebug or water witch.

## Exterior Fields

Other geological methods detect fields of force or energy from subsurface structures or processes. These include gravitational and magnetic fields, heat flows, and radiation. Gravitational fields are stronger over denser materials; since rock is denser than water, they can reveal submerged mountains. Roll at -4 to detect differences in subsurface rocks; this can identify petroleum deposits. Magnetism can identify iron ores; roll at -4 for subtler differences between rock strata. A thermal probe in a borehole can measure how fast temperature increases with depth, or, with a heating element at its tip, can determine thermal conductivity of rock. A more advanced technology applies hyperspectral imaging methods to geological data. The following instruments are commonly used.

*Geiger Counter*: **High-Tech**, p. 49. A TL6 model is \$800, 4 lbs.; a TL8 model with a digital display is \$500, 0.5 lb.

*Gravity Meter*: Classical pendulum gravimeters are \$50,000, 165 lbs. TL7. Compact modern models are \$2,500, 10 lbs. TL8.

*Hyperspectral Imaging Array*: **Ultra-Tech**, p. 61. Gives +3 to detection and analysis rolls. \$160,000, 50 lbs. TL9.

*Magnetometer*: Measures local magnetic fields; acts as a metal detector within one yard. 5 lbs.; 0.1 cubic foot; \$4,000, 6 lbs. TL7. An advanced SQUID magnetometer gives +3 to detection and analysis rolls. \$20,000, 5 lbs. TL9.

*Thermal Probe*: Inserted into a drilled hole in rock up to 20' deep; includes a heat source for thermal-conductivity measurements and a thermocouple to measure temperature. \$150, 2.5 lbs. TL7.

## Deep Imaging

Several other methods project externally generated energy into the earth, and use the transmitted or reflected energy to measure aspects of its structure.

*Electrical Resistivity Array*: An electrical source and a set of detectors, used in an array spaced about 20' apart. Determines the conductivity of underground strata; since this depends

mainly on underground water, roll vs. Expert Skill (Hydrology) to interpret. Source unit: \$7,000, 13 lbs. TL7.

*Ground-Penetrating Radar*: A small radar unit designed to map subsurface features, mounted on a tricycle base. Available in low-frequency (25-200 MHz) and high-frequency (300-1,000 MHz) versions. Low frequencies penetrate 30-150' and produce an image with a resolution of one yard. High frequencies penetrate 0-30' and produce an image with a resolution of one foot. It works better in actual contact with the ground, which avoids distortion at the earth/air interface: +2 to Electronics Operation (Scientific) rolls. Larger vehicular arrays exist that are operated with Electronics Operation (Sensors); these give +2 to Electronics Operation rolls to find geological formations. \$9,500, 27 lbs., 5 lbs. for high-frequency antenna, 45 lbs. for low-frequency antenna. TL7.

*Ultrasonic Mapper*: A handheld ultrasonic device that instantly measures an enclosed space's dimensions, accurate to within 1%; maximum range is 50'. \$35, 0.1 lb. TL9.

## TOOLS

A variety of tools are available for working soil, rock, and ores.

*Chisel*: **Low-Tech**, p. 30. \$20, 0.75 lb. Bronze: TL1. Iron: TL2.

*Crowbar*: **Low-Tech**, p. 30. \$95, 8 lbs. TL1.

*Disassembler Nanoswarm*: **Ultra-Tech**, p. 169. Per square yard: \$10,000, 2 lbs. TL11.

*Drifter*: A heavy-duty version of a jackhammer, mounted horizontally on a wheelbase. Drills five yards/hour in hard rock. Powered by compressed air. \$3,500, 200 lbs.; compressor, \$400, 200 lbs.; uses 3 gallons gasoline/hour. TL6.

*Hand Drill*: **High-Tech**, pp. 25, 26. Drills BL/20 yards/hour in hard rock; used to prepare holes for explosive charges. Hammer: \$10, 15 lbs. Set of drills: \$200, 200 lbs. TL4.

*Jackhammer*: **High-Tech**, p. 27. Drills two yards/hour in hard rock. Powered by compressed air. Jackhammer, \$1,500, 160 lbs.; compressor, \$100, 125 lbs.; uses 1 gallon gasoline/hour. TL6. At TL8, weight is halved and the device is electrically powered.

*Miner's Hammer*: **Low-Tech**, p. 30. Small: \$90, 6 lbs. Large: \$180, 11 lbs. TL1.

*Miner's Pick: Low-Tech*, p. 30. Wood, bone, or antler, \$35, 2 lbs.; TL1. Metal, \$70, 3 lbs.; TL1.

*Morph Axe: Ultra-Tech*, p. 83. \$500, 2 lbs. TL10.

*Shovel: Low-Tech*, p. 30. Wooden, \$12, 4 lbs.; TL1. Metal, \$25, 6 lbs.: TL1.

*Stoneworker's Kit: Low-Tech*, p. 30. \$551, 42.5 lbs. TL2.

*Techbot: Ultra-Tech*, pp. 85-86. General-purpose technical robots that can be programmed to operate in hostile underground environments. TL9: \$20,000, 50 lbs. TL10: \$10,000, 50 lbs.

*Wheelbarrow*: This is the modern European and American design. Carries a load of six cubic feet. \$100, 18 lbs. TL3.

## VEHICLES

Stories about underground travel often feature tunneling vehicles, but realistic digging machines are huge power tools – they move a few yards *per hour*. Experimental designs were pioneered in the mid-19th century, but the first practical design was James S. Robbins' tunnel-boring machine, built in the early 1950s, which used rotating cutting heads to move forward 6.66' per hour. Present-day (TL8) tunnel-boring machines can operate at five yards per hour in rock; multiply  $\times 2$  in hard soil or clay,  $\times 4$  in ordinary soil. Speculative or fantastic designs can work faster.

