GURPS® Fourth Edition

LOW-TECH™

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About *GURPS*

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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

When we think of heroes of legend, epic, and historical fiction, we often remember their equipment. The bows of Odysseus and Robin Hood, the swords and armor of King Arthur and Don Quixote, the ships of the Argonauts and Sinbad . . . in each case, the possessions did much to define their owner. The same holds true for ***GURPS*** adventurers!

GURPS Low-Tech is a guide to innovation and equipment from the Stone Age to the early 18th century. It starts with an overview of technological evolution. Next, it offers perks, techniques, and new versions of advantages and skills for individuals who work with technology. Then it moves to a discussion of fundamental technologies: materials and energy sources. Throughout, the book suggests technological "what ifs."

Mostly, though, ***Low-Tech*** offers *gear* – for communications, combat, measurement, medical treatment, record-keeping, security, stealth, survival, transportation, and much more. Everything an adventurer needs to survive, to explore, and to fight his enemies is right here. This includes both generic equipment, suitable for many different cultures and eras, and the distinctive inventions of specific civilizations. And all this hardware comes with many rules for *using* it.

So whether your goal is equipping a PC or inventing a new setting, open the catalog and start making your wish list!

Low-Tech vs. Basic Set

GURPS Low-Tech revises the statistics for certain equipment in the ***GURPS Basic Set*** for the sake of historical accuracy. All changes are strictly optional; the ***Basic Set*** isn't *wrong,* but it does simplify many things. Players and GMs should discuss which volume takes precedence in their campaign – whether in general or in particular areas (armor, tools, weapons, etc.) – *before* they start gaming.

Publication History

This is the second edition of ***GURPS Low-Tech,*** written for use with ***GURPS*** *Fourth Edition.* It replaces the original ***Low-Tech*** (2001), for ***GURPS*** *Third Edition*. Changes include a greater emphasis on non-European technologies and revisions to allow for new historical research. It also takes over coverage of TL4 from ***GURPS High-Tech,*** *Third Edition* (1998). Additional content comes from the many Third Edition historical sourcebooks – from ***GURPS Dinosaurs*** (1996) to ***GURPS Swashbucklers*** (1999) – and from the low-tech portions of ***GURPS Covert Ops*** (2003). All reused content has been updated for Fourth Edition.

Discussions of broader cultural aspects of technology – and fussier optional rules – have been moved to ***GURPS Low-Tech Companion 1, 2,*** and ***3,*** available from e23.

About the Authors

Peter V. Dell'Orto started roleplaying in 1981, with ***Dungeons & Dragons,*** and has played ***GURPS*** since ***Man to Man.*** Since 1996, he has been an active ***GURPS*** playtester, editor, and author. He wrote ***GURPS Martial Arts*** with Sean Punch, ***GURPS Martial Arts: Gladiators*** with Volker Bach, and many articles for *Pyramid* magazine, including "Deathball" (with Sean Punch) in *Pyramid #3/3.* Besides his interest in writing RPGs, Peter is an enthusiastic martial artist. He currently trains Kachin Bando and holds *shodan* rank in Kendo. He has fought amateur MMA in the Japanese Shooto organization and competed in Grappler's Quest. His other hobbies include strength training, reading, painting miniatures, Japanese, and music. He currently lives and trains in New Jersey.

Dan Howard started roleplaying in 1984 with ***Middle Earth Role Playing,*** and quickly moved on to ***Rolemaster.*** He switched to ***GURPS*** shortly after its first edition; it has been his favorite system ever since. He started contributing to *Pyramid* magazine in 1998, and soon began playtesting ***GURPS*** publications. His debut contribution to a ***GURPS*** supplement was in the first edition of ***GURPS Low-Tech*** – a work he has been interested in improving ever since, especially in his pet area of armor. Dan has an Arts degree in History and Classical Studies. He holds a second dan black belt in Oh Do Kwan Tae Kwon Do, and has competed internationally. Other interests include historical armor reconstruction, renewable energy, and organic gardening. He currently lives in Maitland, Australia with his wife and three children.

Matt Riggsby holds degrees in anthropology and archaeology and, like the rest of his generation, works with computers. He has been the author or coauthor of books on database design and development, as well as many articles for *Pyramid* magazine. He works for a company that produces TL8 medical devices, and lives in a TL6 house with his wife, son, and a pack of domesticated but semi-trained carnivores.

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. (He has 27 linear feet of nonfiction, not counting the *Encyclopædia Britannica*.) His other pleasures including cooking, reading science fiction and alternate history, and running and playing in RPGs, which he has been doing since 1975, when he first encountered ***Dungeons & Dragons.*** His previous SJ Games work includes coauthoring the original ***GURPS Low-Tech*** and writing the latest edition of ***GURPS Fantasy.*** He lives in San Diego with his cohabitant Carol, two cats, two computers, and far too many books!

Chapter One
The Age of Labor

Gnaeus Sergius Martialis offered his greetings to Flaminius Felix, the legate of Egypt. He spared a quick glance for the other guest, an older man in plain but well-made clothes.

"Excellent work you did, Captain, driving off those pirates on your last patrol!"

"The legate does me too much honor," Martialis said. "Keeping pirates in check is no more than my duty to Caesar."

"Just so," said the older man, "but Caesar's servants don't always bear their duty so much in mind."

A hint of a smile touched the legate's face. "Sir, Sergius Martialis is one of my best captains, and the ***Pernix*** *one of the fleet's best ships. Captain, you did better work than you know. You stand before Titus Publicius Pertinax, Prefect of Egypt, who was a passenger in the vessel those pirates were attacking. You served Rome well when you drove them off."*

"Indeed, sir," Martialis said, "that lessens my regret at doing no more. Too often it is so; when our ships find them, they flee, and when they elude us, they have their way with honest men. I wish I could destroy them and put an end to their lawlessness."

"Ah," said the prefect, "you need an Archimedes to arm your ship."

"What, the Greek who defended Syracuse against Claudius Marcellus?" the legate asked. "Would you have the captain's rowers hold up polished shields, to set the pirates on fire?"

The older men laughed, but Martialis said, seriously, "Lord, I know little of Archimedes but the name, and that he was an artificer. But my ship has good service from its scorpions. If some engineer could make deadlier weapons, I would gladly try them against the pirates."

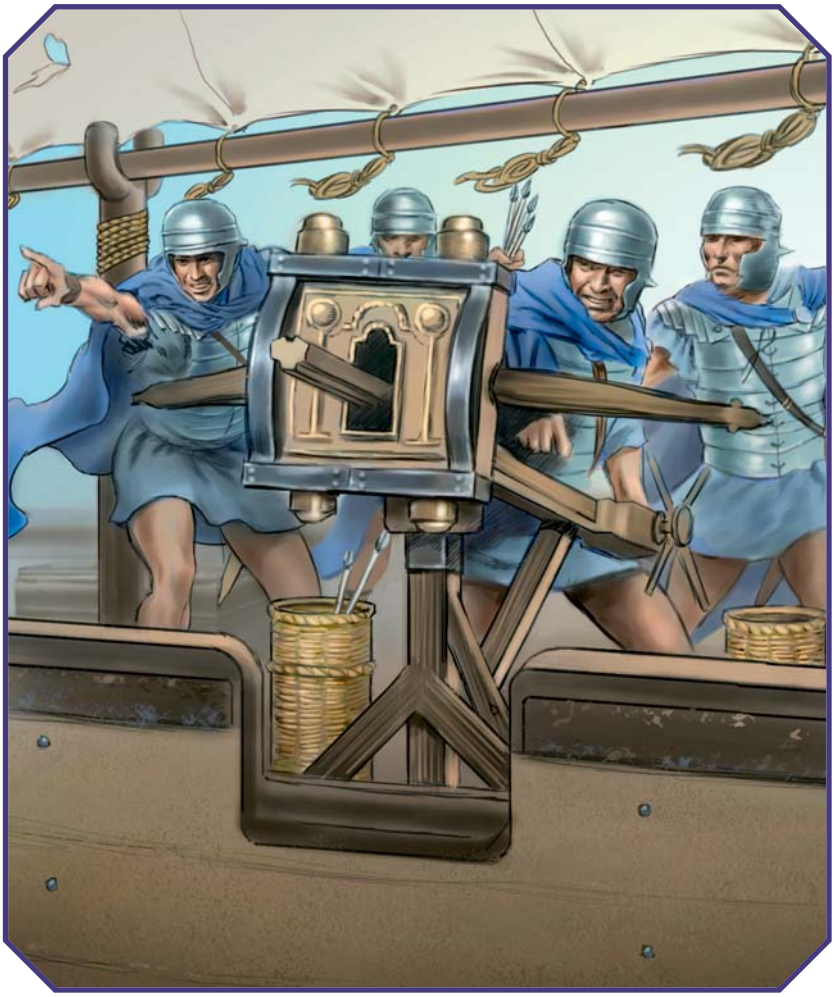
A considering look came into the prefect's eyes. "Captain," he said, "we are in Alexandria-in-Egypt, the site of the Museum – which has the world's greatest library, and its greatest collection of clever men. I think you should seek their advice. A friend of mine, Aristoboulos, is studying there; if the legate will summon a scribe, I'll dictate a letter of introduction."

"Certainly, sir. An excellent suggestion!"

Martialis wondered at the odd tone of his commander's reply.

Low-tech societies are based on human toil. They don't lack other energy sources – fire, draft animals, water, and wind have been harnessed for centuries. But each of these is limited to specific applications; there's no general-purpose power supply comparable to the steam engines of the Industrial Revolution. Wealth is based, not on machines, but on labor and the land that supports it; it grows through increases in the supply of labor, by natural fertility or by slavery and conquest. War, too, is largely a matter of human effort, both in fighting and in moving from place to place.

GURPS Low-Tech is a catalog of tools for such efforts. There are no power lines, batteries, or mobile engines to power these implements, and they don't specify power requirements. This is gear for craftsmen and warriors – and for adventurers who may be either.



Ages of Technology

Tech levels (p. B511) can be defined in several ways. Most have a signature technology – e.g., stone, bronze, or iron – alongside other characteristic technologies. These capabilities allow new forms of political and economic organization. Crucial to adventurers, each TL also has a distinctive approach to weapons and warfare.

TL0: The Stone Age

The Stone Age was longer than all of human history. Treating it as one TL is in a way misleading; it encompasses *several* eras whose technologies differed at least as much as those of ancient Rome and the Middle Ages. In terms important to adventurers, though, it's all fairly similar: small-scale societies that don't support professional warriors or soldiers, armed with stone or wooden hunting weapons. The overall signature technology is worked stone tools and weapons.

Paleolithic (2,400,000 B.C.+)

Signature Technology: Chipped stone.

Other Technologies: Wood, bone, and leather; domesticated dogs; rafts, canoes, and sleds; string; fire; herbs and crude surgery.

Social Organization: Nomadic bands and tribes; rules for marriage, inheritance, and kinship; oral traditions; shamanism.

War: Tribal war bands with hunting weapons; shields.

Mesolithic (8500 B.C.+)

Signature Technology: Multiple small stone chips mounted on a frame or handle.

Other Technologies: Fishing; food storage; basketry; houses.

Social Organization: Chiefdoms and gift-exchange systems; settled communities.

War: Slings; bows and arrows.

Neolithic (8000 B.C.+)

Signature Technology: Ground stone.

Other Technologies: Gardening; food-animal domestication; ceramics; weaving; nets.

Social Organization: Barter; local shrines, priests, and cults.

War: Ditches and other improvised defenses.

Chalcolithic (4500 B.C.+)

At the very end of the Stone Age, native copper comes into use. Some archaeologists call this the Chalcolithic Age. Its technology is essentially that of the Neolithic, with one exception:

Signature Technology: Native copper tools.

TL1: The Bronze Age (3,500 B.C.+)

Signature Technology: Bronze.

Other Technologies: Large-scale agriculture, often with irrigation and plowing; herding; draft animals; wheeled vehicles; large-scale architecture; shipbuilding; written records; practical mathematics; calendars.

Social Organization: City-states and monoethnic empires; written law; armies; long-distance trade and diplomacy; gold and silver currency by weight; marketplaces.

War: Horse-drawn chariots; helmets and body armor; walled cities and siege warfare.

TL2: The Iron Age (1200 B.C.+)

Signature Technology: Iron.

Other Technologies: Riding horses and mounted herdsmen; concrete; large glass objects; arches, vaults, and domes; early water mills; theoretical mathematics; humoral medicine.

Social Organization: Multiethnic empires; founding of universal religions; philosophy; historical scholarship; coinage.

War: Cavalry; war elephants; phalanx warfare; mechanical artillery; specialized war galleys.

TL3: The Middle Ages (600 A.D.+)

Signature Technology: Steel.

Other Technologies: Three-field rotation; moldboard plow; heavy horses; flying buttress; windmills and widely used water mills; distillation; compasses; numerals with zero.

Social Organization: Universal religions; monasticism.

War: Mounted knights; castles; counterweight mechanical artillery; early black-powder weapons.

TL4: The Age of Sail (1450 A.D.+)

Signature Technology: Full-rigged ships.

Other Technologies: Cast iron; the printing press; telescopes; celestial navigation; early synthetic medications.

Social Organization: Nation-states and absolute monarchy; overseas empires; widespread literacy.

War: Cannon; musket and pike; early bayonets; formal military drill; sailing warships armed with cannon; star forts replace castles.

Variant Paths

Ages of Technology (p. 6) offers a rough "average" of progress through history and prehistory, based on the ancient Near East, Greece, Rome, and Europe. Elsewhere in the world, technology evolved differently. Often it was slower; Paleolithic societies existed at the start of the 20th century! Occasionally it was faster. Define a society's TL by the tools and techniques in common use there – *not* by the calendar date.

Different technologies don't always advance in step. Some societies achieve a TL's overall capabilities without all of its characteristic technologies – and sometimes without its *signature* technology! Variant societies can be described as "retarded in a science." A society can also be "advanced in a science," having one set of techniques usually found only at a higher TL; it might even jump from an early technology to a far more advanced one, skipping everything in between. And it's quite possible for a society to be advanced in certain technologies but retarded in others. In extreme cases, a society's TL may be a rough average of capabilities representative of three or four TLs. Judge a society's TL by its *overall* function, never on the strength of a single technology.

Some examples:

Polynesian Navigators: The Polynesians had Stone Age technology overall, with pre-state social organization and without literacy. But they built boats with sails that could cross the Pacific, and developed navigational methods to guide their voyages. Treat them as TL0 with TL2 seafaring.

The Walls of Jericho: Archaeologists working at the site of Jericho discovered that its oldest relics date to 7000 B.C., in the late Neolithic. The original city covered 10 acres and had massive walls surrounded by a ditch. Its 2,400 inhabitants supported themselves by Neolithic farming and gazelle hunting. Jericho is TL0 with TL1 construction and fortification.

Mayan Astronomers: The Maya were the New World's first civilization, building stone cities and keeping written records. But they didn't have bronze, used few metal tools, and had no draft animals. On the other hand, their mathematics was sophisticated, with a symbol for zero; so was their astronomy. Treat them as TL1 with TL0 materials and TL3 mathematics.

African Metallurgy: The kingdoms of Sub-Saharan Africa didn't pass through a distinct Bronze Age; their metallurgy went straight to iron. But they were otherwise organized like Bronze Age civilizations. Treat them as TL1 with TL2 metallurgy.

Medieval Medicine: In many branches of technology, medieval Europe was more advanced than the Roman Empire, from three-course crop rotation to weapons and armor. But for most of the Middle Ages, it didn't support professional doctors, and it failed to advance beyond the Roman Empire in medicine – and in some ways fell behind it. Treat medieval Europe as TL3 with TL1-2 medicine.

Chinese Advances: Europe entered TL4 around 1450. But in the Middle Ages, Europe wasn't the most technologically advanced society on Earth. Between 1000 and 1450, China developed cast iron; the magnetic compass; mechanical clocks; large seagoing junks that traveled as far as southern Africa; the printing press; paper money; and black powder. It's plausible to put the start of TL4 earlier in China – perhaps in 1250, during the Mongol invasions.

Alternative Technologies

What about *making up* technological patterns – those of wholly fictional cultures, or ones that might have arisen had the history of technology gone differently, as discussed on pp. B513-514? The resulting technologies are unlikely to match historical examples perfectly, and probably won't precisely fit the stages that define TL0-4.

Roads Not Taken

An imaginary society may advance unusually quickly in one technology, developing inventions that historical societies didn't achieve until much later. Such societies can be described as "advanced in a science or art" (see *Variant Paths*, above). For example, if a society comparable to ancient Rome had set aside its prohibitions against dissection and discovered blood circulation, it would have been TL2 but advanced in medicine.

A society may develop technologies that were *never* made workable in the real world, advancing along a different path. Such societies can be described as having a TL such as TL(0+1) or TL(3+1). The +1 means that they brought into regular use inventions that the real-world society that inspired them failed to perfect. For example, ancient Roman armorers experimented with compressed-air cylinders to store energy in catapults; if they had achieved a tight enough seal, the result might have been a TL(2+1) society.

Low-Tech gives relatively little attention to such imaginary TLs. It doesn't consider magical technologies, different laws of nature, or the speculations of people in historical societies. It *does* discuss a few inventions that weren't fully developed, asking what would have happened had they been brought into regular use; such inventions define TLs from TL(0+1) to TL(4+1). ***Low-Tech*** also notes some inventions that speculative historians and archaeologists suppose might have been achievable by past societies, if they've been shown to be achievable with those societies' resources. For example, Thor Heyerdahl's raft boat that crossed the Atlantic could have been built with Egyptian materials and methods, although most Egyptologists don't believe this really happened.

Blocked Roads

Another option is to assume that a society attained some level of technology without all of the usual key inventions. For example, many science-fiction writers describe societies that advance rapidly in biotechnology while the physical sciences stagnate. A civilization without access to useful ores might work with stone, ceramics, glass, and hardwoods in lieu of metals.

Pastoral nomads are an interesting variation on this theme. Historically, almost all forms of pastoralism were offshoots of agriculture (reindeer herding is the exception). Thus, pastoralists are TL1 to TL3, despite lacking agriculture, cities, and bureaucracy. Their military technology is often formidable – the Bedouin and the Mongols created huge empires by conquering their civilized neighbors.

Technology for Nonhumans

Yet another way to have technology develop differently is to make its users members of a nonhuman species. Just being larger or smaller can require differently designed gear; see *Adjusting for SM* (see box) and the scaling rules in ***GURPS Low-Tech Companion 2.*** Alternative manipulators, such as an elephant's trunk or a parrot's beak and claws, could require unconventional tool designs. And what if the race relies on a primary sense other than sight, lacks a human sense, or possesses a sense that humans don't, such as a bat's sonar? What if it can affect its environment by means other than muscle contractions, such as an electric eel's discharges?

A race's native environment will also play a role in its technologies. Aquatic beings won't have fire and will make little use of metals. Flying ones will probably avoid heavy equipment, but may be quick to develop navigation and optics.

Adjusting for SM

Clothing, life-support gear, and similar personal items assume a user the size of a normal, adult human (SM 0). When buying equipment for larger or smaller individuals, multiply *cost* and *weight* by a factor that depends on the user's Size Modifier:

SM	*Factor*	*SM*	*Factor*
SM -4	×1/20	SM +4	×20
SM -3	×1/10	SM +5	×50
SM -2	×1/5	SM +6	×100
SM -1	×1/2	SM +7	×200
SM +1	×2	SM +8	×500
SM +2	×5	SM +9	×1,000
SM +3	×10	SM +10	×2,000

Tech Levels and Character Traits

Setting TL doesn't merely determine personal TL (*Technology Level,* pp. B22-23) and that of technological skills (p. B168) – it has far-reaching character-design effects. Some skills don't exist in low-tech societies; e.g., a TL0 person can't have Physician. Others take different forms; for example, at TL0, Weather Sense replaces Meteorology. Finally, special training – such as *Surgical Techniques* (p. 12) – exists to offset certain limitations of low TL.

As well, a few traits affect the relationship between gear and its owner; e.g., *Equipment Bond* (p. 9).

Advantages

Certain advantages require additional thought in low-tech campaign settings.

Language

see pp. B23-25

Realistic TL0 societies lack writing. Individuals from such backgrounds have a comprehension level of Native/None, for -3 points.

Wealth and Status

see pp. B25-29

Adventurers start with Status 0 and Wealth (Average). However, Status 0 isn't the default for every person in every society, but a specific social situation – that of a "free man," with enough liberty and resources to support a life of adventure. At TL1-4, such people are a privileged minority. The average person is a small farmer, with Status -1 and Wealth (Struggling) . . . not usually a slave, but not free to leave his land, and often held in mild contempt socially and legally. City dwellers *may* have Status 0 and Wealth (Average) – but food and housing cost more in cities, so their actual standard of living might not be much higher.

Tribal societies at TL0 are often more egalitarian. See ***GURPS Low-Tech Companion 1.***

Combining Strength

Big jobs in low-tech societies often require combining the strength of several men. You can think of a work gang as a single large, strong creature – and for some jobs, it might be *replaced* by such a creature: a draft animal in a realistic campaign or a giant in a fantastic one. But what's the combined ST score for a group of laborers?

Don't simply add ST scores! For example, summing the ST of 10 average (ST 10) men would give ST 100. Basic Lift for ST 100 is 2,000 lbs. (1 ton), which is 100 times a ST 10 man's BL of 20 lbs. If ST combined this way, a squad of men could carry several times their own weight, like worker ants.

Instead, add BL scores. Basic Lift for the average man is 20 lbs.; so BL for 10 men is 200 lbs. If you need a ST score, take the square root of the number of workers and multiply by their average ST. These calculations work for teams of draft animals, too.

Example 1: The combined BL of 20 men is 400 lbs. An average elephant has ST 45 and BL 405 lbs. Thus, an elephant can carry or pull as much as 20 men; e.g., it could easily power a 15-man beam sling (p. 81).

Example 2: An ox has ST 27. Two oxen, yoked together, have an effective ST of (square root of 2) × 27 = 38.

Perks

Several new perks are important in ***Low-Tech*** games. Each costs a point. For more on perks, see pp. B100-101.

Anachronistic Skill

In some TL4 societies – e.g., Renaissance Europe and early Ming China – nascent experimental science exists alongside older natural philosophy. Each Anachronistic Skill perk grants access to one specific scientific skill that isn't otherwise available until TL5, such as Meteorology (p. 11), Pharmacy (Synthetic), or Physician (p. 11). The GM may define variants for other skills or small groups of skills, or even permit Anachronistic Skill before TL4.

Chariot Training

You're trained at fighting on a fast-moving chariot. You can ignore combat penalties for speed and uneven ground; see *Chariots* (p. 137). This doesn't compensate for penalties due to using a vehicle with solid wheels.

Equipment Bond

You own a piece of equipment – or a kit (tool, medical, etc.) – that's uniquely suited to you. Each item or kit requires its own perk. Whenever you use that gear, you have +1 to effective skill regardless of actual quality. This *is* cumulative with any bonus for high-quality hardware, but the gear needn't be exceptional – you can take this perk even for cheap equipment!

Whatever the equipment's quality, you pay no more than usual for it, because it isn't especially good for anyone else – it has the perfect fit, balance, etc. for *you*. For a kit, the bonus partly reflects the tools or instruments constituting a superior *combination* of gear. However it's explained, this isn't a supernatural attunement of any kind.

If the gear is lost or destroyed, the Equipment Bond doesn't transfer to new hardware. You can acquire a new Equipment Bond in play, but in addition to spending a point, you must spend time searching for just the right item, and then buy it. To avoid such hassles, acquire your equipment as Signature Gear (p. B85).

Applied to a weapon, this perk becomes Weapon Bond. It gives +1 to skill with one weapon. Each weapon requires its own perk; you can't take it for a group of weapons.

Improvised Weapons

You've practiced fighting with everyday items. Ignore skill penalties (only) when wielding them as described under *Improvised Weapons* (p. 63). You must specialize by combat skill. Choose Brawling or Karate to use improvised fist loads effectively.

Naval Training

You've trained at fighting on a rocking ship or boat. You may ignore attack and defense penalties for bad footing under those circumstances.

Two-Man Pike Training

You're trained to work with another warrior to move and fight while wielding a large spear or polearm, which must have Reach 3+. Once you and your companion have *both* taken a Ready maneuver to grasp the weapon, you move and choose maneuvers as a *single* fighter with these stats:

- The *worse* Basic Speed, Move, and Spear skill of the pair.
- Effective ST equal to the *stronger* man's ST plus 1/5 the other man's ST, rounded down, for the purpose of damage, resisting knockback, etc.
- Effective HP equal to the *higher* HP score of the pair plus 1/5 the other man's HP, rounded down, for the purpose of making or resisting slams.

The front man can let go with one hand as a free action, if necessary. He can even draw a one-handed weapon and fight at full skill with that weapon – although the team still moves as a single fighter with the lower Basic Speed and Move, and the pike cannot be used to attack during this time. To resume pike use, the front man must take another Ready maneuver. If either fighter gets separated, he must take a new Ready maneuver to get back on the pike; until then, he's fighting individually while his partner drags the giant spear.

If either fighter lacks this perk, the team cannot combine ST or HP, but still uses the worse Basic Speed and Move, and fights at the lower Spear skill, -2!

Disadvantages

In very low-tech cultures, one disadvantage demands special treatment.

Innumerate

see p. B140

Some TL0 cultures have languages without words for numbers. *Everyone* from such a background is Innumerate. They may be able to keep track of things with tally marks, or on their fingers, but they can't say how many they have, count, or do arithmetic.

For cultures whose languages have number words, Innumerate becomes an individual disadvantage – although it may still be widespread.

Skills

Several skills, especially technological ones (p. B168), have distinctive forms in low-tech societies.

Armoury

see p. B178

At TL0, Armoury (Melee Weapons) defaults to Carpentry-3 if the working surfaces are made of wood, to Machinist-3 if they're stone. Armoury (Missile Weapons) defaults to Carpentry-3; it's the quality of the woodworking that determines whether an arrow flies straight.

At TL1-4, Armoury (Melee Weapons) defaults to Carpentry-3 for weapons made entirely of wood, to Smith (Copper)-3 for metal weapons with bronze working surfaces, or to Smith (Iron)-3 for those with iron or steel surfaces.

Starting at TL3, a new specialty exists:

Liquid Projectors: Building, modifying, and repairing fire-siphons – and, at higher TLs, flamethrowers, water cannon, squirt guns, and other weapons that release streams of liquid or gas. At TL3-4, this and Explosives (Fireworks) default either way at -4.

Astronomy

see p. B179

In low-tech societies, Astronomy (Observational) is fairly common – people may know the night sky better than most moderns! Starting at TL1, there are also astronomers who use mathematics to study the heavens.

Chemistry

see p. B183

Up through TL4 – indeed, midway into TL5 – there's no accurate theory of the composition of matter. Models such as the Greek earth-water-air-fire scheme are to scientific chemistry somewhat as Esoteric Medicine is to Physician. Any analytical or synthetic procedure is at -3 to skill, as it amounts to educated guesswork. Extraction (purifying natural substances) has no penalty, but see *Distillation* (pp. 11-12).

Crewman

see p. B185

At TL1-4, ships can have sails, oars, or both. Sails and oars require different training. Rowing a ship uses a new Crewman skill:

Oarsman/TL: The skill of rowing or paddling a large ship. This includes steering and incidental shipboard tasks, but *not* manning the sails. Oarsman and Seamanship default either way at -2.

Esoteric Medicine

see p. B192

This skill takes the place of Physician in low-tech societies, for treatments not based on herbs or other medicinal substances. It isn't necessarily magical or mystical; it includes purely physical methods such as acupuncture, bleeding and purging, and massage. Some of these actually have useful effects; see Chapter 9.

Guns

see pp. B198-199

Primitive TL3 firearms require their own specialty:

Gonne: An early handheld firearm, amounting to a miniature cannon that fires either darts or stones. It has neither a grip nor a true stock. Instead, it's mounted at the end of a wooden pole. This is either rested on the shoulder, or held between arm and body (like a knight's lance). The design differs enough from later weapons to require its own Guns specialty. This and other specialties default either way at -4.

Lance

see p. B204

This is specifically the skill of charging with a *couched* lance. Striking overhand with an uncouched spear uses Spear skill and the rider's own ST. Basic equipment for Lance is a war saddle and stirrups (see *Riding Gear,* p. 134). A rider with a war saddle but not stirrups can brace himself against the cantle with pressure from his thigh muscles; treat this as improvised equipment (-2 to Lance skill).

Machinist

see p. B206

Machinist/TL0 is used to make stone tools – from pebble tools up to polished jadeite hammers or obsidian-bladed scalpels.

Mechanic

see p. B207

An important machine-type specialty emerges at TL4:

Optical Instruments: Grinding lenses and mirrors, and assembling them into complex devices.

Meteorology

see p. B209

In low-tech societies, this normally takes the form of Weather Sense. At TL4, with the invention of the barometer, someone with Anachronistic Skill (p. 9) can learn true Meteorology and benefit from equipment modifiers.

Physician

see p. B213

The ***Basic Set*** notes that this skill isn't generally available in low-tech societies. But TL4 saw the first steps toward modern medical science, such as Harvey's discovery of blood circulation and early experiments with thermometry (see *Temperature and Pressure,* p. 45). Individuals with Anachronistic Skill (p. 9) may learn Physician/TL4.

If the GM is designing an alternative technological history, he's welcome to have Physician to emerge as part of it – perhaps in an advanced Roman Empire at TL(2+1), or even in a sophisticated Stone Age tribe at TL(0+1).

Submarine

see p. B223

An additional specialty of this skill might exist in some low-tech societies:

Unpowered: Any small, closed, short-duration submersible that relies on muscle power, normally exerted by rowing. *Defaults:* Submarine (Mini-Sub)-5 or Boating (Unpowered)-4.

Surgery

see p. B223

As the ***Basic Set*** notes, without Physician skill, a surgeon is at -5 for operations other than field-expedient surgery; e.g., setting broken bones, treating wounds, and extracting arrowheads or bullets. Because Physician is unavailable in most low-tech societies (see *Physician,* above), this is status quo there.

Surgeons who want to reduce this penalty should see *Surgical Techniques* (p. 12). It's also common to specialize in one form of surgery, such as eye surgery or dental surgery. Optional specialties don't avoid the skill penalty but *are* easier to learn (IQ/H rather than IQ/VH). Eye surgery requires extreme precision; even with specialized instruments, roll at -2 to skill.

Many surgeons, especially in the armed forces, may make a virtue of necessity, with an optional specialty in trauma surgery. This specialty exactly covers the procedures of field-expedient surgery. When performing general surgery, trauma surgeons suffer the -2 for working outside their optional specialty *and* the -5 for lack of Physician.

Another surgical specialty is *venesection:* opening a vein with a lancet in order to bleed a patient. This *isn't* field-expedient, but a practitioner who has studied Esoteric Medicine (any form that includes bleeding) isn't subject to the -5 for lack of Physician. Failure doesn't result in significant bleeding, but critical failure opens an artery, causing dangerously fast bleeding. This works as described in *Bleeding* (p. B420), but while the initial incision doesn't itself inflict any HP of injury, HT rolls to avoid ongoing HP loss to bleeding are at -4 and must be made every *30 seconds*.

Techniques

One way to overcome some of the limitations of low-tech equipment is to improve specialized techniques (see pp. B229-230). Anybody who knows the prerequisite skill can attempt these at default.

Blood Vessel Pressure

Hard

Default: First Aid-3.
Prerequisite: First Aid; cannot exceed First Aid skill.

This technique is a substitute for using a tourniquet (p. 145). It can stop bleeding from the scalp, ear, or other location that can't be tourniqueted but that has accessible blood vessels. The patient must be cooperative or restrained. The caregiver presses against an artery, reducing blood flow and slowing bleeding as for a successful First Aid roll. He may opt to make a *ST*-based (rather than IQ-based) roll. He must maintain the hold for a full minute, at the cost of 1 FP.

If using *Bleeding* (p. B420) and the initial Blood Vessel Pressure roll fails, the medic can maintain the hold at a cost of 1 FP per additional minute. Each minute allows another Blood Vessel Pressure roll, as well as the patient's HT roll. If either succeeds, the wound doesn't bleed in that minute.

At the GM's discretion, this technique can also be based on Pressure Points skill. The prerequisite becomes Pressure Points; the default, Pressure Points-2; and the maximum level, Pressure Points+2.

Distillation

Hard

Defaults: Alchemy or Chemistry.
Prerequisite: Alchemy or Chemistry; cannot exceed prerequisite skill+6.

Distillation is one of the basic methods for purifying chemical substances. It appears at late TL2, when Roman and Chinese experimenters begin to develop alchemy and chemistry (the two aren't clearly distinguished until TL5). It's used to produce alcohol (p. 25), among other things.

Roll against Chemistry skill for distillation. The proper temperature is vital and must be judged by observation; a distiller can improve his judgment up to Chemistry+6 using this technique. In a TL5+ lab or distillery, with accurate thermometers, getting the right temperature is easy and the full +6 is automatic. Early thermometers, before Fahrenheit's (see *Temperature and Pressure,* p. 45), are less accurate, giving only +4. Thermometer bonuses *replace* technique bonuses; the two never add.

Success doubles the concentration of the desired substance; critical success means the yield is nearly pure. Failure doesn't change the concentration. Critical failure produces the wrong substance, or (at the GM's discretion) causes a lab accident such as a burst vessel or a fire.

Hands-Free Driving

Hard

Default: Teamster (Equines)-4.
Prerequisite: Teamster (Equines); cannot exceed Teamster (Equines)-1.

Chariot warriors don't normally drive their own chariots – their hands are occupied with weapons. They leave the task to a charioteer. If the driver is disabled or unavailable, though, a warrior may loop the reins about his waist or fasten them to his belt, steering by leaning against them. This is never as good as having the reins in hand, and it's risky; if the chariot is disabled, he'll be dragged over the ground! He also can't dodge without losing control of the horses; treat this as a control roll failed by SR or less (see *Control Rolls,* p. B466).

Hands-Free Riding

Hard

Default: Riding-3.
Prerequisite: Riding; cannot exceed Riding skill.

This technique represents training to remove the penalties under *Mounted Combat* (p. B396) for controlling your mount using one hand or no hands. Roll against Hands-Free Riding instead of Riding to control your mount using no hands. If you've *improved* this technique, you may ignore the -1 for using only one hand.