Standard vehicular statistics describe these machines' ability to move over land, or in previously cleared tunnels; their performance in excavating is discussed separately.

### Nuclear Subterrene

The 1950s and 1960s saw a variety of proposals for applying nuclear energy. Among these was the subterrene, a tunneling machine that would use a nuclear reaction to heat molten lithium and use it to melt rock. A layer of cooling lithium would flow back between the vehicle's sides and the vitrifying rock walls, to be recirculated into the reactor. Tunneling speed would be unchanged in clay, soil, or sand. No workable subterrene was ever built, but the concept remains popular in the conspiracy literature.

The use of a nuclear reactor would limit the minimum size of the craft. If it had been made workable, it might have looked like this.

*"Atomic Mole" Medium Subterrene*: 12' diameter; 280' long; 200 tons; \$28M; 2,400 cubic feet/hour (tunnel length 7.5 yards/hour). TL(7+1). For a superscience version, change tunnel speed to cubic feet/minute and tunnel length to yards/minute, multiply cost  $\times 3$ , and change to TL(7+1)^.

## Tunnel-Boring Machine

Tunnel-boring machines (TBMs) are huge cylinders with cutting heads at the front. Conveyor belts at the rear carry excavated soil or rock back to a convenient site for hauling it away. Though written up as a vehicle, a TBM has no wheels or tracks; it pushes itself forward with hydraulic jacks anchored in the tunnel walls, one step at a time, with effective Move far less than 1. To get it to a new site, it's loaded onto another vehicle. Its Hnd reflects the difficulty of steering for the other vehicle.

Standard designs are available for diameters up to 20-25'; larger diameters up to 45' (for tunneling in rock) or 60' (for tunneling in soil) are available as custom designs (treat each large machine as a prototype – see pp. B473-474). For campaign use, the following designs can be taken as standard:

*Small TBM*: 6' diameter; 140' long; 19 tons; \$350,000; 400 cubic feet/hour (tunnel length 5 yards/hour). TL8.

*Medium TBM*: 12' diameter; 280' long; 150 tons; \$2.8M; 1,600 cubic feet/hour (tunnel length 5 yards/hour). TL8.

*Large TBM*: 18' diameter; 420' long; 510 tons; \$9.5M; 3,600 cubic feet/hour (tunnel length 5 yards/hour). TL8.

*Extra Large TBM*: 21' diameter; 500' long; 825 tons; \$15M; 4,900 cubic feet/hour (tunnel length 5 yards/hour). TL8.

### Segmentary Burrowing Vehicle

In a technologically advanced society, burrowing vehicles might have bionic designs modeled on the body structure of segmented worms, which are evolutionarily adapted to tunneling in firm soil. The model presented here is designed for military use; it can tunnel through sand or ordinary soil, and has enough internal space for 50 "subterrenes" and basic medical and intelligence support for them. It may also carry small combat or spy robots, mines, or heavy weapons.

The "big worm" burrows by expanding its middle segments to their maximum diameter to anchor them in place, and contracting and elongating its forward segments to thrust them through soil, after which it expands them, pulling forward the segments behind them, in a series of peristaltic waves. This creates a tunnel 6' in diameter. A double-ended design allows it to reverse direction and retreat if necessary. It cannot tunnel through rock; in clay or packed soil, it moves at 1/5 speed and requires an hourly HT roll to avoid losing 1 point of HT to mechanical stress.

The craft is 50% heavier than water and cannot float, but is sealed and can move through water-saturated soil.

*"Mimizudai" Troop Carrier*: 5' diameter, 162' long at minimum expansion; 6' diameter, 112.5' long at maximum expansion; 155 tons; \$14M; 14,500 cubic feet/hour (tunnel length 40 yards/hour).

## Vehicle Table

TL	Vehicle	ST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ.	DR	Range	Cost	Locations	Notes
7+1	Atomic Mole	295	-4/5	11	2/2	200	3	+10	4+1	12	–	\$28M	C	
8	Small TBM	135	-3/4	11f	–	19	0.2	+8	1	6	8	\$350K	–	
8	Medium TBM	265	-4/5	11f	–	150	0.4	+10	1+1	6	8	\$2.8M	–	
8	Large TBM	400	-5/5	11f	–	510	0.6	+11	2+1	6	8	\$9.5M	–	
8	Extra Large TBM	475	-5/5	11f	–	825	0.7	+12	2+1	6	8	\$15M	–	
12	Mimizudai	255	-2/6	12	0.25/0.25	155	25	+8	4+55	200/75	60	\$14M	–	[1, 2]

### Notes

[1] The mimizudai has heavy armor on its front and rear segments, and lighter armor elsewhere.

[2] Living metal construction allows the mimizudai to regenerate 27 HP per hour, unless it is destroyed.

# CHAPTER FOUR

# DWELLERS IN THE DARKNESS

Real underground creatures aren't threats to human explorers; they're small, slow, and blind. Nonetheless, human imagination populates the subterranean realm with creatures as varied and dangerous as those on the surface. Such threats work especially well in horror campaigns, but any cinematic campaign may have hostile or mysterious beasts beneath the earth.

People who encounter such beings won't necessarily know what they are. Scientists may regard them as a new ecosystem, while superstitious people may call them monsters – and both could be right!



## SPIRITS OF THE UNDERWORLD

The world's interior is a mysterious place and the subject of many legends. In many fantasy settings, it's the habitation of magical races, or is inherently magical in its own right. Spirits, especially those of the dead, are often thought to occupy hidden places, or appear under conditions where clear perception is difficult. Thus, the dark interiors of caves are natural places for spirits to manifest. Entering a cave can be a transition into a realm of mysterious forces, not only the home of the spirits of the dead, but also of elemental spirits of the earth.