Mounted Reload

Hard

Default: Lower prerequisite skill-3.
Prerequisites: Guns *and* Riding; cannot exceed lower prerequisite skill.

Mounted Reload lets you load a muzzleloader while mounted; see *Loading* (pp. 94-95). You must specialize by Guns specialty *and* Riding specialty. Failure means starting over; critical failure means a dropped weapon, spilled powder or shot, or an extinguished match (matchlock or cannonlock only).

This feat is two-handed. Use Hands-Free Riding (above) for riding more complex than straight-line travel. Any failure means you must start over, in addition to its other bad effects.

Quick Mount

Average

Defaults: Acrobatics-3, Jumping-3, or Riding-3.
Prerequisite: Acrobatics, Jumping, or Riding; cannot exceed prerequisite skill.

For riders before the invention of the stirrup, getting onto a horse was a challenge. It required either stepping onto a mounting block or vaulting onto the horse's back using this technique. See *Mounting Up* (p. B396).

Surgical Techniques

Hard

Default: Varies.
Prerequisite: Surgery.

Low-tech surgeons may learn specialized techniques for particular operations. These offset Surgery penalties, and cannot exceed Surgery skill unless stated otherwise. Some examples:

Bonesetting (TL0): Setting bones isn't necessarily *invasive,* but as it involves manual manipulation, and trauma surgeons are trained to do it, it's part of Surgery. A simple fracture (*lasting* crippling; see p. B422) requires a Surgery roll, plus or minus the ST difference between surgeon and patient. Bonesetting is possible without instruments, so many of the TL penalties for surgery don't apply. The technique buys off the -1 for working without X-rays and -2 for working without anesthesia. Compound fractures (*permanent* crippling) are beyond the limits of low-tech medicine.

Trepanning (TL0): Making a hole in the skull by removing a circular piece of bone, by scraping, cutting away the rim, or drilling (see *Trephin,* p. 148). Practiced since the Paleolithic, this procedure can relieve pressure on the brain after a crushing blow to the skull (treat as stabilizing a mortal wound, p. B424) or, at the GM's option, relieve Chronic Pain (p. B126) due to migraines. Cannot exceed Surgery+4.

Cataract Surgery (TL2): Using a needle to pierce the eyeball and treat cataracts (see *Eye Surgery Instruments,* p. 149). This can reduce Bad Sight to normal vision or Blindness to Bad Sight, *if* the problem is due to cataracts. The technique buys off the -2 for eye surgery and -5 for non-field-expedient low-tech surgery for this operation. When learning it, base Surgery on DX (not IQ).

Cutting for the Stone (TL2): Making an incision into the bladder to extract a bladder stone. This counts as minor surgery (see *Surgery and Surgical Equipment,* p. 147). This technique buys off the -5 for non-field-expedient low-tech surgery for this operation.

Thong Throwing

Hard

Default: Thrown Weapon (Spear)-2.
Prerequisite: Thrown Weapon (Spear); cannot exceed Thrown Weapon (Spear).

This technique uses a thong wrapped around a javelin. When releasing the weapon, the thrower pulls back on the thong, imparting spin. This improves Acc and Range (see *Muscle-Powered Ranged Weapon Table,* p. 77). Readying a javelin for such a throw requires two hands and a Ready maneuver.

Low-Tech Inventors

In most low-tech societies – and *all* TL0 ones – there isn't a specialized profession of "engineering." People who make things use skills like Architecture, Armoury, Machinist, and Mechanic; inventors are tinkerers, using Engineer at its default to one of these skills. Still, a successful tinkerer may buy Engineer, at the GM's discretion. And some societies *do* have professional engineers; Archimedes, Vitruvius, and Leonardo da Vinci all had Engineer skill. If someone is paid to invent new devices, writes books on technology, and/or has a social role that allows intellectual inquiry and an interest in technology, the GM can treat him as an engineer.

Many new devices are actually modifications of existing ones, not fundamental new concepts; e.g., a prodd (p. 73) is a modified crossbow. A low-tech inventor can create these via *Modification* (p. B477). If the original device is common, the GM may waive the need for prior *Analysis* (p. B477). The Gadgeteer advantage isn't needed to devise modifications – although an inventor without it won't gain the speed benefit! The GM is free to rule that any novel device is subject to the usual requirements of inventing, and definitely should do so for a higher-TL device.

Gadget Control

Players whose characters live in low-tech societies may want to have them invent all sorts of useful devices, and not see why they can't. After all, to the players, these items are old news. For example, they probably know that black powder is 75% saltpeter, 15% charcoal, and 10% sulfur ground together – so why can't the PCs make it?

In some campaigns, the answer is, "Fine. Go ahead." Myths describe "culture heroes" who gave their people all their key technologies. Romantic stories about prehistory sometimes have cavemen leaping through three or four major advances in a single lifetime. Let the PCs buy Gadgeteer and turn them loose!

For other campaigns, a more realistic treatment of the difficulties is the whole point. The "castaways in time" genre – from L. Sprague de Camp's *Lest Darkness Fall* to S.M. Stirling's Nantucket series – focuses on modern people struggling to invent modern devices in the historic past. Practically any major invention has other inventions as prerequisites, which a little research can identify. The GM can have the adventurers struggle to achieve these prerequisites. Remember the skill penalties for working with concepts and equipment below your native TL (p. B168).

For inventors native to a given TL, such inventions may mean working *above* it, at much steeper penalties (p. B168). And maybe the answer is simply, "No, you can't try to invent black powder" (see *The Big What If: Early Black Powder,* p. 85). There may be practical problems that are harder to solve than the players imagine. And there may be no reason for the idea to occur to the inventor in the first place – especially in a society with no tradition of experiment for its own sake. If miraculously fast technological advance isn't a campaign theme, the GM should become familiar with the modifiers to Concept rolls for new inventions (p. B473) and apply them ruthlessly.

The Economics of Equipment

Low-tech economies don't work like industrial ones! There are no assembly lines and there's little standardization. Transportation is slow and imported goods are expensive; thus, most equipment is locally made. Adventurers who want to acquire new gear or keep their old stuff working have to deal with the consequences.

Buying Equipment

Buying gear in low-tech societies can be a challenge. Most objects are made one at a time by craftsmen, or by the people who will actually use them. There are exceptions – a wealthy ruler may be able to pay for his army's gear, and even set up workshops to turn out standard models – but such equipment isn't usually intended for sale and isn't easy to buy, unless you're a wealthy ruler yourself. Thus, each item is unique. There are standard categories in ***GURPS*** equipment lists, such as "shortsword" and "medium shield," and it's convenient for game purposes to assume that everything in each category is identical, but in reality there's a lot of variation and few if any standard models. These differences are part of the justification for Equipment Bond (p. 9).

Because of this, prices are less standardized. For a merchant who sells a lot of the same item to a large pool of customers, supply and demand narrow the price range. If there's one item and one customer, narrowing is done by bargaining; for instance, if the merchant would sell for any offer of at least $100, and the customer would be willing to pay as much as $200, the price could end up anywhere in that range – and both buyer and seller will try to get as close as possible to the other's limit. The prices in ***Low-Tech*** are convenient for game purposes, but low-tech buyers – and even sellers – might have only a vague idea of what an item should sell for.

Rulers sometimes decree standard prices, but more often for necessities such as bread, wine, or salt than for adventuring gear or luxury goods.

If you can't find what you want locally, don't expect to have it shipped. Not only are shipping costs high, but it's expensive to send messages between cities – and even more costly, not to mention time-consuming, to go there yourself. Mostly, what's available is what's in stock *where you are*.

In a village or a town, this might not be much! Transportation limits the seller, too; if he can't sell something to locals, he may wait a long time for an out-of-town customer. Anything that isn't in steady demand will sit on his shelves, tying up his wealth without earning anything. To avoid this, a lot of goods aren't made in advance; they're created by a craftsman, from raw materials, when someone promises to buy them, and probably makes a down payment. Getting a new suit of clothes may mean waiting a week or a month.

In a city, there's room for storekeepers, who hold goods until someone asks to buy them. An armorer may have a display of swords or pistols, for example. But buyers have to look for the kind of thing they want, judge its quality, and haggle over the price.

In a metropolis, such as Rome or Edo, the economy will work more like that of a modern society. Commonly used goods may be sold in large, well-stocked shops, for established prices, and even made in large quantities.

The GM who wants to keep things simple can bypass the bargaining and shopping, and just ask for rolls to locate a seller who has the equipment the adventurers want – or, if those fail, to locate a craftsman who can make it. Use *Finding a Hireling* (pp. B517-518) for this. If that doesn't work, though, the would-be customers can't just go down the street to the next shop and try again.

Custom-Made Equipment

Equipment quality is discussed on p. B345. In addition to those cost multipliers and skill modifiers, several other features can be added to almost any gadget for which both cost and weight are given (*not* drugs, etc.). Multiple modifications are possible; e.g., "expensive" and "styling" commonly occur together. Each modifier has a "cost factor" (CF). To find final cost, multiply the modified item's list cost by (1 + total CF). If total CF is below -0.8, treat it as -0.8; thus, final cost cannot be below 20% of list cost.

Cheap and Expensive Gadgets

Cheap gadgets use inexpensive materials. They're either clunky (weight is ×1.5) *or* fragile and finicky (weight is unchanged, but apply -2 to HT and *halve* DR). Either way, CF is -0.5.

Expensive gadgets are made of lighter, stronger materials. Weight is ×2/3. CF is +1.

Neither option is available for weapons or armor.

Combination Gadgets

Combination devices aren't new: Australian aborigines made multipurpose woomeras (p. 75) that could function as digging sticks, fire drills, handles for stone chisels, and even percussion instruments! To create such items, follow these guidelines.

Cost and Weight

Starting with the costs and weights of the component gadgets:

- If *all* of the gadgets can be used at once, *weight* is that of the heaviest gadget plus 80% of the weight of the others (weight savings being due primarily to shared housing). *Cost* is that of the costliest gadget plus 80% of the cost of the others.
- If only *one* gadget works at a time, *weight* is that of the heaviest gadget plus 50% of the weight of the others (due to shared parts). *Cost* is that of the costliest gadget plus 50% of the cost of the others.

For weight calculations, use the gadgets' *empty* weight, after subtracting any ammunition weight.

Cost calculations always come *before* cost factor. Combined equipment cost is the new base to which cost factors apply.

Legality Class

A combination gadget's LC is that of the component with the *lowest* LC.

Disguised

A gadget or a weapon may be disguised as something of similar shape; e.g., a knife built into a belt buckle. Finding the hidden item requires the Search skill. CF is +1 for a mass-produced item, +4 for a custom-built one.

Quality

The quality grades for tools and gear on p. B345 have associated CFs: 0 for basic, +4 for good, and +19 for fine.

Rugged

A "ruggedized" gadget is built to withstand abuse, harsh weather, and damage. It has a shockproof and/or waterproof case, heavy-duty framework or fasteners, etc. This gives +2 to HT and *doubles* normal DR. Weight is ×1.2. CF is +1.

This option isn't available for clothing, weapons, or armor, except as specifically noted.

Styling

Any gear can have a more fashionable appearance: inlaid jewels, hand-tooled leather, embroidery, brocade work, silver or gold plate, etc. This is common for presentation-grade weapons. Styling grants a bonus to reaction rolls from collectors and potential buyers, and to Merchant skill rolls made as Influence rolls (p. B359) on such people: +1 to rolls for +1 CF, +2 for +4 CF, or +3 for +9 CF.

For detailed options, see *Decorated Equipment* (pp. 37-38).

Maintaining Equipment

The GM decides how much maintenance to require in the campaign. According to the ***Basic Set*** (*Maintenance,* p. B485), most low-tech gear doesn't need any – it is rarely complex, often has no moving parts, and isn't usually "more elaborate than a screwdriver or a knife." Realistically, though, even a simple blade needs to be cleaned regularly, to keep it in good condition, and should be sharpened after use. Thus, it's mainly a question of dramatic appropriateness.

If an item costs less than 0.1% of average starting wealth ($0.25 at TL0, $0.50 at TL1, $0.75 at TL2, $1 at TL3, or $2 at TL4), the GM may assume it's so simple that the rules for maintenance and breakdowns don't apply. If the GM feels that malfunction is possible, though, even the cheapest device – especially if it's also *cheap* (p. 14) – isn't exempt.

Maintenance checks and HT rolls for failure *always* apply to complex items or those regularly placed under stress. The GM is encouraged to waive those rules when they would needlessly bog down play . . . and enforce them ruthlessly in dramatic situations, such as when the PCs are cut off from a source of spare parts! The GM should also enforce them in campaigns that focus on soldiers, sailors, or guards. In real life, such specialists spend much of their time checking and maintaining their tools.

Repairing Equipment

If a gadget breaks down, it will need repairs (see *Repairs,* p. B484). Repairs require rolls against a suitable repair skill: Armoury (p. B178) for weapons and defenses; Machinist (p. B206) for tools; Mechanic (p. B207) for vehicles; and Sewing (p. B219) for fabric other than body armor. At the GM's option, fixing a complex system might involve *several* skills, depending on what broke down.

Repairs also require tools; see *Tool Kits* (p. 30). Major repairs call for a substantial investment in parts, too. If tools or parts are absent, the Machinist skill can be used to fabricate them.

> *Why should I let the toad* ***work***
> *Squat on my life?*
> *– Philip Larkin, "Toads"*

Storing Equipment

Part of maintaining equipment is storing it properly when it isn't in use. Expensive gear isn't just left lying around – especially not if the owner relies on it in life-or-death situations! Sheaths, quivers, and holsters don't only make weapons easy to reach; they shield them from bumping against hard surfaces. Military bases have armories to keep weapons in good condition when they're not being used. Gear that isn't stored properly will need maintenance before it's used again, even if it's normally exempt. Equipment that's exposed to harsh conditions (see *Sand, Slime, and Equipment Failure,* p. B485) can have worse problems.

Equipment Statistics

The following terminology and statistics are used to describe the equipment in later chapters.

TL (Tech Level)

Each gadget's tech level appears in parentheses after its name; e.g., "Abacus (TL2)." This is the TL at which the item can be reliably manufactured at the listed cost. For ***Low-Tech,*** "manufactured" doesn't mean "mass-produced"; it means that making it is within the capabilities of an experienced craftsman.

Cost and Weight

Many gadgets list cost and weight at the end of their description; e.g., "$200, 20 lbs."

Cost: This is the gadget's price in generic ***GURPS*** "$" (see *Tech Level and Starting Wealth,* p. B27). It *doesn't* include ammunition or other consumables.

Weight: This is the gadget's weight under Earth-normal gravity (1G), given in pounds (lbs.) or in some cases in tons (1 ton = 2,000 lbs.). Weight *does* include ammunition or other consumables, except where noted. Items listed as having "negligible" ("neg.") weight aren't truly weightless; assume that 20 to 50 such items weigh 1 lb.

LC (Legality Class)

The legal codes and technologies of low-tech societies developed along distinct paths; cultural factors can influence how strictly different technologies are regulated by law. Tribal societies often don't even *have* laws, although customs or religious taboos may control their people's actions just as strictly. Within a civilized society, the same possessions – not just weapons and armor, but luxury goods (see *Luxuries,* pp. 36-39) – may be forbidden to some social classes, but permitted or even mandatory for others. Rather than trying to define an exact LC for each item, ***Low-Tech*** gives ratings to broad classes of items, occasionally noting special exceptions for particular devices. The GM should feel free to adjust these for particular cultures and for different social classes within a culture.

Tech-Level Specialization

Characters must learn technological skills at a specific TL. Skills based on IQ suffer hefty penalties when used at any other TL, while those based on other attributes get smaller penalties; see *Tech-Level Modifiers* (p. B168). Equipment from another TL will likely be *unfamiliar,* too, unless it's an improved or obsolete version of something with which the hero is already familiar; see *Familiarity* (p. B169).

In reality, while technologies do sometimes change rapidly, mature ones can remain stable for a long time. As an optional rule, the GM may treat a TL penalty for a *DX-based* skill as if it were an unfamiliarity penalty rather than a default penalty for a different-TL version of the skill. This exemption doesn't extend to other skills, or even to IQ-based rolls for DX-based skills!

Example: After days of running from the bloodthirsty tribe of cannibals whose lands he's been exploring, João Monsaraz stumbles onto the banks of the Amazon, where he finds a dugout canoe. Paddling a TL0 canoe with Boating/TL4 (Unpowered) would usually give a whopping -4 to skill. However, the GM rules that a canoe is a canoe, and that this is merely an issue of familiarity. After a frustrating day spent learning the dugout's intricacies and limitations – and taking frequent looks over his shoulder – João operates it at no penalty.

HP, HT, DR

HP: Calculate a gadget's HP from its weight. Use the table on p. B558. Almost all gadgets use the Unliving/Machine column.

HT: Assume that a gadget has HT 10 unless otherwise noted. *Ruggedized* (p. 14) gear is HT 12; some *cheap* (p. 14) items are HT 8. The +1 or +2 skill bonus for *good* or *fine* quality also adds to HT. The HT bonuses for ruggedized and quality equipment are additive; a rugged, fine pocket watch would have HT 14.

DR: Use the guidelines on p. B483. Most gadgets are made of wood or thin metal with DR 2. Weapons are normally DR 4 – or DR 6 for solid-metal melee weapons. Armor, vehicles, etc., have their specified DR. Ruggedized gadgets have twice their normal DR.

Other Statistics

Where appropriate, other statistics may appear – notably volume in cubic feet.

Specialized Equipment

Certain items are described in a different format from that used for most gadgets:

Armor and Protective Gear: These use the statistics defined on p. B282.

Shields: These use the statistics defined on p. B287.

Vehicles: These use the statistics explained on pp. B462-463.

Weapons: These use the statistics described on pp. B268-271.

Equipment Bonuses

Low-Tech includes examples of equipment from every quality grade defined in *Equipment Modifiers* (p. B345). In item descriptions, any skill bonus for a gadget's quality is followed by "(quality)"; e.g., "provides a +2 (quality) bonus to Armoury skill." Quality is *basic* if there's no bonus, *good* if the bonus is +1, and *fine* if at least +2. At TL0-4, *best* is the same as *fine.* Higher-quality equipment is *generally* heavier and more expensive.

A gadget may give a skill bonus or penalty because the underlying technology is easy or hard to use or realistically fails seldom or often. An example is the penalty for low-TL surgical instruments (see p. B424). Such a modifier is comparable to a ranged weapon's Accuracy. Any modifier *not* marked "(quality)" is "intrinsic" like this. It has nothing to do with quality; it applies whenever you use that kind of equipment.

Quality bonuses, intrinsic bonuses, and the +1 for Equipment Bond (p. 9) *are* cumulative.

Chapter Two
Core Technologies

*"What in the gods' name is **that?**" Martialis asked.*

***That** was a bronze globe, with two spouts emerging from it at awkward angles. Two posts raised it above a tripod base; below it lay a brazier.*

Martialis had quickly felt at ease before Aristoboulos; his manners were very like those of the ship's surgeon, Caelius Calvus. Now he spoke like a tutor to his pupil. "That, my young friend, is a toy created by Hero, two centuries past. It's an outgrowth of his work on pneumatics, taking power not from air, but from steam. Glaukon! Fetch charcoal and water!"

The slave bustled about under Aristoboulos' orders, pouring water into the hemispherical base and kindling a fire under it. As the room grew hot, steam whistled through the two spouts – slowly at first, but as it came faster, the globe began to spin.

"You will observe," said Aristoboulos, "the great rapidity of its motion. That indeed is the greatest barrier to making practical use of it. Hero gave up on it and went on to engines with more measured motion and more governable power – or else your ship might be driven through the water by steam, rather than men's muscles."

*"I don't know," Martialis said. "You'd need a big globe to drive the **Pernix,** and a big fire. You'd be in danger of burning your own ship. Could any captain in his senses risk using such an engine?"*

The basic technological building blocks of the ancient world were an extremely small subset of those of the industrial age. Minerals were limited to what could be found on or near the surface. Plant and animal resources were subject to slow, disorganized selective breeding that took centuries to yield significant improvements. Materials were processed using techniques that were art as much as science. Yet the great empires of the past – and ultimately the tools that would produce the industrial world – were built on this foundation.

Materials

For most of its existence, humanity has used materials taken from the environment and only lightly processed: wood, grass, earth, stone, hide, and bone shaped into useful objects.

Stone and Earth

The most durable items from antiquity, and therefore those about which we know the most, were made from inorganic materials, starting with stone and earth.

Flaked Stone Tools

Produced at least 2.5 million years ago, the oldest surviving tools are made from flaked or chipped stone. Materials such as flint, chalcedony, chert, and obsidian have a glassy internal structure. When a mass is struck, the shock of the impact propagates in a predictable wave and cracks the stone along the wave's edge.

The simplest stone tools were made by striking a stone with a hammer – typically a convenient pebble – to knock off a single *flake* with a sharp edge. Flake tools can be extremely sharp, but their edges wear down after a few cuts, even on something soft such as cloth fibers. More durable tools were shaped by striking multiple flakes from a *core*. The working edge was actually a series of small edges produced by removing the waste flakes, giving a serrated look. Core tools aren't as sharp as flakes, but can be "resharpened" by knocking off more flakes.

By the Neolithic, *pressure-flaking* was developed: a punch made of horn or bone was pressed against a core's edge to produce minuscule flakes. Some TL1 societies, notably the more sophisticated civilizations of Mesoamerica, could produce pressure-flaked blades five or six inches long and less than a quarter-inch thick, each with a razor-sharp edge.

Though larger flakes and well-shaped cores could be used by themselves, many stone tools were incorporated into composite items; e.g., arrow and spear heads were attached to wooden shafts. As stone tools become more sophisticated, very small stone parts – *microliths* – came into use. Tiny flakes were set in wood or bone handles to yield sickles, or added to spears and arrows as barbs.

Ground Stone Tools

Ground stone axes were made from extremely hard minerals such as basalt and jadeite. Stones were given a rectangular or oval shape by pecking and rubbing against other stones, and then one end was polished down to an edge. This wasn't particularly sharp – perhaps comparable to a dull slothead screwdriver. It was more durable than a chipped stone tool, though! Fixed to a wooden haft, it could fell trees or break bones. When the edge dulled from wear, more grinding could resharpen it. Softer stones such as limestone and pumice could be shaped more quickly, yielding tools for grinding grain and other dried foods.

Given their great weight, ground stone tools are usually associated with sedentary cultures. Nomadic hunter-gatherers might carry a ground stone axe or mace, but a heavy bowl or grinding stone is too inconvenient to lug around.

Cut Stone

By TL1, sedentary societies began to make use of a different range of stones. Blocks of stone were cut by a number of methods, most often direct chiseling, sawing, abrading with sand or thick wire, and drilling. Although stone was still relatively expensive, entire stone buildings became affordable, and stone quickly became the material of choice for palaces, fortifications, and sacred buildings.

Gypsum was one of the first stones deliberately shaped for building; from the Bronze Age through the Middle Ages, civilizations around the Mediterranean used it as a structural or decorative material. Sandstone also saw use, notably in the American Southwest. Slate – which breaks easily into flat plates – was employed occasionally for construction and frequently for roofing. Limestone, though, became the overwhelmingly popular material, used for everything from the Pyramids to Gothic cathedrals. It was common and, while harder than gypsum and sandstone, balanced durability and workability. Even harder stones, notably marble and to a lesser extent granite and basalt, were on occasion used for particularly fine masonry, but the cost was usually prohibitive.

Stone was cut for tools and portable decorations, too. The usual building stones were shaped into both fine sculptures and sophisticated grindstones that more efficiently turned grain into flour. The Vikings made extensive use of soapstone, which was soft enough to carve with iron knives.

Earthenware and Brick

Pottery first appeared around 12,000 B.C., in Japan. It's made of a material common everywhere: dirt. Wet clay – possibly containing an admixture of *sizing* (sand, shell, or ground waste pottery), which stiffens the clay and prevents slumping during firing – may be shaped, left to dry, and baked to at least 1,080°F. The clay particles fuse into chemically stable earthenware pottery.

Indefinitely reusable and resistant to moisture and vermin, pottery is excellent for long-term storage. However, pottery vessels are also brittle and heavy. Containers light enough to be easily portable are fragile, while those thick enough to withstand jostling are too heavy to carry casually. Thus, they are the storage of choice only for sedentary peoples. While invented by hunter-gatherers, pottery didn't really take off until the rise of agriculture.

Precious Stones

Tiny quantities of semiprecious stones were used for ornamentation far into antiquity, but they weren't seriously mined or worked until the sixth millennium B.C. in Egypt and China. Bronze Age civilizations used turquoise, jade, lapis lazuli, jet, and varieties of quartz. These stones were soft enough to carve into seals and tiny figurines, or into very thin pieces for inlay.

Precious stones were discovered later. Emeralds were mined in Egypt by the early second millennium B.C.; sapphires and rubies, in southern Asia in the first millennium B.C.; and diamonds, in south-central India around the fourth century B.C.

Most of these stones came from a handful of sources. For example, Egypt remained the Old World's sole source of emeralds well into the Middle Ages, while all ancient lapis lazuli came from northeastern Afghanistan.

Note that such stones were used almost entirely for decoration at TL0-4. Watch movements using jeweled bearings were invented early in the 18th century (very late TL4).

Formed into blocks rather than vessels, pottery becomes brick. Clay for bricks was sometimes mixed with straw or pierced with holes to lighten the final product. Brick is far more durable than any material short of stone, but also less expensive than stone.

High-Fired Ceramics

Fired to 1,700°F, ceramics start to *vitrify,* or become glassy, throughout. The resulting materials, sometimes called "stoneware," are tougher and more waterproof than earthenware, but still slightly porous. However, stoneware needs more than just heat. Many clays don't vitrify at such temperatures – they melt! Stoneware requires more careful clay processing and a more limited range of sizing materials than earthenware.

The first stoneware appeared around 3000 B.C., in Mesopotamia. Fully vitrified stoneware – which is completely waterproof – dates to the first millennium A.D., in China. It appeared even later in Europe.

Porcelain, first produced in China late in the first millennium A.D., is a particularly prized high-fired ceramic; see *The Race for Porcelain* (below). It's made from *petuntse* and *kaolinite* – not particularly common minerals – and the resulting clay is difficult to work. When fired at 2,200°F, however, it completely vitrifies, becoming both waterproof and slightly translucent.

The Race for Porcelain

The story of porcelain in Europe is a low-tech tale of scientific research and industrial espionage. Chinese porcelain commanded astronomical prices in Renaissance Europe. However, its production was a mystery to European potters. Powerful patrons, seeking money and prestige, sponsored workshops attempting to re-create Chinese ceramics. Experimentation produced useful near-misses such as "soft" porcelain (which mixes glass with white clay) and bone china (which contains large quantities of bone ash), but the secret remained elusive for centuries.

In 1709, Johann Böttger, an alchemist working for the Elector of Saxony, finally produced a hard, translucent ceramic that could be decorated with glazes resembling those used in China. The formula for porcelain was a jealously but imperfectly guarded secret for years thereafter. Nevertheless, the industrial spies who uncovered Böttger's secret kept it hidden themselves, and Europe had only three factories producing porcelain until the middle of the 18th century.

Glass

Historical glass was made of *silica,* which forms the body of the glass; a *flux* (usually sodium carbonate), which lowers silica's melting point from above 4,000°F to just over 2,000°F; and lime, which controls the water solubility of sodium carbonate and keeps the glass waterproof. Metallic salts were sometimes added for color. Production methods placed significant limits on glass' form and quality.

Core Formation (TL1). In this process, developed around 3500 B.C., raw materials were combined and sometimes layered to produce multiple colors, surrounded by fuel, and completely covered to retain heat. This produced a biscuit-shaped lump of colorful but mostly opaque glass. Some shaping was eventually possible, with cores being shaped around earthen forms that were scraped out later.

Glassblowing (TL2). In the first century A.D., improved furnace designs allowed glassmakers to use open furnaces and inflate lumps of molten glass on the ends of metal tubes, producing attractive thin-walled vessels.

Optical Glass (TL3). By the 11th century in the Near East and 12th century in Venice, glassblowers developed truly clear and colorless glass suitable for corrective lenses and transparent windows. They used a potassium-rich flux and naturally pure sand without color-causing metallic salts. Glass mirrors backed with silver foil began to compete with heavier, more expensive mirrors made from solid metal plate. However, metal mirrors remained in use for some purposes. At TL4, Isaac Newton invented an alloy for telescope mirrors (see ***GURPS Low-Tech Companion 1***), called *speculum metal:* a tin-heavy bronze with arsenic added to remove the red-orange color.

Mortars and Mineral Adhesives

A *mortar* is a mixture of an adhesive and sand, extending the adhesive and giving it greater strength once set.

Mud (TL0). A mixture of dirt and water is extremely vulnerable to water, but it's very cheap and makes a good windproof surface. Consequently, it was the material of choice for many domestic structures in dry environments. Reduce the HP of stone or brick buildings using mud mortar by 5%.

Plaster (TL1). Plaster, made from burnt gypsum, was used as early as 7000 B.C. The most common application was smooth wall surfaces, but it could be poured into molds to produce inexpensive sculpted decoration. Plaster is a good background for painting, but the artist must work *quickly,* while it's still wet! Reduce the HP of stone or brick buildings using plaster-based mortar by 2%.

Lime (TL1). Serious structural adhesives are based on lime, which was in use by 4000 B.C. Lime is produced by heating limestone to 1,500°F, which turns it into a powder. *Quicklime,* the initial product of such heating, is a caustic powder (*Lime Powder,* p. 130). It's also unstable – over time, it reabsorbs atmospheric carbon dioxide and reverts to limestone. For safe storage and handling, it's mixed with a little water to produce "slaked lime." Adding more water gives a paste that sets into a solid form. Mixed with salt and a lot of water, quicklime becomes *whitewash:* a rough, thick white paint used from at least late TL2. Lime has also been used as a bleaching agent and a cleanser.

Concrete (TL2). Concrete is a mixture of lime mortar, *pozzolana* (a volcanic ash), sand, and stones. It's waterproof and even sets underwater. This mixture was first used by the Greeks as early as 500 B.C. Roman masons realized that it could be poured into wooden forms and set strongly enough to serve as a structural material in its own right.

Inferior concretes – not as strong, but still water-resistant – could be made with ground pottery in place of pozzolana. Both fell into disuse by the Middle Ages, perhaps because they required specialized knowledge to compose and use.

Metals

Use of stone- and earth-based materials eventually led people to exploit metals. Few metals are available in a *native* (naturally pure) state; gold and copper are the most common, but even those are extremely rare. Serious metal use requires that ores be *smelted:* heated to a temperature where the metal separates from the elements with which it has combined in the ore. The discovery of smelting unlocked large quantities of metal and made possible the Bronze and Iron Ages.

Copper, Bronze, and Brass

Copper (which melts at 1,984°F) was the first tool metal, used by 5000 B.C. in the Near East. It makes tolerably good tools, but alloying it improves its workability and hardness. Several important copper alloys – comparable to iron in hardness – started to appear around 3500 B.C. in Egypt, the Near East, and north-central China.

Arsenic Bronze (TL1). An alloy with 2% arsenic, likely produced by smelting ore that happened to contain arsenic, was the first popular copper alloy and the most widespread into the third millennium B.C. Arsenic is toxic, however, and may have left smiths with long-term nerve damage.

Tin Bronze (TL1). The preferred copper alloy ("bronze" almost always refers to tin bronze) contained 5% to 15% tin. In addition to being nontoxic, tin bronze was easier to cast. Tin is extremely rare, though, so other alloys remained in use, and inferior low-tin bronzes were common.

Brass (TL1). This alloy is 5% to 15% zinc. The problem with producing brass is that when zinc oxide – the primary zinc ore – is smelted, the zinc escapes as a gas. Instead of making pure zinc, smiths in the first millennium B.C. added zinc oxide to copper and heated them together, releasing the zinc into the copper.

Wire

Wire was first made early in TL1 by laboriously pounding metal rods into grooved anvils, or with grooved hammers. By early TL2, *drawing* (pulling metal through a narrow hole) was developed. Both techniques were practiced with soft metals such as gold first and iron later. Regardless of methods and materials, wire-making was expensive and time-consuming.

Wire was produced mainly for decorative purposes (necklaces and chains, wrapping around a core to make a textured surface, etc.), but iron and bronze wire were cut into segments for mail links, pins, and other applications where stiffness was a virtue. Since great lengths were unwieldy, and wire broke easily during production, pieces were rarely more than a few yards long.

Note that strong, flexible "piano wire" isn't actually wire, but metal wrapped around a fiber core. It first appeared late in TL4.

Iron and Steel

Copper and its alloys suffered from a significant flaw: scarcity. While iron requires more work to produce, it's many times more common in the Earth's crust. Native meteoric iron was used in minute quantities from as early as 4000 B.C., but iron manufacture didn't begin until around 1500 B.C., in the Near East.

Iron can be smelted at 2,190°F, but it doesn't *melt* until 2,800°F – far beyond the reach of furnaces until TL5. Unlike copper, then, early iron didn't run out of the furnace into a convenient puddle. When ore was smelted, the iron was contained in a matrix of rocky slag. Smiths pounded a softened but still solid *bloom* of *wrought iron* out of this with hammers.

Iron wasn't as easy to alloy as copper, but it could be treated to incorporate carbon, turning it into steel (iron containing 0.5% to 1.5% carbon). The most widely practiced technique was to hammer a piece in a charcoal fire. Carbon from the fire infiltrated the surface, hardening it. Smiths might extend the technique by welding together thin layers of hardened and unhardened iron, or stretching and folding partially hardened iron, producing pieces that balanced wrought iron's resilience with steel's durable hardness.

Smiths eventually developed two main methods of making steel through and through. The easier method combined finely crushed iron ore and charcoal dust in a small clay container. With sufficient heating, carbon completely infiltrated the iron, lowering its melting point to an achievable 2,100°F. The resulting metal had to be hammered extensively, but this technique – practiced through most of TL3 Asia, but unknown in Europe – produced small quantities of high-quality steel.

The other method, the *blast furnace* (TL4), involved pushing lots of air through lots of charcoal in the furnace, burning it quickly and producing very high temperatures. In addition to generating tremendous heat, this increased the iron's carbon content to 5%, pushing it past steel into very hard but brittle *cast iron.* Cast iron could later be cooked in an oxygen-rich atmosphere to reduce its carbon content, turning it into steel.