## Speleid

240 points

Greek legend assigned spirits, or nymphs, to varied environments: dryads to forests, naiads to springs and rivers, nereids to the open sea, oreads to mountains. The speleid, or cave divinity, is among those spirits that are less often encountered and less well known. A nymph has no actual position in human society but can interact with citizens and rulers of city-states as if she were Status 6, represented by her Honorary Title (an equivalent of Courtesy Rank for Status).

Nymphs have a special variant of the Spirit meta-trait (p. B263). They can become visible and tangible at a cost of 1 FP/minute. They can also use magic on corporeal beings, but only in visible and tangible form. The traits included in the Nymph meta-trait are Doesn't Breathe [20], Doesn't Eat or Drink [10], Doesn't Sleep [20], Immunity to Metabolic Hazards [30], Insubstantiality (Difficult Materialization, -20%) [64], Invisibility (Only in Spirit Form, -10%; Substantial Only, -10%) [32], and Unaging [15].

**Attribute Modifiers:** DX+2 [40].

**Secondary Characteristic Modifiers:** Per+2 [10].

**Advantages:** Appearance (Beautiful) [12]; Magery 1 [15]; Nymph [191]; Sensitive Touch [10].

**Perks:** Honorary Title 6 [6].

**Disadvantages:** Dependency (Mana, Hourly) [-25]; Disturbing Voice (Can Only Whisper) [-10]; Shyness (Mild) [-5].

**Quirks:** Distinctive Features (extreme pallor); Never Wears Clothing; Prefers the Mana of Her Own Domain; Protective of Plants and Animals in Her Domain. [-4]

**Features:** Night Vision (Native illumination level -9; see *Night Vision*, p. 18).

## LIVING FOSSILS

With the emergence of evolutionary theory, biologists identified some species, such as the platypus or the coelacanth, as "living fossils." Present-day cryptozoologists hope to find even more impressive survivors, such as the hypothetical plesiosaur of Loch Ness or the central African *mokole-mbembe*, which might be a dwarf apatosaurus. Fiction often envisions not single species, but entire surviving ecosystems, as in Arthur Conan Doyle's *The Lost World* or Jules Verne's *A Journey to the Center of the Earth*. Placing such living fossils underground explains why they haven't been found; it also makes some sense to have both living and dead fossils in the earth.

Some fictional treatments have a single ancient organism in suspended animation, entombed in rock or ice, waiting to be restored to life, as in the Japanese film *Rodan*. For more exotic variants, a supernatural-horror campaign could have undead fossil dinosaurs. A weird-science campaign could have fossils spontaneously generated within the earth (see p. 6) “ripen” into true and dangerous life.

## Griffin

Classical writers referred to griffins (also spelled “gryphon”) not as fantastic beasts, but as a natural species found in the interior of Asia – quadrupeds with eagle-like beaks and lionlike bodies. Such creatures are often represented in Scythian art and may have been inspired by the ceratopsian fossils common in central Asia. In an alternate history, they might have survived into the present as living fossils in some subterranean realm.

**ST** 14; **DX** 13; **IQ** 2; **HT** 11.

**Will** 10; **Per** 10; **Speed** 6.00; **Dodge** 9; **Move** 5.  
SM 0; 350 lbs.

**Traits:** Colorblindness; Damage Resistance 3 (Tough Skin); Damage Resistance 2 (Partial, Skull only; Tough Skin); Peripheral Vision; Quadruped; Sharp Beak; Wild Animal.

## Zwerg

-10 points

When *Homo sapiens sapiens* appeared in Europe, they largely displaced the native Neanderthals; recent evidence suggests some interbreeding between the two groups. Some Neanderthals took refuge in caves, where intense evolutionary pressure reduced their stature. They jealously resist intrusion by modern humans, but in some places, the two species have taken to silent barter of useful minerals for food and fuel.

Zwergen are as heavy and strong as humans, but average only 4' tall, with short legs that reduce their mobility, and large, powerful arms. They can make almost all the sounds of human speech, but their vocalizations aren't broken into discrete words. The sounds more closely resemble music, with some recurrent motifs but no “grammar.” Gestures that suggest shapes or actions often accompany verbal expressions. As a result, zwergish thought is largely concrete rather than abstract.

**Attribute Modifiers:** IQ-2 [-40]; HT+2 [20].

**Secondary Characteristic Modifiers:** SM -1; Will+2 [10]; Per+2 [10]; Basic Move -2 [-10].

**Advantages:** Acute Hearing 2 [4]; Arm ST 1 (Two Arms) [5]; Damage Resistance 1 (Partial, skull only, -70%) [2]; Night Vision 3 [3]; Temperature Tolerance 1 (Colder) [1].

**Disadvantages:** Appearance (Unattractive) [-4]; Incurious (12) [-5]; Sense of Duty (Clan) [-5].

**Quirks:** Careful; Dislikes Open Spaces; Protolinguistic. [-3]

**Skills:** +1 to Mimicry [2].



## CAVE CREATURES

Zoologists distinguish *trogloxenes*, surface animals that may shelter in caves; *troglophiles*, cave animals that can survive on the surface; and *troglobites*, animals that can only survive in caves. (In *GURPS* terms, troglaphiles and troglobites have Dependency on an Occasional environment.) *Trogloxenes* are sometimes very large – the cave bear weighed between 1,200 and 1,600 lbs. Full-time cave dwellers are usually small. Fantastic underground races often fit the same pattern: The gigantic cyclopes go out of their caves to herd flocks of sheep, but smaller races such as goblins are often full-time cave dwellers.

Troglobites mainly occur in caves with high humidity, close to 100%. They can survive on limited food and oxygen, with slow metabolisms that often give them long lives. Most stay in deep, lightless regions, and are blind or even eyeless, relying on sensitivity to air currents, sonar, or (for aquatic species) electric-field sense.

*Those who had caught sight of any of them said that they had greatly altered in the course of generations; and no wonder, seeing they lived away from the sun, in cold and wet and dark places. They were now, not ordinarily ugly, but absolutely hideous, or ludicrously grotesque both in face and form.*

– George MacDonald, *The Princess and the Goblin*

## Scuttler

A multilegged creature related to the velvet worms, looking somewhat like a centipede, but without a rigid exoskeleton. It's a scavenger and carrion feeder, but doesn't necessarily wait for its prey to die; it may attack a sleeping or injured animal, injecting saliva that contains a paralytic poison. Scuttlers live in colonies, and swarms may assault a large animal, jointly sucking out its soft tissues while it's helpless. They move almost noiselessly, and will delay attack until several can strike at once. A scuttler can consume up to half its own weight for transport back to its colony, taking on a bloated shape.

**ST 3; DX 11; IQ 2; HT 11.**

**Will 10; Per 10; Speed 5.50; Dodge 8; Move 2.**

SM -3; 3.5 lbs.

**Traits:** Blindness; Damage Resistance 1 (Tough Skin); Dependency (Cave environments; Hourly); Discriminatory Smell; Extra Legs (30 Legs; Cannot Kick); Fatigue Attack 1d-1 (Follow-Up, Teeth; Limited Uses, 3/day; Symptoms, Paralysis, 1/2 FP); Invertebrate; No Fine Manipulators; Payload 10; Selfless (6); Sharp Teeth; Silence 5; Slippery 5; Vibration Sense; Wild Animal.

### Scuttler Swarms

A swarm is about half a dozen scuttlers. It has Move 1 when stalking, and Move 2 when fleeing. It does 1d cutting damage per turn, with a follow-up of 1d-1 fatigue damage per point of cutting damage; armor protects with its normal DR. Dispersed after losing 4 HP, the swarm will normally flee if the target goes on the attack.

*Not a nasty, dirty, wet  
hole, filled with the ends of  
worms and an oozy smell,  
nor yet a dry, bare, sandy  
hole with nothing in it  
to sit down on or to eat:  
it was a hobbit-hole,  
and that means comfort.*

– J.R.R. Tolkien,  
*The Hobbit*

## BURROWERS

Other underground creatures actually burrow. A segmented body, like an earthworm's, is mechanically efficient for burrowing. Vertebrate burrowers may have large, blunt claws that

scoop dirt backward as they crawl forward. Fantasy races and some alien races may be burrowers.

Realistic burrowing is slow (see *Tunneling*, p. 13). Fictional burrowers, however, may be fast enough to overtake a running man – examples include *Dune's* sandworms and the monsters of *Tremors*.

## Nightfolk

**15 points**

Nightfolk are a hominid species that adopted scavenging rather than carnivory as a source of additional food. They use tools such as knives to cut up animal remains, but rarely weapons, and especially not missile weapons. Being nonaggressive, they shelter in burrows by day and come out to scrounge by twilight or moonlight. They often defend their burrows with elaborate traps. They process their food by growing a symbiotic fungus on it, which forms the bulk of their diet. Being accustomed to soft food, they have reduced dentition and in particular no canine teeth. However, they have powerful arms and hands for digging, which they may use to strangle animals that aren't quite dead – or, if they're desperate, intruders in their burrows.

When living near high-tech societies, they may scavenge junkyards for useful equipment. If they develop their own advanced technology, it's likely to be more biological than mechanical.

**Attribute Modifiers:** ST-3 [-30].

**Secondary Characteristic Modifiers:** SM -1.

**Advantages:** 3D Spatial Sense [10]; Arm ST 2 (Two Arms) [10]; Danger Sense [15]; Flexibility [5]; High Manual Dexterity 1 [5]; Nictitating Membrane 1 [1]; Night Vision 4 [4]; Parabolic Hearing 2 [8]; Reduced Consumption 1 (Cast-Iron Stomach, -50%) [1]; Sensitive Touch [10]; Strangler (p. 19) 2 [10].

**Perks:** Burrower [1].

**Disadvantages:** Odious Personal Habits (Eats Human Remains) [-15]; Semi-Upright [-5]; Shyness (Mild) [-5]; Unusual Biochemistry [-5]; Weak Bite [-2].

**Quirks:** Congenial; Incompetence (Thrown Weapon); Nosy. [-3]

## LIFE UNDER PRESSURE

Life even exists within solid or liquid rock well below the ground. Cores drilled deep into the crust during petroleum exploration have contained microorganisms living within microscopic pores in rock. These *extremophiles* can survive temperatures as high as 230°F, at which water remains liquid only because of the very high pressure also present. Many of these are anaerobic – they cannot survive exposure to oxygen. They appear related to other organisms, classified as Archaeobacteria or Archaea, that live in extreme environments on Earth's surface, such as “black smoker” hydrothermal vents deep in the ocean. Some estimate that their total weight may exceed that of all life elsewhere on Earth.

Organic life at greater depths, inorganic life, or multicellular organisms tough enough to drill rock are highly speculative fiction. If they existed, they would have to tolerate extreme pressures and temperatures, and be anaerobic. Surviving these conditions has no point cost for such creatures, since conditions on the surface would kill them (see *Under the Hood: Game Mechanics for Crystalloids*). The Chthonians of the Cthulhu Mythos are a classic example.

## Crystalloid

71 points

The vast heat flux at the boundary of the inner and outer cores might give rise to life and even intelligence. One such theoretical race, made of crystallized impure iron, stores memories in magnetic domains. It senses by sonar, and aspires to venture into the bitterly cold mantle and crust, if they can build suitable craft. An average crystalloid weighs 343 lbs. but is less than a cubic foot in volume.