Early smiths might use 8 lbs. of ore and 36 lbs. of charcoal to produce a pound of iron. By the beginning of TL3, a well-designed furnace could produce a pound of iron from 7 lbs. each of ore and charcoal. However, less-efficient designs – using up to twice as much charcoal – were common. Depending on the quality of the excavated ore, the total amount of charcoal (including roasting and other preprocessing) could rise to 30 times the amount of metal produced!

Early furnaces produced 100 to 150 lbs. of iron at a time. By TL4, large furnaces could produce up to a ton of iron. Late-TL4 furnaces producing cast iron consumed twice as much charcoal as their wrought-iron predecessors.

Minor Industrial Metals

Copper and iron weren't the only metals of industrial significance before TL5.

Lead

Too soft for tools, lead was nevertheless important by TL2. With its malleability and low melting point (621°F), it was ideal for durable waterproof seals, roofing, and water pipes. It was also used in sling bullets (p. 74), weights for fishing nets, and clamps connecting masonry blocks, and as an ingredient in enamels and glazes.

Lead ores used in antiquity were frequently associated with other metal ores, notably silver. Lead was produced as a byproduct of smelting those metals. The combined ore was heated in an oxygen-rich atmosphere to remove other metals and convert any lead ores into lead oxide gas. The lead oxide was captured in a layer of ash or sand, and then heated again in a low-oxygen atmosphere to smelt out the lead. Since lead is toxic, long exposure to its vapors could cause neurological problems for smiths who worked with it.

Mercury

In addition to fanciful alchemical work, mercury was used for ore processing. Gold, silver, copper, and zinc are mercury-soluble. Mixing them or their ores with mercury forms an alloy, or *amalgam*. Iron doesn't form amalgams, and so was used for mercury flasks. At least as early as TL3, mercury was used to capture silver and gold in unrefined ores. The amalgam was heated to remove the mercury (producing a toxic gas, like lead smelting), taking less total work than conventional smelting.

Mercury was obtained from *cinnabar,* its sulfide ore. Cinnabar was also in demand as a red pigment. Heated to 930°F in an oxygen-rich atmosphere, it naturally decomposes and releases mercury vapor.

Tin

Tin was rarely used on its own, but was in demand for bronze and *pewter:* a family of dull-silvery tin-heavy alloys. Pewter formulations include antimony, copper, lead, and zinc in varying proportions. Pewter was too soft for tool use but easy to work and cast (melting point around 500°F), making it a popular choice for household items starting late in the Middle Ages. Pewter served a similar function to silver, but was cheaper (though not much – tin is only slightly more common than silver) and didn't tarnish.

Zinc

Pure zinc was produced in India by the 13th century A.D., spreading to China by the 16th. The ore was smelted into a vapor, which was directed downward into a water-cooled vessel to condense into solid metal. It was occasionally used for ornaments and coins, but more often for high-zinc brass alloys. Smelting zinc directly into copper to make brass imposes a maximum zinc content of just under 30%. Brasses with higher zinc content require the addition of pure metallic zinc, and resemble gold.

Precious Metals

Tools were made from lesser metals, but economies were built on gold and silver!

Gold: Gold melts at 1,947°F. It generally appears in a native state, and was used by 5000 B.C. Its malleability made it ideal for decorative use. Native gold might contain other metals – particularly silver – but purifying it was rarely a concern in the New World, and only became important in the Old World with the rise of coinage.

Silver: Silver melts at 1,763°F. It typically occurs with other metals – usually lead or gold. When separating silver from gold was important, unpurified metal leaf or dust was combined with salt and heated to the melting point to combine the silver with the chlorine in the salt. The pure gold was poured off, and the remainder smelted again to recover the silver.

Platinum: A few societies discovered minute quantities of native platinum, but most didn't even recognize it as a metal. Spanish conquistadors discarded platinum nuggets as worthless lumps in valuable silver! Even in societies that valued it, platinum couldn't be smelted or melted down, and was too rare to be anything but a curiosity.

Organics

While surviving relics of antiquity are mainly inorganic, far more items were made from perishable but more-abundant organic materials: wood, grass, and animal parts and products.

Wood

Woods can be divided roughly into *softwoods* and *hardwoods*. Softwoods – mostly from evergreens – are less dense and therefore less durable, but easier to transport and work, and faster-growing. Denser hardwoods are preferred for most applications, but take much longer to grow. Historically, most species were found to be better for some uses than others, to the point that certain woods were important trade items. For example, in the Bronze Age, Lebanon exported cedar through the eastern Mediterranean.

There are indications that hunter-gatherers deliberately cultivated forests. While trees weren't systematically planted like fruit orchards, they were kept free of underbrush. This gave hunters better visibility and other useful plants room to grow.

Where possible, foresters didn't kill trees. By 4000 B.C., woodsmen practiced *coppicing:* cutting the tree close to but not at the ground. Since the roots were intact, new shoots came up far faster than from a seedling. Willow for basketry could be harvested every year, though decades might pass between harvests of slow-growing hardwoods.

Under normal circumstances, it takes 2×(square of diameter in inches)/BL minutes to fell a softwood tree using a metal axe – or *double* this time for hardwood. Stone axes aren't as sharp or as well-hafted as later axes, and are far less efficient; *quadruple* these times when using one. Cutting lumber costs FP at the same rate as digging ordinary soil for most trees, or digging hard soil for especially dense woods such as oak or ebony (see *Digging,* p. B350). Depending on the tree species and its tendency to grow branches, it takes 5-10 times as long to trim it into a useful log, or up to 30 times as long to turn it into firewood. A square mile of forest can provide 1,200 to 2,600 tons of wood, although only half to two-thirds of that might be turned into logs and boards for building.

Wood dries for several months after it is cut, shrinking in the process. Lumber is typically *seasoned* – left to dry and deform – so that it reaches a stable shape before being used. This doesn't matter when building wooden items for short-term use (e.g., catapults during a siege), but anything made from fresh wood will warp and can even break over time. Any object made from unseasoned wood loses a point of HT every other month for six months. Each time it loses HT, roll against the new HT; failure means the item drops a step in quality (for instance, a good-quality weapon becomes cheap). On a critical failure – *any* failure, for a cheap-quality artifact – the object breaks and becomes useless.

Bone, Horn, and Shell

Bone, horn, and shell can be cut and carved in much the same way as wood, but are superior for some applications. Being more resistant to fraying and splintering, they're suitable for pointed tools: awls, sewing needles, etc. They can even be turned into *weapons* – all can be sharpened to a point, and some shells provide a cutting edge.

These materials saw heavy use in tools into the Bronze Age, when metals took over their niche. They continued to fill decorative roles, though. For instance, horn and ivory can be turned into flat plates. They're softened with hot water or steam, cut open, and separated into layers which can be flattened, dried, and carved into combs, utensils, and shapes for inlay. Likewise, certain shells – particularly those with a pearly layer of nacre – were cut into small parts for use as inlays.

Leathers

Leather is animal hide treated to preserve both substance and flexibility. It may have been the first clothing material, and was used for containers and protective coverings. It's windproof, water-resistant, and harder to damage than fabric. However, it's also more difficult to repair once damaged – and while leather provides short-term protection from water, significant wetting will cause it to stiffen and crack upon drying.

To make leather, hide is scraped free of flesh and hair – possibly after treatment with salt, lye, dilute lime solutions, or dung, or simply being left to age for a few days. If dried at this stage, the scraped hide becomes stiff *rawhide*. To remain flexible, leather needs to be *tanned*.

Tanning extracts water from inside the cells that make up the leather, while leaving them otherwise intact. The earliest tanning material was brains, although some societies used solutions made from boiled oak or aged urine. The customary rule is that an animal has enough brains, crushed into water, to tan its own hide. The tanning solution must be rubbed or stamped well into the hide, which takes two to three hours. Finally, the hide may be lightly smoked and oiled to enhance suppleness and repel insects.

Active working time for scraping and stretching might be just a few hours. However, the hide must spend considerable time soaking and drying. The entire process takes one to three weeks.

Furs

A fur is simply a hide turned into leather without damaging the hair on the outside. The fleshy side must be scraped carefully to prevent damage to hair roots, and washed to remove any oils on the hairs themselves. The tanning process has to be carried out carefully to avoid tearing out the hair. The extra effort for superior insulation was often worthwhile at TL0 – but as cheaper cloth appeared at TL1, fur production became a luxury trade.

Domestication

Domestication is the process of adapting plants and animals to breed in close proximity to humans. The animal species best-suited to domestication are those that aren't fussy about their diet and the conditions under which they reproduce, and that are amenable to living near humans. At the same time, humans have worked to create "artificial" environments – e.g., irrigated fields and safe, grassy pastures – to keep a species nearby.

Dogs might have been the first domesticated species, as early as 30,000 B.C. However, domestication didn't take off until the rise of agriculture between 9000 and 8000 B.C. Several cereal grains were first cultivated in Egypt and the Near East during that period, followed by corn and squash in Mexico by 7000 B.C., and rice in the Yangtze Valley around the same time. Humans began to cultivate an increasing number of species (e.g., almonds in the Near East, around 4100 B.C.), eventually foregoing wild species as economically significant.

Adaptations for domestication were often the result of selection. For example, the earliest domesticated animals were smaller than their wild ancestors, likely because weaker animals were easier to confine! Similarly, many domesticated crops required less effort to harvest than their wild cousins, because easy-to-harvest varieties were gathered disproportionately from the wild.

After initial domestication, humanity subjected suitable species to countless generations of selective breeding. For instance, horses grew steadily larger from their small, initially domesticated size. The emergence of new demands likewise influenced breeding efforts. Notably, animals were originally domesticated largely for meat, but by 3000 B.C., a range of new uses appeared in the "Secondary Products Revolution." Animals were kept increasingly for wool, milk, and labor, and were bred for traits that supported those uses.

Fiber

Human use of fibers – probably as cordage – goes back at least to 32,000 B.C., in the form of linen fibers collected from wild plants.

Reeds (TL0). Reeds such as *flax, jute, hemp,* and *sisal* are processed by crushing or soaking. The earliest woven fabrics yet found, dating to 7000 B.C., were made of flax. However, shoes woven from sage – somewhere between fabric and wicker – date to at least 8000 B.C.

Cotton (TL0). Several societies had access to cotton, independently domesticated in Mesoamerica and India. It must be combed to remove tiny seeds before it can be spun.

Wool (TL0). Wool wasn't used extensively until the late Neolithic. Collected mostly from sheep in the Old World and llamas in the New, wool must be treated (usually boiled) to remove oils before it can be spun. Wool is expensive, as it requires that large herds of animals be maintained, but it spins easily, is an excellent insulator, and can be felted.

Silk (TL1). Silk is made from the cocoons of several moth species. Only one – the mulberry silkworm (*Bombyx mori*) – could be cultivated. Others were gathered from the wild in small quantities; for example, the Greeks gathered fiber from wild moths on the island of Cos. Silk from domesticated silkworms was first produced in China in the early third millennium B.C. Despite being traded as far as Egypt, it remained a Chinese monopoly until the late first millennium B.C. Sericulture reached the Byzantine Empire by the early Middle Ages. Silk is exceptionally strong and easy to make into extremely fine thread. The fibers have a triangular cross section, giving silk an attractive iridescent quality.

Spider Silk (TL4). Spider silk wasn't exploited on an industrial scale, but TL4 chemists experimented with it. The primary historical use of spider web – when it was used as all – was to dress small wounds (see *Cobwebs,* p. 146). However, stripped of adhesives, spider silk can be turned into thread with potentially twice the strength of silk. For spider-silk armor, see *Silk* (p. 104).

Rope, String, and Thread

Many fibers can be turned into cord simply by rolling them between the hands or fingers. Early yarn spinning used a *spindle:* a rod that held a mass of fibers on one end and the developing strand wrapped around the other.

Early in TL3, the *spinning wheel* appeared, increasing the speed of yarn and thread production. The wheel was attached by a belt to a spindle, like one that would be used by hand. Instead of the spindle being turned slowly by hand, the wheel rotated it quickly, drawing a thread from a mass of fibers held in the spinner's hand. By TL4, the Chinese had developed wheels that could turn up to five spindles at once.

Rope production typically involved twisting long strands together, giving them a definite left- or right-turning tendency. Length was limited by the size of the laying yards that could be cleared for their manufacture. Historically, ropes longer than 200 yards were extremely rare. For greater lengths, multiple ropes were usually spliced together.

All the ropes described below are 1" thick. To get thicker or thinner ropes, multiply weight, cost, and strength by the *square* of the diameter in inches. The thickest ropes in antiquity – connected to harnesses or capstans rather than pulled by hand – topped out at around 2.5" in diameter.

Example: 10 yards of 1" hemp rope can support 2,000 lbs., cost $30, and weigh 9 lbs. A 3/8" rope of the same material can support 9/64 × 2,000 = 281 lbs., costs $4.20, and weighs 9/64 × 9 = 1.26 lbs. Rounded up, these figures are similar to those on p. B288.

A 1" diameter rope is about the thickest that ordinary humans can grasp effectively. Larger individuals can grasp thicker ropes: Double diameter for every +2 SM; for odd SM, multiply by 1.5 for the extra +1. You *can* use a rope that's too thick for you, but you suffer -1 per excess inch of thickness to both effective ST and applicable skills (e.g., Traps skill to set snares).

The weights listed below assume *stationary* loads: hauling cargo, suspension bridges (see ***GURPS Low-Tech Companion 3***), etc. For situations where the rope undergoes *dynamic* loads and sudden shock – e.g., towing and climbing – it can support only *half* as much. For instance, that rope with a maximum load of 281 lbs. will only support 140 lbs. if the user is climbing quickly . . . or if he falls and the rope must save him! If he climbs slowly (less than half normal climbing speed), the rope will support the full 281 lbs.

Grass (TL0). A quick, temporary rope can be made by braiding the stems and leaves of grass or thin reeds together. A green grass rope has about 1/5 the strength of a rope made from tougher plant fibers. Supports 360 lbs. Per 10-yard length: $3, 9 lbs.

Vines/Ivy (TL0). A thick, supple vine – or several thinner ones twisted together – can make a serviceable rope. Supports 900 lbs. Per 10-yard length: $10, 9 lbs.

Plant Fibers (TL0). Standard rope is made from tough plant fibers like *flax, papyrus, jute,* and *yucca.* Supports 1,800 lbs. Per 10-yard length: $20, 9 lbs.

Hemp and Manila (TL0). These plant fibers are stronger than most. Today, manila is preferred over hemp because it's more resistant to water and salt. Supports 2,000 lbs. Per 10-yard length: $30, 9 lbs.

Animal Hair (TL0). It's difficult to collect enough hair to make a rope of significant length. The Romans seem to have preferred goat hair. Human hair is useful because it can be grown longer than the hair from many other mammals; cord made from women's hair was sometimes used in catapult springs (see *Mechanical Artillery,* p. 78). Use the stats for rope made from plant fibers.

Asbestos (TL2)

Besides the organic fibers known in antiquity (see *Fiber,* above), one mineral fiber saw use. *Asbestos* – mined in the Near East and India – was spun and woven, with considerable effort, into an extremely expensive fireproof fabric as early as the first century B.C. It was made into easily cleaned table linens (just throw them on the fire!) and fireproof clothing. The earliest commentators on asbestos noted damage to the lungs of those who mined it. Asbestos goods, if available, cost 100 times as much as other cloth items, and provide DR 2 vs. burning damage.

Braided Hide (TL0). Rope can be made by braiding or plaiting together leather or rawhide strips. Walrus, seal, buffalo, rhinoceros, and caribou hide have all been used for this. Treat as plant fiber rope (p. 25), except that it costs three times as much and can only be manufactured in lengths of up to two yards, which must be spliced together to obtain longer segments. Hide rope is also highly susceptible to water; wet hide can handle *half* its normal load. These rules apply equally to dried gut, often used for bows and stringed musical instruments.

Silk (TL1). Silk is extremely strong but loses some of that strength every time it's processed; thus, raw silk is best for rope. Silk is highly susceptible to ultraviolet radiation and abrasion, and deteriorates quickly; it loses 10% of its strength per year (see *Rope Deterioration,* below). Supports 5,000 lbs. Per 10-yard length: $100, 5 lbs.

Rope Deterioration

All fibers deteriorate over time. Some are susceptible to moisture, mildew, and rotting; others, to ultraviolet radiation (present in sunlight). Most don't like temperature extremes. Frequent use causes abrasion. Impact reduces strength even further.

As a general rule, rope that's used regularly loses 5% of its strength per year; e.g., a rope that could support 2,000 lbs. when new will support only 1,600 lbs after four years. Severe conditions – especially excessive moisture – *double* the deterioration rate. Conversely, rope stored in a cool, dry, dark environment loses a mere 1% per year *if* it doesn't see regular use. Rope is sometimes coated with tar to protect it from weather; this doubles cost and increases weight by 10%, but halves deterioration rate.

Cloth

The earliest fabrics – and the most common ones through history – were woven. Yarn went on a loom in a set of taut parallel strands (the *warp*). The weaver passed a separate strand of yarn (the *weft*) back and forth between warp threads at a right angle. The simplest looms (late TL0) required the weaver to weave the weft back and forth between the warp threads individually; later designs (TL1, although inexpensive older designs persisted into TL2) separated warp threads into alternating groups with a V-shaped passage – the *shed* – between them. The loom could be operated to switch the upper and lower threads of the shed, locking the previous weft thread in place and preparing the way for the next.