The Striking Surface perk allows the crystalloid to inflict 1 extra point of damage with unarmed attacks, thanks to its armored carapace.

A crystalloid's comfort zones are as follows.

- Native gravity 0.45 G; G-increment 0.1 G.
- Native pressure 3,300,000 atmospheres; normal range 2,640,000-3,960,000 atmospheres.
- Native temperature 9,000°F; comfort zone 8,505-9,495°F.

Because of the density of the molten iron in which they live, the base range of their sonar is 24,000 yards.

A crystalloid on the surface has additional advantages or disadvantages, depending on the technology that keeps it alive. One inhabiting a sealed chamber filled with molten iron could fairly have Increased Life Support [-40], given the extreme measures needed to keep it alive. A form-fitting environment suit wouldn't give it this disadvantage, but the wearer may need High TL to have access to it; see *Crystalloid Surface Suit* (below). If no such protective gear exists, the GM may add Can't Wear Armor (-40%) to the crystalloid's DR, reducing the template value by 12 points.

It's also possible to design a crystalloid super that can function on the surface, with the following traits: Burning Attack 3d (Always On, -20%; Emanation, -20%; Explosion 3, +150%) [32]; Improved G-Tolerance (1 G increment) [15]; No G-Intolerance [10]; Sealed [15]; Temperature Tolerance 40 [40]; Tunneling 3 [45]; and Vacuum Support [5]. This adds 162 points to the racial template, raising cost to 233 points.

The surface of Earth's inner core has an area of seven million square miles. At TL8, it has a carrying capacity of 700 million crystalloids.

**Attribute Modifiers:** ST-1 [-10]; IQ+2 [40]; HT+2 [20].

**Secondary Characteristic Modifiers:** SM -1; HP+5 [10]; Basic Move-2 [-10].

**Advantages:** Absolute Direction (p. 18) [5]; Amphibious [10]; Detect Magnetic Fields (Precise, +100%; Signal Detection, +0%) [20]; Doesn't Breathe [20]; DR 6 [30]; Extended Lifespan 2 [4]; Extra Arms 10 (Short, -50%) [50]; High Manual Dexterity 2 [10]; Injury Tolerance (No Eyes; No Neck) [10]; Scanning Sense (Sonar; p. 18) [20]; Single-Minded [5]; Spines (Short) [1]; Telecommunication (Magnetic-Ripple Comm; see below) [10].

**Perks:** Striking Surface. [1]

**Disadvantages:** Blindness [-50]; Decreased Time Rate [-100]; G-Intolerance (0.1G) [-10]; Selfish (12) [-5]; Short Arms (2) [-10].

*The very place, where he have been alive, Undead for all these centuries, is full of strangeness of the geologic and chemical world.*

– Bram Stoker, *Dracula*

### Crystalloid Surface Suit (TL11)

A form-fitting environment suit that protects against the dangerously low pressures of the mantle or the near vacuum of Earth's surface, and against temperatures as frigid as -109°F. It provides life support for up to two weeks. It contains biomedical sensors that allow remote diagnosis at -2, or give +1 to hands-on diagnosis, but only for crystalloids. Its material is interwoven crystals of refractory metals, giving DR 10 against most forms of injury, but DR 20 against burning and corrosion. It weighs 20 lbs. and costs \$40,000.

## Under the Hood: Game Mechanics for Crystalloids

By the standard rules for hot and cold temperatures (pp. B93, B430, B434), crystalloids would have a comfort zone 55°F wide, from 8,972.5°F to 9,027.5°F (see *Physics of Earth's Interior*; p. 8). With HT 12, they would need Temperature Tolerance 705 to survive on the surface. **Underground Adventures** adopts a variant treatment of temperature comfort zones, modeled on the standard rules for native pressures and Pressure Support (pp. B77-78). The GM may want to use this for non-water-based life in general.

The midpoint of the human comfort zone is 62.5°F; this is 522° above absolute zero. The crystalloid comfort zone centers on 9,000°F, which is 9,460° above absolute zero, approximately 18× as high. The width of their comfort zone is 55°F × 18 = 990°F, from 8,505°F to 9,495°F.

Each point of Temperature Tolerance adds HT × 18° to this. A HT 12 crystalloid with Temperature Tolerance 39 for cold (allowing down to 81°F) could just barely survive on the Earth's surface.

Magnetic fluctuations, not sound, form the basis of crystalloid communication. A new version of Telecommunication (p. B91) represents this.

**Magnetic-Ripple Comm:** You communicate using electromagnetic waves generated by a fluctuating magnetic field. Your signal is omnidirectional. Base range is 500 yards in line of sight when you are immersed in the material of Earth's outer core; in rock or air, it decreases to five yards. *10 points.*

# CHAPTER FIVE

# ADVENTURES

# UNDERGROUND

Underground places and activities can be the focus of an entire campaign, or the backdrop for a short episode in a longer campaign. Different sorts of places can present different kinds of challenges, and on different scales.

## HIDDEN PLACES

Explorers may discover a pre-existing underground site – a natural cave or an abandoned catacomb. What kind of adventure this leads to depends on their reasons for going into it. Do they want to explore it, loot it, hide in it, travel through it, or rescue someone from it?

Any venture into an unknown place tests the adventurers' skills, endurance, and resolve (see Chapter 2). When they go

underground, they pass into a different world; the GM can make this more vivid by emphasizing the sense of transition and the limits of perception and mobility.

## Caves

Caves typically form in porous rock such as limestone. Other cave types exist, such as lava tubes near volcanoes and glacial caves. See *Types of Caves* (below) for specifics.

Whatever their origin, caves aren't built by human beings or designed for human use. Confront explorers with the full range of natural hazards for each type of cave, such as slopes, vertical shafts, narrow passages, and bad footing; poorly oxygenated air, or passages flooded with cold, dark water; branches and twists that make navigation baffling.

## Types of Caves

Caves originate in several different ways. Each type of cave has distinctive characteristics.

*Aeolian caves* are created by the erosive action of wind, especially in sandstorms or dust storms. They can form in any type of rock. They tend to have smooth walls and little rubble, but their shapes may be irregular, following veins of softer rock, and have tight passages.

*Glacier caves* are cavelike openings through ice masses, created when water flows through or under them, or occasionally by geothermal heat. Obviously, most glacier caves are cold! If there is any flowing water, treat it as being exactly at freezing temperature (32°F). The exit of a glacier cave is characteristically at the forward (lower) end of the glacier; in some glaciers, this is in or under the ocean. Glacier caves are often unstable. Their surfaces tend to be smooth but slippery, giving -2 to Climbing; consider them bad terrain.

*Lava tubes* form in volcanic areas, when molten lava flows out beneath a hardened crust; they have been reported to exist on the moon. They often have multiple small branches that drained into a main tube, making navigation challenging (see *Navigation*, pp. 10-11). The surfaces are typically smooth, but the floors may be wrinkled, and some lava tubes have stalactite-like formations created by dripping

lava. Lava tubes in live volcanoes can still be dangerously hot (121-150°F; see *Heat*, p. B434).

*Limestone caves* are the commonest sort, formed when groundwater dissolves limestone. Similar caves can form in chalk, gypsum, marble, and other soluble minerals. In some cases, hydrogen sulfide fumes turn water into sulfuric acid, which has faster effects. The resulting cracks weaken the stone, resulting in cave-ins or sinkholes, characteristic of *karst* terrain. Footing in limestone caves is often bad because of rubble. Parts of these caves may be submerged, and aquifers breaking through can flood them. Continuing water action can produce stalactites (which grow down from the ceiling), stalagmites (which grow up from the ground), and columns. Water is normally at the mean annual surface temperature for the area, but water in geothermally active areas may be as hot as 121-150°F.

*Sea caves* form as waves and currents erode sea cliffs, especially during storms. Most are relatively short, 100 yards or less, and may not be completely lightless. Some are above current sea level, but many are partially submerged, especially at high tide; they require wading, swimming, or boating to get to them. Freshwater streams can have similar erosional effects. Water is at or a few degrees below the surface temperature.

## Ruins

Through natural erosion, the level of the ground rises over time, gradually burying many structures, especially abandoned ones. Later generations may come back to explore them, whether seeking lost historical information or simply looting. This kind of venture is the focus of much dungeon fantasy; “dungeons” are more often abandoned ruins than working prisons.

Ruins are likely to be better suited to human visitors than natural caves, having been built for human occupancy in the first place. Even so, as they age, they become more structurally unsound and dangerous. Some ruins may have deliberately contrived dangers, left by builders who don't want their tombs or vaults raided! Complex mechanisms are likely to fail in a few

*There is a tendency to utilize underground space for the less ornamental purposes of civilization; there is the Metropolitan Railway in London, for instance, there are new electric railways, there are subways, there are underground workrooms and restaurants, and they increase and multiply. Evidently, I thought, this tendency had increased till Industry had gradually lost its birthright in the sky.*

– H.G. Wells,  
*The Time Machine*

years or even a few days, but an intentionally unsafe structure may last until some incautious explorer walks over it. In a fantasy or horror setting, tombs may be haunted, or protected by ancient curses.

## EXCAVATIONS

Where no caves exist, human beings can create their own. See *Mines and Tunnels* (pp. 13-14) for expanded rules for this process.

Excavation can be a short incident in a longer campaign. A party of adventurers, or a larger group that includes them, may need to dig a tunnel to bypass a fortress's defenses, escape from a prison, or save their own lives after a cave-in. At other times, they may need to unearth a buried treasure, or the entrance to a dungeon.

Less often, an entire campaign might focus on excavation: mining some valuable mineral in a remote location, or building a tunnel or an underground habitat. Incidents in such a campaign can include encounters with subterranean hazards; equipment breakdowns and supply shortages; social and political conflicts such as labor disputes; and even sabotage by angry miners or rival organizations.

An artificial underground space can also be the background of a campaign, as a setting for adventurers or a base of operations. Even an entire city might be constructed beneath the surface; see the Underground terrain option in *GURPS City Stats* (p. 5).

## SUBTERRANEAN WORLDS

Finally, a subterranean place can be an entire realm, with its own civilizations. Hollow-earth realms are expansive and often have their own light sources; effectively, they're an exotic variant of the surface more than a true underground place. Cave complexes are dark and cramped, though they may run on for hundreds of miles. Their inhabitants will be adapted to such conditions, perceiving by infravision, sonar, or other exotic senses, and feel at home there. Outsiders, however, may find such a setting alien, and the adventure should emphasize this.

A twist on this is to have subterranean beings venture to the dangerous and exotic surface (see *Crystalloids*, p. 30).

## The Underground Future

Science-fiction writers have offered many images of future underground societies. The details depend on the reasons for going below the surface of a planet.

*Military Defense:* After the invention of nuclear weapons, radioactive fallout became a major fear. During the 1950s and 1960s, many people built shelters. In grimmer visions, nuclear-war survivors might have to stay underground indefinitely.

*Progress of Civilization:* In *The Time Machine*, H.G. Wells showed a future society moving its industry underground, after which evolution reshaped the working class into natural cave dwellers. Similar dystopian visions appear in

later science fiction, often as the price of a technological society. A planetwide ecological catastrophe can be the basis for a contemporary treatment.