Knitting uses a more complex technique but simpler tools. It appeared in northern Europe as early as 6500 B.C. (late TL0), with a single-needle technique producing tubes of yarn. True knitting, using two needles, didn't appear until around 1000 A.D. (TL3). Early knit pieces were also tubes, almost always used for stockings, although they might be cut open to form flat pieces. Flat knit fabrics didn't appear until the 1500s (TL4).

Finally, cloth was created by *felting* – possibly as early as TL2. Instead of being spun into threads for weaving, wool fibers were wetted, rubbed against one another to fray the surfaces, and pressed together. Felt is relatively dense and stiff, but extremely resistant to unraveling.

Some textiles were treated with a hybrid process. Woolen fabric, once woven, was scrubbed with urine (TL2) or fuller's earth (a type of clay; TL3) to remove residual oils, and then pounded in water to mat fibers together into a hard-wearing form like felt. This process, *fulling,* was an important medieval industry.

Wicker and Thatch

Grass, reeds, wood strips, pine needles, and leaves have all been used to make light, inexpensive wicker baskets. Basketry is produced much like woven cloth: long strips of material are intertwined to lock strands together. However, wickerwork almost never involves anything like a loom. The usual materials are stiff enough to retain a shape and resist tangling. Basketwork is typically springy and resilient, too.

Loose basketwork, leaving large gaps between strips, can provide very light storage. Exceptionally tight work with fine materials can be watertight – at least temporarily.

Wicker can also be a structural material. Tight bundles of grass and reeds approach light woods in stiffness and density. Many early civilizations, including the Egyptians and many South American Indians, used boats made from bundles of reeds (see *Rafts,* pp. 138-139, and *Reed Boats,* p. 143). Such bundles were the roofing of choice for northern Europe. Tatami mats, made from reeds and straw, were an important flooring material in Japan. And small buildings worldwide have been made from woven grass and weeds on wooden frames.

Like all organic matter, basketry is sensitive to moisture. It suffers more from wear than many other materials; a year's regular use can destroy a basket. Contrary to film depictions, though, well-kept thatching doesn't burn any more readily than solid wood. No more air reaches the inner stalks of grass than might reach the inside of a log, so only the surface burns. Poorly maintained thatching – with split bindings and frayed ends – is quick to catch fire! For the purposes of *Making Things Burn* (p. B433), treat thatching as *resistant,* becoming *flammable* if old and frayed.

Paper and Its Cousins

Several light, flexible surfaces were used for writing (see *Flat Media,* p. 46), of which paper was a relative latecomer.

Barkcloth (TL0). The inner bark of certain trees found around the Indian and Pacific Oceans can be pounded into thin layers resembling strong, rough paper. Though mostly made into clothing, this was occasionally used for maps and other drawings.

Pith "Papers" (TL1). Several paper-like materials are manufactured from layers of thin strips of pith from plants, laid out perpendicular to each other and pressed together. They have a natural adhesion that holds them together, though glue is often necessary to join smaller sheets into longer scrolls. In Asia, pith papers are customarily termed "rice paper," although they're made from several different plants. Egypt's pith paper is *papyrus,* made from a species of reed.

Parchment (TL2). Very thin hides (usually sheep or goat) can be scraped smooth or processed with lime to remove hair without scratching the skin. Parchment was first used in Anatolia as early as the second century B.C. It became the dominant writing material in temperate Europe by the Middle Ages. Unlike leather, parchment isn't tanned, so it remains white. Particularly fine parchments are called *vellum* but manufactured the same way. The most prized vellum came from the skin of unborn calves, which is thin, hairless, and large enough to make it worth the trouble.

Paper (TL3). True paper consists of small fibers suspended in water, deposited on a fine-meshed screen, and left to dry. Since paper could be made from a variety of fibers, it provided a cheaper writing medium than its predecessors. Paper originated in China, where it was known by the first century B.C. The technology spread through India and the Near East into Europe by the 12th century. Asian papers used a range of fibers, including silk and mulberry bark; Western papers were made predominantly from linen. At TL4, the Chinese began to produce paper from bamboo, reducing the cost considerably.

Organic Adhesives and Matrices

As stones were best held together by mineral mortars, organic materials were best held together by organic adhesives.

Glue (TL0). Most low-tech glues were produced by boiling hide and connective tissue to render out collagen. Glues from fish are thin and light, and suitable for delicate jobs. Glues from mammals are thicker and heavier. Animal glue was often stored in solid form and melted or mixed with water to make it liquid again.

Plant Resins (TL0). A variety of trees found throughout eastern Asia yield fresh resins that set on exposure to warm, moist air to produce a hard, shiny finish. These can be colored with a number of mineral pigments, or combined with ground bone and horn to create a more durable surface. Multiple layers can even be carved and polished.

Tar (TL0). Tar or *pitch* is a resin derived from plants or mineral deposits. Vegetable tar is produced by gathering the runoff from charcoal-making; 40-50 lbs. of wood might yield 1 lb. of tar. Mineral tar is simply dug up. Tar is a thick liquid when heated but solid and waterproof at room temperature, making it valuable as an adhesive and as caulking for barrels and ships. Flammable but slow-burning, it can also be used to make long-burning torches.

Drying Oils (TL1). Certain vegetable oils gradually harden on contact with air – the process being polymerization, not strictly drying – and can serve as a finish for furniture and a medium for paint. *Linseed* oil was the best and earliest, appearing in Egypt during the second millennium B.C. Others – including *castor, poppy, safflower, soybean, tung,* and *walnut* oil – became available by TL3.

Shellac (TL1). An alcohol-soluble resin produced by the *lac* insect native to southern Asia (though it was widely exported), shellac saw initial use as both an adhesive and a red-purple dye. At TL3, it came to be employed as a protective coating on paintings and woodwork, although it was still most prized for its color. The word "lacquer" derives from the same root as "shellac," but can refer to any resin, notably the plant resins in Asian lacquerware.

Wax (TL1). In addition to being flammable, *beeswax* was used as an adhesive and a light-duty waterproof sealant. Although it's a far worse adhesive than glue or tar, wax melts at a comfortable temperature and can be pressed into convenient shapes.

Chemistry

Low-tech chemical technology bears little resemblance to the modern version. Concentrations are low, purity is dubious, and time and temperature are matters of feel rather than precise measurement. Nevertheless, low-tech chemists can practice many important and lucrative trades.

Alcohol

Ethyl alcohol was first produced by fermentation late in TL0, and has remained an important commodity ever since. Alcohol solutions produced by the most common yeasts start to top out at 5-6%. Even the hardiest microbes can't manage concentrations greater than 18% – the strongest drink available until TL3.

Heat distillation appeared as an experimental technology in the early days of the Roman Empire, and became available on a useful scale at TL3 (see *Distillation,* pp. 11-12). Early chemists could easily double the alcohol content of a solution, perhaps even triple it, but the process was very inefficient. Much alcohol escaped as vapor, chemists worked in batches of a quart or less, and without accurate temperature control it was difficult to vaporize alcohol without vaporizing too much water as well. Consequently, multiple distillations faced diminishing returns. Nevertheless, distillers achieved concentrations of up to 90% alcohol by late TL4. Batch size also increased at TL4, with early industrial boilers capable of distilling barrels of liquid at a time.

People in colder climates developed *freeze distillation.* Alcohol solutions could be left to partly freeze during winter. Because alcohol freezes at a lower temperature than water, the initial phases of freezing form ice with a lower proportion of alcohol. When this ice is scooped out, the solution left behind has higher alcohol content. This can be done repeatedly – once again, with diminishing returns – to concentrate the alcohol to 30%.

Methyl alcohol, or *wood alcohol,* was produced in minute quantities by heating wood in an oxygen-free environment, perhaps as early as TL1. It was made only sporadically thereafter through late TL4. While intoxicating, it's extremely toxic. Half an ounce of pure methanol can cause blindness and five ounces can be lethal – although producing that much of it before TL5 would be a long and difficult undertaking.

Acids

Several acids were available in antiquity, although not at concentrations found in modern labs.

Acetic Acid (TL0). The most commonly available acid, acetic acid gives vinegar its sharpness. It's produced by the oxidation of alcohol – and like alcohol, was typically found at concentrations of 5% to 18% (although TL3 Muslim alchemists were able to distill it). It had uses in chemistry, but was widely used as a cleaning agent. *Concentrated* acetic acid isn't as corrosive as the generic "acid" on p. B428: Being splashed with it causes 1 point of corrosion damage; being immersed in it, 1d-3 corrosion damage per second; and swallowing it, 1d+1 corrosion damage at the rate of 1 HP per 15 minutes. All HT rolls to avoid eye damage are at +1. It won't dissolve metal objects. Ordinary vinegar inflicts *no* injury, but splashing it in the eyes causes severe pain (p. B428).

Inorganic Acids (TL3). These acids were manufactured in small quantities by heating mixtures including sulfite ores: alum and sulfite ores for *sulfuric* acid; salt and sulfite ores for *hydrochloric* acid; and saltpeter and sulfite ores for *nitric* acid. This produced acidic vapors that were condensed into a liquid. Such acids were more than 30% pure, but limited to batches of a few ounces at a time. Nitric acid dissolves silver, making it useful in gold refining. These acids inflict damage as on p. B428.

Aqua Regia (TL3). This mixture of nitric and hydrochloric acid was invented by an eighth-century Muslim alchemist. The name – meaning "royal water" – comes from the mixture's ability to dissolve gold, the "royal metal."

I gave you countenance,
credit for your coals,
Your stills, your glasses,
your materials . . .

– Ben Jonson,
The Alchemist

Pigments

Pound for pound, pigments for paints and dyes (along with spices and medicines) were the most valuable historical goods. Pigments have a base cost of $5 to $30 per pound, adjusted by *Luxury Pricing* (p. 37).

Mineral pigments require minimal chemical processing, and are resistant to light and air. (*Exception:* Green pigments are frequently light-sensitive.) Earth tones are the most common, and provided mainly by iron oxides in abundant minerals. Other mineral colors tend to be either toxic (one of the best and most widespread reds is a lead ore) or expensive (lapis lazuli, a blue semiprecious stone, is ground to powder for use in paints).

Organic pigments can require considerable processing, and fade much faster than mineral pigments. For example, berry juices might provide a purple color, but start to fade in a few hours. Some organic pigments require more sophisticated chemistry, too. Indigo – derived from several plants and a few mollusks – can be used as a dye, but is colorless while dissolved in water; once exposed to the oxygen in air, it gains color.

Other Chemicals

A surprising range of chemicals could be derived easily from natural raw materials, or simply taken directly from the environment.

Salt (TL0). Obtained by mining or by evaporating water in natural or artificial seaside pans, salt (sodium chloride) was an economically significant and frequently government-controlled commodity. The term "salt" was applied to numerous compounds: *borax* (sodium tetraborate), *natron* (sodium carbonate, with bicarbonate impurities), *nitre* (sodium and potassium nitrate), sodium bicarbonate (known to us as baking soda, but used historically as a cleaning agent and a flux), and others. Often found together in varying proportions, these chemicals were difficult to distinguish from one another. As a result, ancient craft procedures might specify the salt of one place as useful for pottery glazes, the salt of another as a superior flux, and so on.

Alum (TL1). A family of metallic sulfides, alum has been used as a mordant and in papermaking (alum creates a smooth-faced paper), medicine (for its styptic and antimicrobial effects), leatherworking (as an aid to tanning), and water purification. It is sometimes mined in a naturally pure form, but is more often found in deposits that must be refined by roasting or boiling. It's used in enough industrial processes that access to alum supplies became a significant political and economic issue by TL3.

Potash (TL1). This alkaline potassium compound is manufactured by soaking hardwood ashes. In a liquid solution (*lye*), it was combined with fats to make soap. In solid form, it was an important glassmaking ingredient. While it can be used as a fertilizer, it rarely was.

Petroleum (TL2). Alchemists around the Middle East experimented with surface pools of petroleum as early as the Iron Age. It was mostly used as a treatment for skin diseases, but petroleum-rich rocks were sometimes burned for heat. By early TL3, petroleum was distilled in small quantities to produce *naphtha,* used as lamp oil and probably in Greek fire (see *Combustibles,* p. 84).

Ether (TL3). Ether was first isolated in the late 13th century A.D., but its anesthetic properties weren't noted until late in the 16th. Dosage wasn't established, so it wasn't a *safe* anesthetic – the patient could easily overdose, go into a coma, or even die.

Saltpeter (TL3). Nitrate compounds were used in firelighters at least as early as TL1, but pure saltpeter wasn't refined until TL3. Although saltpeter was mined from guano deposits in a few locations, it was mostly manufactured. Dung was mixed with slaked lime or wood ash and kept damp for months. Saltpeter was washed out of the mixture and dried into crystals. Saltpeter gives off oxygen when heated, making it an accelerant for combustion (see *Combustibles,* p. 84).

Fuel and Power

Through most of history, there have been four meaningful sources of energy: *fire* from burning vegetable matter, *muscle, water,* and *wind.*

Fire

Fire was used at least 1.5 million years ago in stone hearths. Wood was probably the first fuel, but humanity has exploited a much wider range of combustible materials.

Wood

Wood burns in two stages. The first stage, with visible flames, produces temperatures of 500-600°F. As the wood burns, it slowly decomposes into charcoal, which leads to the second stage. Charred wood burns without flames but at a far higher temperature: 1,000-1,100°F.

Firewood is collected from fallen branches and dead trees where possible, or cut and left to season. It's easier to gather dry branches from the ground than to cut down living trees. Fresh wood produces 25% less useful heat per pound than dry wood, so it's burned only as a last resort. In terms of *Making Things Burn* (p. B433), starting a fire is easiest with dry wood, which is *flammable;* harder with seasoned wood, which is *resistant;* and most difficult with green wood, which is *highly resistant*.

Charcoal

Charcoal – used by TL1 if not earlier – is wood that has been heated in a low-oxygen atmosphere to remove water, tar, and other impurities, reducing it to near-pure carbon. It's manufactured by stacking wood or putting it in a pit, lighting it, covering the fire, and letting the wood smolder for several days.

The result is a lightweight substance (25-40% of original weight) that burns long and hot (charcoal provides nearly twice as much heat per pound as dry wood), and without impurities or flames. The low weight makes it easier to transport from the forests where it's produced to the foundries and potteries where it's used; the lack of impurities makes it superior for metallurgy. Charcoal's main drawback is the quantity of wood needed to produce it – growing metallurgical industries mean widespread deforestation.

Other Fuels

Wood and charcoal filled most fuel needs at TL0-4, but several other substances saw use under special circumstances.

Fats, Oils, and Waxes (TL0). Animal fats and vegetable oils have a higher energy density than wood, but don't burn any hotter, can't be converted into charcoal, and are much more expensive. They were used almost exclusively for lighting. Animal fat fueled Paleolithic lamps (TL0). Vegetable oils became available after the rise of agriculture (TL1). Vegetable oils cost $2 per pound. Low-quality animal oils and fats that burn with a strong smell or lots of smoke are $4 per pound. Clean-burning waxes are $8 per pound.

Agricultural Waste (TL1). Straw, dried grass, olive pressings, and other flammable debris can be used to build fires. Agricultural waste – which on average provides a bit less energy than wood, and is harder to collect – sees household rather than industrial use, but there's some speculation that oil-rich olive pressings could be used effectively in firing pottery and processing metals. Waste is usually free; if it must be purchased, it costs $0.25 per pound.

Dung (TL1). The dung of large herbivores contains a high proportion of undigested vegetable matter, and is combustible when dried – although it doesn't provide as much energy as wood. It burns slowly and evenly, letting cooks leave fires unattended for an hour or two while food cooks. While it's often more valuable to farmers as fertilizer, it's a convenient fuel for herdsmen and nomads. Dung is normally free wherever animals are herded; if it must be purchased, it costs $0.25 per pound.

Peat (TL1). Compressed, partially decomposed vegetation mined from wetlands, peat is essentially a precursor of coal. Dried peat blocks provide about as much energy as wood on a pound-for-pound basis, but because peat is harder to extract, it's typically a second-choice fuel source. $0.60 per pound.

Coal (TL4). Before TL5, small amounts of coal were used where it was available on the surface, but coal-mining wasn't widely practiced. Coal often contains foul-smelling impurities that make it undesirable, and mining frequently costs more than cutting trees. Some coal-rich regions, notably China, began to experiment more with coal at TL4, but widespread use didn't come until the Industrial Revolution. If available, coal costs $0.60 per pound.

Animal Power

Exploitation of animal labor began long after animals were domesticated. Horses were used as riding animals as early as 4000 B.C., and to pull chariots after 2000 B.C. However, they weren't large enough to provide agricultural traction until TL3. Cattle initially filled that role; around 3500 B.C., they were used to pull plows, and by 1000 B.C., they (and other beasts) were used to drive machinery such as rotary querns and water pumps. Dogs saw occasional use in North America – as did llamas in the Andes – but neither plowed fields nor drove machinery.

Harnesses

How best to attach draft animals to a load is far from obvious; thus, harness designs evolved gradually through the millennia.

Horn Yoke (TL0). An early method of harnessing oxen in Mesopotamia: a wooden yoke attached to the horns! This *halves* all divisors for pulling loads (see *Pulling and Dragging,* p. B353). For example, when pulling a two-wheeled cart with a horn yoke, divide weight by 5, not by 10. $32, 18 lbs.