*Planetary Senescence:* H.G. Wells was a pioneer here, too; *The First Men in the Moon* showed an underground lunar civilization. Many writers envisioned Martians going underground as their planet lost its air. For a version based on up-to-date planetary science, Earth's internal radioactivity might still be active when the sun's future expansion makes the surface uninhabitable. If the planet could be propelled into a wider orbit, or out of the solar system, Earth's inhabitants might tunnel to get closer to their remaining heat source.



# CAMPAIGN SEEDS

Here are some ideas to get you started on underground campaigns that rely on these rules.

## SVARTALFHEIM

In an age of legend based on Norse myths, a band of heroes must undertake an impossible quest. An oracle tells them to seek magical aid from the sons of Ivaldi, the dwarven smiths who made Odin's spear, Frey's magic ship, and Sif's golden hair. After a long journey to one of its secret entrances, they find their way into the caves that lead down to Svartalfheim, the dwarven realm. Their journey must continue miles below the ground, through both inanimate dangers and areas occupied by strange beasts. As they go lower, mysterious watchers stalk them. Only if they show courage and treat the caverns with respect will they get a hearing. Even then, it will be a suspicious one, given the dwarves' past dealings with Loki. The heroes may have to pay a high price, or vow great services, to get what they need.



## DRAGONS IN THE EARTH

In 430 B.C., the philosopher Empedocles led an exploration party into the crater of Mount Etna and discovered a gateway to a vast underground realm. This massive kingdom was lit by phosphorescence, and inhabited by gigantic beasts unknown to the surface. In the centuries that followed, explorers, hunters, miners, and colonists ventured into the subterranean realms.

Adventurers of this alternate timeline can be sent to map the underworld's farther reaches, perhaps even finding a gateway to Hyperborea. Alternatively, they can bring its great beasts back alive for natural philosophers, gladiatorial impresarios, or generals experimenting with armored cavalry.

## CATACOMBS

Rome is famous for its catacombs, but even its rulers don't realize how deep they go or what inhabits them. As the first millennium approaches, demons, survivors of pagan cults, and the unsanctified dead gain power and threaten the living. The Church has gathered a small band of knights, outlaws, and scholars of forbidden lore to take the fight into the catacombs and the realm of the dead.

## THE GREAT TUNNEL

In 1880, British and French engineers set to work on a new wonder of the world: a tunnel under the English Channel. As it nears completion, unexpected obstacles appear. Labor agitators try to start a strike. Jingoists who think the tunnel will open England to invasion want to sabotage it. Mysterious foreign spies scout out the tunnel to plan that future invasion. A team of British and French police officers is assigned to make sure that nothing goes wrong. Detectives, engineers, and military officers can be called in as consultants, or reporters can come hunting for news stories.

## SALVAGE

The asteroid mining boom didn't pay off for everyone. Newly plentiful resources raised the world's standard of living – but as prices for rare earths and platinum metals dropped, overcapitalized mining firms earned too little to pay back their fixed costs. Many operations had to shut down.

A quarter century later, venture capitalists under pressure from the mining combines are buying up the derelict projects. Vulcan Metals has sent out a reclamation team to 1620 Geographos, a small Mars-crosser asteroid where Bauer & Liebknecht GmbH abandoned a partially built facility.

Can the mine be brought into profitable operation with modern, low-cost equipment, or should it just be salvaged? What hazards will the engineers and operators face in their work? And are they just letting their oxygen get low, or are those moving shapes they occasionally glimpse abandoned robots that were never shut down – and whose command codes have long been misfiled?

Geographos can be the setting for a campaign about heroic entrepreneurship, disaster in outer space, or classic horror, as the GM prefers.

*The earthquakes began and grew until all down America from the Arctic Circle to Cape Horn, hillsides were sliding, fissures were opening, and houses and walls crumbling to destruction.*

– H. G. Wells, "The Star"

# APPENDIX

# RECOMMENDED READING

This bibliography includes both factual and speculative discussions of Earth's interior, as well as fiction with underground settings. In the nonfiction section, works of mainly speculative interest are marked with an \*. The nonfiction titles are self-explanatory; comments are offered on the fiction.

*Five miles meandering with  
a mazy motion  
Through wood and dale  
the sacred river ran,  
Then reached the caverns  
measureless to man,  
And sank in tumult to  
a lifeless ocean.*

– Samuel Taylor Coleridge,  
“Kubla Khan”

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Oldroyd, David. *Thinking about the Earth: A History of Ideas in Geology* (Harvard University Press, 1996).

Skinner, Brian J., Porter, Stephen C., and Botkin, Daniel. *The Blue Planet*, 2nd Edition (Wiley, 1999).

Stack, Barbara. *Handbook of Mining and Tunnelling Machinery* (Wiley-Interscience, 1982).

## FICTION AND CLASSICS

Alighieri, Dante (John Ciardi, translator). *Inferno* (Signet Classics, 2009). The first volume of Dante's three-part epic takes Dante and his teacher Virgil on a journey through a Hell set beneath the surface of the world. Written between 1308 and 1321.

Baum, L. Frank. *Dorothy and the Wizard in Oz* (Forgotten Books, 2008). The darkest of Baum's Oz novels, taking Dorothy and her companions on a desperate journey through a series of underground realms. Written shortly after the San Francisco Earthquake. Originally published 1908.

Blish, James. *A Case of Conscience* (Del Rey Impact, 2000). An interstellar exploration team, accompanied by a reptilian alien, returns to a future Earth where civilization has moved underground for protection from nuclear attack. Originally published 1959.

Bulwer-Lytton, Edward. *The Coming Race* (CreateSpace, 2011). A portrayal of an advanced underground society, which became the inspiration for a variety of 20th-century occultist movements. Originally published 1871.

Burroughs, Edgar Rice. *At the Earth's Core* (Wildside Press, 2003) and several sequels. Burroughs' classic high-adventure style in the best-known "hollow earth" setting. Originally published 1914.

Cherryh, C.J. *Heavy Time* (Grand Central Publishing, 1992). Space-mining technology and economic conflicts over mining are keys to the plot of the hard-science-fiction novel. Originally published 1991.

Forster, E.M. "The Machine Stops," *The Eternal Moment* (Mariner, 1970). A story of a decaying underground civilization of the future, inspired by Forster's reading of H.G. Wells. Focuses on a rebel who attempts to explore the earth's mysterious surface. Notable for its anticipation of the Internet. Originally published 1909 (story) and 1928 (book collection).

Garner, Alan. *The Weirdstone of Brisingamen* (Sandpiper, 2006). An ancient relic draws two children into a quest in a perilous underground realm. Originally published 1960.

Heinlein, Robert A. *The Moon Is a Harsh Mistress* (Orb Books, 1997). Ice miners play a key role in the struggle of prison colonies on the moon for independence. Originally published 1966.

McDonald, George. *The Princess and the Goblin* and *The Princess and Curdie*, in *The George McDonald Treasure* (Kahley House, 2007). A miner's son defends a young princess from degenerated subterranean creatures. Originally published 1872 and 1883.

O'Neill, Joseph. *Land Under England* (Overlook, 1985). A subterranean explorer encounters monstrous beasts and a totalitarian underground state. Originally published 1935.

Pratchett, Terry. *The Fifth Elephant* (2000). Pratchett's first detailed look at dwarfish traditions and politics, involving the coronation of a new Low King; many scenes take place in the underground realms of Überwald. Other Discworld novels with notable underground scenes are *Men at Arms*, *Carpe Jugulum*, *Thud!*, and *Snuff*.

Rucker, Rudy. *The Hollow Earth* (Monkeybrain, 2006). A fanciful novel in which Edgar Allen Poe and a companion enter the Earth's interior through an opening in Antarctica.

Verne, Jules. *A Journey to the Center of the Earth* (Oxford University Press, 2008). Translated by William Butcher. The most modern version of Verne's classic novel. Originally published 1864.

Wells, H.G. *The Time Machine* (New American Library, 2002). The climax of the Time Traveller's adventures is a desperate venture into the subterranean realms of the anthropophagous Morlocks.

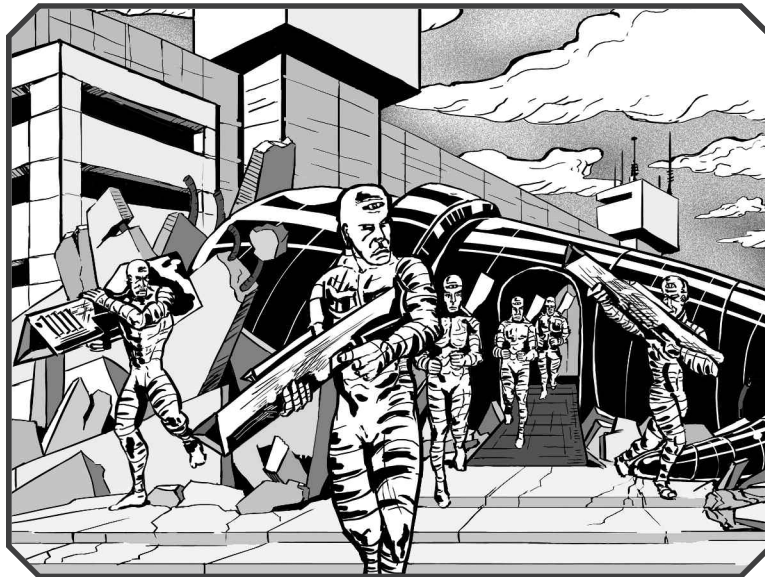
*The Goonies* (Richard Donner, 1985). A group of children ventures into a cave to look for a lost pirate treasure.

*Pan's Labyrinth [El laberinto del fauno]* (Guillermo del Toro, 2006). A young girl in 1944 Spain escapes from family and political conflicts into a surreal underground realm. A traditional fantasy-quest theme takes an extremely dark form.

*The Ruins* (Carter Smith, 2008). This biologically based horror film has several intense underground scenes in the ruins of a Mayan temple.

*The Third Man* (Carol Reed, 1949). Film noir set in post-World War II Vienna, with a climactic sequence in the sewers.

*Tremors* (Ron Underwood, 1990). A cult monster film in which huge wormlike burrowing creatures attack a small town.



## FILM

*Big Trouble in Little China* (John Carpenter, 1986). An American adventurer helps his Chinese friend rescue his girlfriend from captivity in a tunnel complex underneath San Francisco's Chinatown.

*Daylight* (Rob Cohen, 1996). A freakish series of accidents traps several groups of people in a collapsing tunnel under the Hudson River.

*The Descent* (Neil Marshall, 2005). Six women venture into an unexplored cave system and are pursued by carnivorous humanoid "crawlers."

## TELEVISION

*Beauty and the Beast* (Ron Koslow, 1987-1990). A beautiful young woman discovers a hidden realm in tunnels under New York, and falls in love with one of its inhabitants.

*Neverwhere* (Neil Gaiman, 1996). A modern-day Londoner discovers the hidden realm of "London Below."

## MUSIC

Rick Wakeman, *Journey to the Center of the Earth* (A&M Records, 1974). A musical work based on Verne's novel, with voice-over narration of the journey.

*In retrospect, the barest idea of a sudden, lone descent into such a doubtful abyss – and at a time when one's whereabouts were unknown to any living soul – seems like the utter apex of insanity. Perhaps it was – yet that night I embarked without hesitancy upon such a descent.*

*– H.P. Lovecraft, "The Shadow Out of Time"*

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