Breast-Strap Harness (TL0). This is a rope or leather harness that wraps around the animal's chest. Initial research suggested that this and other early harnesses rode up and choked horses wearing them. Recent reconstructions have shown this to be incorrect. The real drawback is that on horses, these harnesses appear to be inefficient when used to pull plows or drag loads on the ground (again, *halve* the pulling divisor), as opposed to when pulling wagons. For large animals (e.g., oxen and horses): $75, 8 lbs. For smaller ones (e.g., goats and dogs): $49, 3 lbs.

Shoulder Yoke (TL1). A heavy-but-simple wooden frame fitting around an animal's shoulders, designed to enable oxen and horses to pull heavy loads. Treat as a breast-strap harness. $56, 47 lbs.

Horse Collar (TL3). A close-fitting, padded harness tailored to the horse's anatomy, allowing full power for dragging *and* plowing. $64, 18 lbs.

Water and Wind

The first experiments with water power were probably the horizontal waterwheels seen in China at early TL2. In these, the wheel lay sideways in the water, pushed by the stream, and rotated an axle attached to a grindstone above. It resembled a wagon axle turned on its side. The design was simple, requiring no gearing, but inefficient.

Undershot and *overshot* wheels were invented nearly simultaneously around 200 B.C. These upright designs were pushed by water either traveling under or pouring down on top of the wheel. They were both more complex and more expensive than a horizontal wheel (particularly overshot wheels, which can require a long mill-race to deliver water to the top of the wheel), but also more powerful and more versatile.

The earliest windmills appeared in Persia around 600 A.D., and closely resembled the horizontal waterwheel. Half of a shaft with paddles protruding from it was exposed to the wind. The force of the wind against the paddles turned the axle and powered machinery.

Around the 13th century, both China and northern Europe developed vertical windmills. Sail-like vanes faced the wind, engaging drag forces to make the mill much more powerful. Many early windmills were in buildings set on posts, so that they could be picked up and turned when the wind shifted. By late TL4, windmills were built with turrets that had rotating bearings, making them far easier to readjust.

Most powered mills, regardless of type, provided power equivalent to ST 20-40 – and horizontal mills rarely exceeded that. The largest mills could generate the equivalent of up to ST 125 at TL3 and ST 175 at TL4.

Rudimentary Steam

The *idea* of steam power goes back at least to the Alexandrian philosopher Hero in the first century A.D., but came well in advance of the engineering know-how to make it meaningful. Hero's *aeolipile* was a hollow metal sphere on a pivoting mount. Nozzles at either pole shot out steam jets when water inside was heated to boiling, making it rotate. Steam-based devices appeared sporadically thereafter: steam-driven pistons opened doors in grand Roman temples, steam pipes made artificial birds flap their wings in Byzantine palaces, and steam jets slowly turned an Ottoman philosopher's roasting spit.

These devices were expensive toys. They leaked, wasted heat, and expended valuable fuel and metal to do jobs that any other energy source – human labor, draft animals, waterwheels – could do far more cheaply. A typical TL2-4 steam contraption consumes 30 lbs. of wood and 10 gallons of water per hour. It drives a single powered accessory that can perform any one repetitive action that a ST 10 man could perform; e.g., opening a door, sawing, or blowing a horn. Such a contrivance might be mounted on a ship or a heavy wagon for transport, but the engine isn't powerful enough to be self-propelled. $20,000, 1,000 lbs.

Tools and Basic Equipment

In an age without automation or many large machines, these tools produced essentially everything of note. All are LC4 unless otherwise specified.

Carpentry

In addition to these tools, carpenters often use chisels similar to those under *Mining and Tunneling* (p. 30) and hammers like those under *Smithing* (p. 30).

Adze (TL0). Like an axe, but with the blade perpendicular to rather than parallel to the haft. Treat as a poorly balanced hatchet in combat (-2 to skill). $40, 2 lbs.

Drill, Bow (TL0). A bow drill resembles a small bow and arrow, except that the arrow is perpendicular to the plane of the bow, its blunt end is held steady in a socketed block, and the bowstring is wrapped around it. The user moves the bow back and forth, making the arrow spin and drill a hole at the pointed end. Does thr-1(2) pi+ damage per second. $8, 1 lb.

Drill, Pump (TL0). The pump drill uses an arrow-like shaft with a weight near the pointed end, a crossbar with a hole through which the shaft passes, and strings that connect the ends of the crossbar and the end of the shaft. The user spins the vertical shaft, which wraps the cords around it and pulls the crossbar up. Pushing down the crossbar spins the shaft with enough force that the cords, which unwrapped when the user was pushing down, wrap around again in the opposite direction and pull the crossbar up again for another push down, and so on. Does thr(2) pi+ damage per second. $18, 1.5 lbs.

Lathe (TL1). A lathe spins a piece of wood with a back-and-forth motion so that it can be shaved down or have carvings applied evenly around it. It requires either an assistant or a foot pump with an attachment to a spring (usually a tree branch) to provide motion. $235, 40 lbs.

Saw (TL1). A small saw for single-person use. Does sw-3(2) cut per second. $20, 3 lbs.

Square (TL1). An L-shaped tool, use to make sure right angles are correct. $7, 2 lbs.

Auger (TL2). This T-shaped drill produces broader holes than contemporary tools, but drills slowly because of the awkward grip. Does sw-2(2) pi++ damage every *other* second. $24, 4 lbs.

Brace and Bit (TL3). The familiar hand-cranked, U-shaped drill with a metal bit appeared at the end of the Middle Ages. Does sw-2(2) pi++ damage per second. $30, 5 lbs.

Chemical

Alembic (TL2). This tall jar has a tight-fitting lid with a beak-like spout pointing down and away. It vaguely resembles a penguin! When the alembic is heated, vapors rise into the spout, where they condense and drip into a separate container. Alembics are fragile, and usually heated in a sand or water bath to regulate temperature. $8, 1 lb.

Aludel (TL2). A stackable vessel used for sublimation, pear-shaped and open on both ends. A series of aludels are stacked over the material from which the chemist intends to extract vapors, the bottom is heated, and vapors condense around the edges of the cooler upper vessels. $2, 0.5 lb.

Crucible (TL2). A small (1-2 cups) but thick ceramic pot, with a small spout or angled edges to facilitate pouring. $6, 0.75 lb.

Cupel/Scorifier (TL2). These two similar vessels (cupels are smaller and flatter) are made from bone ash, which draws off oxidized metals when heated, helping isolate gold and silver from small samples. $2, 0.25 lb.

Cloth and Leather

Awl (TL0). A thin, pointed tool for piercing leather and heavy fabric. Awls are bone or horn at TL0. Metal ones are available at TL1, but inexpensive bone and horn stayed in use into TL4. $10, 0.25 lb.

Loom, Vertical (TL0). A simple rope-and-wood loom that may be hung from a post or a tree, suitable for producing cloth no larger than 6'×3'. $25, 4 lbs.

Needle, Sewing (TL0). A very thin sliver of bone, thorn, or metal (TL2) that can draw a thread after it. $3, neg. Halve cost for sewing *pins,* which lack an eye.

Spindle (TL0). A near-universal tool for producing thread, this is a rod with a small weight and a dull spike on which to put a bundle of raw fiber. Some spindles are sharp enough to do thr-2 imp. $4, 0.5 lb.

Loom, Backstrap (TL1). A header board through which threads pass, a shuttle to wrap thread around, and a beater to manipulate the thread. Loom capable of producing cloth a yard wide: $36, 5 lbs.

Scissors (TL1). Pre-modern scissors were made from a single piece of metal, bent into a U shape with blades on the ends. The arms of the U were squeezed together like a pair of tweezers to make the blades cross. Does thr cut damage every *other* second. $35, 1.5 lbs.

Thimble (TL2). A tiny cup to protect a finger while sewing. $2, neg.

Loom, Treadle/Flying (TL3). A full-frame loom that automatically adjusts sheds for faster weaving of fabric up to 6' wide. $440, 60 lbs.

Fishing

Fish Trap (TL0). Many traps were developed to capture fish while the fisherman was busy elsewhere. Most were anchored baskets with hinged, inward-opening doors; fish could enter but not escape. *Fish wheels,* used on North America's Pacific coast, incorporated several nets or baskets on spokes around an axle. The wheel was partly submerged, and the force of the water rotated it like an undershot waterwheel. Fish were scooped out of the water and retrieved by an attendant. Fish traps – particularly fish wheels – worked well when fish population density was high; +2 to Fishing skill in such areas. Trap capable of catching fish up to 10 lbs.: $14, 2 lbs.

Fishhook (TL0). A small bit of barbed bone – or possibly metal, at TL2+. $6, neg.

Fishing Spear (TL0). A thin, spear-like tool used to catch fish near the surface of the water. The point may be forked (perhaps extensively – some designs have a cluster of points) and/or barbed to counteract the effects of refraction on aim. Treat as a javelin (see Chapter 5), but poorly balanced for throwing (-2 to skill).

Net (TL0). Per square yard: $20, 10 lbs.

Mining and Tunneling

In addition to these items, miners and stonemasons used some of the equipment under *Carpentry* (pp. 28-29). Mining tools require ST 11.

Chisel (TL1). Chisels are made from bronze (TL1) or iron (TL2+), with ends ranging from small points to broad, axe-like shapes to scalloped edges. However, all are shaped to fit in the hand (5"-8" long) and take the impact of a hammer on the far end. When used with hammers, chisels convert damage from crushing to *piercing.* A typical chisel is $20, 0.75 lb.; others may cost and weigh from half to twice as much.

Crowbar, Large (TL1). A 5'-6' metal bar, providing improved leverage. In combat, treat as a cheap-quality tetsubo (see Chapter 5). $95, 8 lbs.

Hammer (TL1). Hammers for mining had heavy metal heads, sometimes slightly pointed on one end. Brandished in anger, a hammer uses Axe/Mace skill, and has Reach C and Parry 0U. Small hammer (sw cr damage): $90, 6 lbs. Large hammer (sw+1 cr): $180, 11 lbs.

Pick (TL1). At TL1-4, a typical pick is made of wood, bone, or antler. This does -1 to the damage listed on p. B271, takes twice as long to break up normal or hard soil (see *Digging,* p. B350), and will *break* if used on stone: $35, 2 lbs. Metal picks, which do full damage, are used mostly by professional miners: $70, 3 lbs.

Shovel (TL1). Before TL5, a typical shovel is wooden, which *doubles* base digging time (see *Digging,* p. B350): $12, 4 lbs. A metal-edged one multiplies base digging time by only 1.5: $18, 5 lbs. All-metal shovels use base digging time, but cost enough that only professional miners use them: $25, 6 lbs.

Smithing

In addition to these tools, smiths used a variety of punches and chisels, similar to the chisels under *Mining and Tunneling* (above). Smithing tools require ST 11.

Anvil (TL1). A metal block 6"-7" across, surface-hardened and tapered at the bottom to fit into a hole in a tree stump. It also has small holes to assist nail production, or grooves for wire production or other fine shaping. $1,300, 100 lbs. Larger, less-portable models can weigh up to 500 lbs., with a corresponding increase in price.

Hammer (TL1). Blacksmithing hammers are much lighter than mining hammers. Like chisels, hammers came in varied shapes for specific purposes. For example, a grooved hammer might be used to make wire, while other hammers may have heads presenting a rounded surface, a dull edge, or a point. Typical hammer: $30, 2.5 lbs.

Pliers (TL1). Slightly larger than the user's hand, suitable for getting a firm grasp on small objects. $15, 1 lb.

Shears (TL1). Heavy, pincer-like shears for cutting softened metal. Do thr+1(2) cut damage. $65, 2 lbs.

Tongs (TL1). Two feet long, suitable for grasping heavy objects and holding them firmly at a distance. $40, 3 lbs.

Draw Plate (TL2). A stone block with holes of graduated sizes through which to draw wire. $50, 2 lbs.

File (TL2). A metal plate with a rough face for grinding down edges. $45, 1 lb.

Jeweler's Tools

Jewelry requires tools similar to but smaller than regular smithing tools. Jewelers' versions of the above tools – except the draw plate – are available at double cost and with half weight. These *don't* have a ST minimum.

Stone Knapping

Hammer, Soft (TL0). A piece of bone, horn, or wood used for softer percussion than a rock. $4, 1 lb.

Hammer, Stone (TL0). A rounded pebble large enough to hold comfortably in the hand. Free, 2 lbs.

Punch, Small (TL0). An antler or sharpened bone suitable for pressure flaking. $6, 1 lb.

Punch, Chest (TL1). A T-shaped punch with a pointed, possibly copper tip. The user places the crossbar of the T against his chest and presses the point down on the edge of a prepared core to produce a long, thin blade. $10, 2 lbs.

Tool Kits

These kits represent basic sets of tools necessary to carry out important crafts without equipment penalties. Some costs and weights are rounded to account for minor odds and ends.

Tailor's Kit (TL0). Appropriate to working with any cloth or leather. An awl, a pair of small knives (TL0) or scissors (TL1), four needles with different-sized eyes, 20 pins, a measuring rod (TL1), a thimble (TL2), and 100' of thread. $95, 2.75 lbs.

Carpenter's Kit (TL1). An adze, a bow drill, four chisels, a hammer, a hatchet, a level, a measuring rod, a saw, a square, and an abrasive stone for sanding. $250, 21 lbs.

Fletcher's Kit (TL1). Appropriate to making and repairing arrows and crossbow bolts (TL2) in the field from semi-prepared parts. Making arrows from raw materials requires the carpenter's kit (above), at minimum. Includes a small knife, a large knife, small pliers, an arrow-straightener (a stone or a bone with a long groove; despite the name, it's used to check a shaft for straightness, not to change its shape), and abrasive for sanding. $95, 4 lbs. For parts (shafts, heads, feathers, and glue or pitch), add half the cost and the full weight of the finished arrows.

Smith's Kit (TL1). A minimal set of tools includes three hammers, tongs, four chisels, shears, and a file (TL2). $330, 17.5 lbs. The smith must find a flat rock to use as an anvil (for TL2+ smiths: -1 to skill and roll vs. Smith every day of use to avoid breaking it). A full kit with a portable iron anvil is available at TL2: $1,630, 117.5 lbs.

Alchemist's Kit (TL2). An alembic, two aludels, a brazier, two crucibles, four cupels or scorifiers, a large pot to use as a water or sand bath, several pieces of clean cloth for filtering, tongs, a balance scale, and a small mortar and pestle. $175, 25 lbs. Many societies regard alchemists with mistrust, classifying alchemy as either fraud or black magic; there, this kit is usually LC2, with the "license" being protection from someone in authority.

Stoneworker's Kit (TL2). A large hammer, a small hammer, six chisels of different shapes, a large crowbar, a small crowbar (p. B289), a square, a level, and an auger. $551, 42.5 lbs.

Chapter Three
General Equipment

Aristoboulos held up a round object made of bronze, like a shield with the handle on the wrong side. It was over a cubit in diameter, and he handled it as though it were heavy for him.

"Here," he said, "is a catoptric fire-starter."

"I suppose you could fill it with fuel, like a brazier," said Martialis. "But I think it would tip over easily."

"No, no, the fuel goes in a different container. Here, take the handle." Aristoboulos passed the strange device to Martialis, and took down an incense-burner and a small block of incense. "Now let's go out into the sun."

Beneath the hot Egyptian sun, Martialis raised the fire-starter, and Aristoboulos pointed out the bright spot on the ground. Martialis shifted his grip, until the spot was on the incense-burner, and tiny – and the incense caught fire, filling the dry air with its scent.

"And that," said Aristoboulos, "is how Archimedes set fire to Roman ships. The curved surface of the bronze brings all the heat of the sun to a single point, which we call the ***hearth,*** *for the heat is as great as that of a fire."*

"I've seen burning glasses do the same," Martialis said.

"Very like it. But of course no one can make a glass so large as this."

Even on a hair-raising adventure, people must see to everyday life – especially getting enough to eat and drink, and staying warm and dry. Means of achieving these goals span the spectrum from survival through comfort to luxury. Except as noted, everything here is LC4.

Shelter

One of life's fundamental needs, even for wandering hunter-gatherers, is protection from the elements. While most dwellings were stationary (for architecture, see ***GURPS Low-Tech Companion 3***), travelers often needed to arrange shelter *quickly.*

Improvised Shelter

Shelter – particularly for nomads – wasn't necessarily carried. It was sometimes built on the spot from available materials.

Igloo (TL0). An igloo requires deep, well-compacted snow. After digging an entrance trench, the builder cuts slightly trapezoidal blocks of snow 6"-8" thick and roughly a foot wide and tall. He then stacks the blocks into a dome, which he covers with loose snow. Snow is a good insulator; an inhabited igloo attains a cool but survivable temperature above freezing. It can even survive a small fire, if an exhaust hole is poked through the roof. Building a 6' igloo takes 4 hours and a roll against Survival (Arctic). A completed igloo provides +2 to *subsequent* Survival (Arctic) rolls, and offers cover DR 1. The igloo itself has DR 0, HP 44. Blocks are generally carved using a wooden *snow saw* ($28, 2 lbs.) – but any reasonably long, flat object would work.

Lean-To (TL0). This is a series of leafy branches propped up against a fallen tree or a steep slope to form a triangular sheltered area. Building a lean-to requires a Survival roll and 3 minutes with a metal axe or 8 minutes with a stone axe; without tools, it takes 15 minutes and an additional Survival roll to scrounge fallen branches. A lean-to affords no cover DR and can be swept away with a single swinging attack. It gives +1 to Survival and must be rebuilt daily (another Survival roll).

Semi-Prepared Shelter (TL0). Nomadic hunter-gatherers in cooler climates couldn't afford permanent homes but still desired shelter along established migration routes. They sometimes stacked durable materials (most often stones, but some used mammoth bones) into low walls. When passing through the area again, they could make a temporary roof from hides or branches in about an hour. Building such a shelter with a 6' diameter takes about a day and provides +1 to subsequent Survival rolls for someone staying there. The walls of a semi-prepared shelter provide cover DR, which varies greatly depending on locally available materials. Unremarkable walls include a 6" thickness of piled stone (DR 78, HP 74; cover DR 48) or a foot of piled bone and branches (DR 12, HP 54; cover DR 6-12).

Portable Shelter

Nomads, pilgrims, soldiers, and traveling merchants commonly carry shelter with them. Portable items include both complete shelters and parts for sprucing up temporary dwellings.

Tents

Tents appear as early as TL0. Many, like those on p. B288, are simply large pieces of hide or fabric separating inhabitants from the elements. However, specialized tents were developed to provide superior protection in particular environments.

A tent offers concealment but *not* cover DR – it's *fragile,* and destroying a pole will usually collapse it, trapping anyone who fails to escape (roll vs. DX) as though tangled in a large cloak. It takes one minute per 20 lbs. to put up or take down a tent. Large tents can be broken up into smaller bundles (as light as 20-30 lbs. each) for distribution among bearers for transport.

Bedouin Tent (TL1). A large residential tent made from breathable woolen cloth. Side walls are 5'-6' tall. The roof is flat or slightly peaked. Gives +1 to Survival (Desert) rolls. A 15'×15' tent (DR 0, HP 20): $340, 200 lbs.

Yurt (TL1). This is a round, collapsible wooden-lattice framework, including a domed top, covered by a heavy felt shell. Yurts are more durable than other tents (offering cover DR 1) and cannot be knocked down by a single blow to a support. Yurts insulated with tapestries and rugs, or additional layers of felt, grant +1 to Survival (Plains) – or to *any* Survival specialty, in a cold climate – but have double cost and 1.5 times weight. A 10'-diameter yurt (DR 1, HP 20): $480, 200 lbs. A 15'-diameter yurt (DR 1, HP 28): $1,200, 500 lbs.

Legionary Tent (TL2). Made from treated leather panels, this tent is more water- and wind-resistant than a cloth one. It covers a 10'×10' area (sleeps six to eight comfortably) and, at 6' in height, is tall enough for standing in the center. A legionary-style tent gives +1 to *any* Survival specialty. DR 1, HP 14. $225, 45 lbs.

Semi-Portable Housing Elements

Better tents (particularly yurts) and many less-expensive permanent structures (e.g., mud-brick buildings) may be equipped with a few elegant durable features. These are often reused as the owners move or rebuild their homes.

Door (TL0). A framed door that can be placed in an opening in a tent or a temporary building. As focal points for visitors, portable doors are often elaborately decorated. Provides cover DR 1. DR 1, HP 23. $210, 70 lbs.

Partition (TL0). A long cloth or straw panel hung from ceiling beams or tent poles, turning a large space into individual rooms. Has no DR or cover DR, and can take 12 HP before being slashed to ribbons. A 6'×10' partition: $80, 33 lbs.

Beaded Curtain (TL1). A series of cords on which objects such as beads, bamboo segments, or shells are strung. Provides no cover DR, but visually divides an area into subareas, and offers light concealment (-2 to hit; see p. B408). Passing through it makes noise (see *Alarms,* p. 123). Also acts as a deterrent to flying insects. DR 0, HP 5. $30, 2 lbs.

Carpet (TL1). Carpets, produced by tightly tying knots together on a loom in a thick, durable weave, can be used as portable floors. A typical rug: $45, 1 lb. per square foot.

Folding Screen (TL1). A set of hinged panels, made from wood or a frame filled with paper or wicker, providing a free-standing barrier. Provides no cover DR, and any attack knocks it over. A 6'×6' partition (DR 0, HP 14): $400, 55 lbs.

Wicker Fence (TL1). Wandering herdsmen sometimes carry lightweight wicker panels for creating temporary corrals. These are planted in the ground with wooden spikes protruding from the bottom. They provide no protection other than concealment, but domesticated animals won't try to push past them unless driven by panic. A 3'×3' panel takes 10 seconds to set up in most ground; it can be knocked over by winning a Quick Contest of ST vs. ST 9. DR 0, HP 9. $20, 13 lbs.

Domestic Conveniences

Merely being a primitive doesn't make one uncivilized . . . well, it *can,* but it doesn't mean a lack of desire for comfort. Pleasant temperatures, a nice place to sleep, and a safe place to keep things were as important to wandering tribesmen and feudal warlords as they are to us.

Heating and Cooling

Prior to the refrigeration and efficient furnaces of the industrial age, cooling and heating mostly worked on an individual level.

Portable Heating

Brazier (TL1). A footed metal dish in which coals can burn, with a handle or a chain for easy transport. Can be used for cooking, and will raise the temperature of a small room (up to 100 square feet) by 5°F. $65, 3 lbs.

Warming Pan (TL2). An almost entirely enclosed brazier with a long handle. The pan is slid under bedcovers, and the coals within slowly combust through the night, keeping the bed warm. While used primarily for comfort, it allows a bed to qualify as a "heated suit" for the purpose of resisting cold; see *Cold* (p. B430). $80, 4 lbs.

Portable Cooling

Water Jug (TL0). An unglazed earthenware jug (see *Containers and Storage,* p. 34) filled with water slowly loses water to the outer surface, where it evaporates, carrying away heat and cooling the vessel. Water kept in unglazed jugs loses 5% of its weight per day to evaporation, but grants +1 to Survival (Desert) and Survival (Jungle).

Fan (TL1). Folding fans, constructed of wooden slats, or wood with a fabric or paper web, are a convenient way of providing oneself with a light breeze. $10, 0.25 lb.

Parasol (TL2). This collapsible canopy-on-a-stick provides complete protection from sunburn (p. B434). Parasols existed in China by 1000 B.C., and were adopted around the Mediterranean a few centuries later. One-yard-diameter parasol of wood and plain cloth: $12, 3 lbs. *Double* cost and *halve* weight for bamboo and silk. In either case, multiply cost and weight by four for a two-yard-diameter parasol, usually held by one person to shelter another.

Light

All of these light sources are *precarious:* Roll 3d if one is dropped, exposed to strong wind, or carried faster than Move 3. On 12 or less, it goes out! Exceptions are noted.

Oil Lamp (TL0). Oil lamps burn for 24 hours on a pint of fuel. The earliest designs, available by 38,000 B.C., were stone or pottery bowls with a notch to hold the wick. Such lamps were completely open, and prone to spilling if moved quickly. If knocked over, they burn for a second before going out, doing 1d-3 burn damage to the surface onto which they're spilled. On a dry surface, this may be enough to start a *real* fire! $10, 4 lbs. At TL2, classical pottery lamps became completely enclosed, with a spout to hold a wick: $20, 2 lbs.

Torch (TL0). A bundle of rushes, providing an hour of light: $3, 1 lb. An improved version – dipped in pitch – burns for twice as long and won't go out if carried at a run: $7, 1 lb.

Candle (TL2). Burns for 12 hours. *Tallow* candles are smoky, and burn with a distinct odor: $5, 1 lb. *Beeswax* burns with a minimum of smoke and smell: $9, 1 lb.

Covered Lantern (TL2). An oil lamp (as above), but with the flame protected by thin sheets of translucent bone (or glass, at late TL3). Doesn't go out in a strong wind or if moved quickly. $40, 2.5 lbs.

Furniture

Although furniture could be massive, fragile, or otherwise made for stationary use, these examples are designed for *portability.*

Household Furniture

Collapsible Bed (TL1). A substantial wooden bed frame held together by pegs, which can be removed for rapid dismantling. Mattresses are supported by a network of ropes, which must be tied across the frame. $560, 195 lbs.

X-Frame Chair (TL1). One of the earliest forms of portable furniture was the X-frame chair: a folding wooden frame with a cloth or leather seat, essentially identical to a modern folding director's chair. $70, 30 lbs.

X-Frame Table (TL1). Similar to an X-frame chair, but larger, and with neither arms nor back. A 3'×3' table, seating at least four: $200, 75 lbs.

Bedding

Low-tech bedding – particularly *cheap* bedding – is notorious for providing homes to fleas, mice, and other vermin. In addition to offering an uncomfortable night's sleep, old bedclothes, mattresses, and pillows may spread disease (see *Contagion,* p. B443).

Headrest (TL0). Some societies use carved *wooden* headrests instead of pillows. $8, 3 lbs.

Mattress (TL0). Low-tech mattresses resemble modern quilts more than they do modern mattresses. Wealthy folk layer several for greater comfort! Cheap mattress for one person, made from reeds stuffed into a cloth sack, or from woven straw (like a Japanese tatami): $60, 16 lbs. Fine *feather* mattress: $850, 30 lbs.

Blanket (TL1). For one person: $20, 4 lbs.

Hammock (TL1). Mayan rope hammocks were light, portable bedding, perfect for hot climates but very uncomfortable in the cold: $15, 3 lbs. Old World hammocks used solid cloth sheets instead of open nets: $22, 4 lbs.

Pillow (TL1). Coarse, straw-filled cushion: $5, 1 lb. Top-quality feather pillow: $70, 2 lbs.

Sheets (TL1). Fine but relatively light cloth to cover a bed. For one person: $35, 2 lbs.

Containers and Storage

The vessels in the *Containers Table* (below) are appropriate for long-term storage and transport. They come with hinged lids, stoppers, or other covers, as appropriate. Weights are in pounds.

A container's buyer may specify minor features for free.

Containers Table

	1/4 cup 3.5 cu. in.	*1 cup 14 cu. in.*	*1 quart 58 cu. in.*	*1 gal. 0.13 cu. ft.*	*2 gal. 0.27 cu. ft.*	*6 gal. 0.80 cu. ft.*	*20 gal. 2.7 cu. ft.*	*40 gal. 5.3 cu. ft.*	*80 gal. 11 cu. ft.*	*120 gal. 16 cu. ft.*
Cloth Bags										
Cost	$0.10	$0.25	$0.75	$1.75	$2.75	$6	$13	$20	$32	$42
Weight	neg.	neg.	0.1	0.25	0.5	1	2	3	5	6
HP	1	2	2	3	3	4	5	6	7	8
Earthenware Jars										
Cost	$0.10	$0.25	$1	$3	$7.50	$16	$41	–	–	–
Weight	0.15	0.3	1	4	10	20	52	–	–	–
HP	2	3	5	7	9	11	15	–	–	–
Glass Bottles										
Cost	$0.50	$1.50	$3.75	$13.50	$21	–	–	–	–	–
Weight	0.15	0.4	1	4	6	–	–	–	–	–
HP	3	3	5	7	8	–	–	–	–	–
Leather Pouches										
Cost	$0.25	$0.75	$2	$4.50	$7.35	$15	$34	$53	$85	$111
Weight	0.05	0.1	0.3	0.75	1.25	2.5	5.5	9	14	18.5
HP	2	2	3	4	5	6	8	9	10	11
Metal Boxes										
Cost	$7	$18	$46	$115	$367	$761	$1,700	$4,050	$6,417	$8,409
Weight	0.4	1	2.5	6.5	20	42	94	225	356	467
HP	3	4	5	8	11	14	19	25	29	32
Wicker Baskets										
Cost	$0.10	$0.15	$0.50	$1.75	$3	$7.50	$16	$39	$62	$108
Weight	neg.	0.07	0.25	1	1.5	3.75	8	20	31	54
HP	1	2	3	4	5	7	9	11	13	16
Wooden Boxes/Barrels										
Cost	$0.50	$1	$3	$10	$17	$31	$55	$113	$178	$239
Weight	0.05	0.1	0.25	1.5	2.5	6	11	32	50	88
HP	2	2	3	5	6	8	9	13	15	18

Notes

Cloth bags have DR 0, are Fragile (Combustible) (p. B136), and neither take damage from nor protect contents from crushing attacks. They can carry roughly 0.5 oz. of weight per cubic inch of capacity, or 55 lbs. per cubic foot.

Earthenware jars have DR 1 and are Fragile (Brittle) (p. B136). *Porcelain* vessels have triple cost. Either type can carry about 1.5 oz. of weight per cubic inch, or 160 lbs. per cubic foot.

Glass bottles have DR 1 and are Fragile (Brittle). They can carry as much weight as earthenware jars.

Leather pouches have DR 2 and can carry around 0.75 oz. of weight per cubic inch, or 83 lbs. per cubic foot, but otherwise have the same characteristics as cloth bags.

Metal boxes have DR 3. Prices assume iron (TL2). *Bronze* (TL1) has quadruple cost. Either type can hold approximately 2 oz. of weight per cubic inch, or 215 lbs. per cubic foot.

Wicker baskets have DR 0, are Fragile (Combustible), and neither take damage from nor protect contents from crushing attacks. Their loose, open weave is unsuitable for holding grain, soil, or anything else that could easily run out. They can carry as much weight as leather pouches.

Wooden boxes/barrels have DR 0 and are Fragile (Combustible). They can carry as much weight as earthenware jars.

Container Options

A container's buyer may specify *minor* features for free. For example, a glass or earthenware vessel may have a flared neck, handles, or a pointed bottom (which acts as both a handle and a stand that sinks into soft ground) for easier carrying. Large chests intended for sea voyages typically have short legs or casters, or simply sides that project as much as an inch below the bottom, to help keep the bottom dry and extend the chest's life.

Other options cost extra:

Compartmentalized: Containers may be given internal compartments (pockets in cloth or leather, dividers in wooden boxes, etc.). This lets someone familiar with the container's contents find items in less time. *Light compartmentalization* reduces search times by 10%: +10% weight and +0.25 CF. *Heavy compartmentalization* reduces search times by 25%: +20% weight and +0.5 CF.

Locked: Wooden and metal containers may have locks (pp. 120-121); add the lock's cost to the container's final, modified cost.

Reinforced: Weight can be increased by up to 500%, increasing maximum load by the same percentage. Find HP from the higher weight (see p. B558). CF is 1/100 the added weight percentage, up to +5 CF at +500%.

Waterproof: Waterproof wooden barrels became available at TL2: +100% weight and +3 CF. Completely waterproof pottery vessels – stoneware or glazed earthenware – have +1 CF; porcelain is waterproof without modification. Wicker baskets can have a tighter weave that's waterproof for 30 minutes: +50% weight and +1 CF.

Personal Gear and Consumer Goods

Personal comforts and luxuries have always been with us – although compared to the average present-day person, most folk could afford fewer of them. Expensive consumer goods such as perfumes and spices were the objects of immense mercantile networks that supported wealthy, important states.

Personal Gear

As unspectacular as it may be, almost everyone in a low-tech society needed a way to make fire, stay clean, and carry his possessions.

Fire-Starting Gear

The simplest fire-starting gear is two pieces of wood. Vigorously rubbing one against the other produces heat, fine sawdust, and eventually an ember, which may be placed on tinder (dry leaves, wood shavings, etc.) to set it alight in turn. Any attempt to start a fire without dedicated equipment takes 6 minutes and a Survival or Housekeeping skill roll. *Double* fire-lighting time if any of the components aren't completely dry – and kindling that's actually damp to the touch won't catch fire *at all* with low-tech methods! More-sophisticated tools speed the ember-lighting process, but still require a skill roll unless otherwise noted. Friction techniques cost 1 FP per 3 minutes of effort.

Firebow (TL0). A firebow is a bow drill (p. 28) adapted to fire-starting, producing friction with a dull point rather than drilling a hole with a sharp one. Base fire-starting time: 2 minutes. $5, 0.75 lb.

Flint (TL0). A piece of flint, plus a bit of metal or mineral against which it can strike a spark. Makes a loud noise, which can ruin concealment attempts! Base fire-starting time: 30 seconds. $2, 0.2 lb.

Prepared Block (TL0). A wooden shaft and a block with resin-treated grooves. The user rubs the shaft's tip in a groove to produce friction. Base fire-starting time: 3 minutes. $3, 0.5 lb.

Enhanced Tinder (TL1). Dried fungi soaked in a nitrate solution, which catch fire more easily than dry wood. *Halves* fire-starting time (thus, enhanced tinder cancels out the doubling for damp conditions). Per use: $2, 0.1 lb.

Burning Glass (TL2). Handheld lenses and mirrors were occasionally used to focus sunlight. They're fragile, expensive, and only useful in clear sunlight. Polished metal mirror or natural quartz ground into a lens (TL2): $40, 1 lb. Clear glass lens (TL3): $20, 0.5 lb.

Fire Piston (TL2). The fire piston, from Southeast Asia, is a narrow 5" shaft that fits tightly into a cylinder. The shaft has a niche for a bit of tinder at the tip. Sharply slapping the shaft into the cylinder compresses the air in the chamber, heating it enough to ignite the tinder. Base fire-starting time: 30 seconds. $15, 0.5 lb.

Sulfur Matches (TL3). Sulfur-impregnated pine slivers appeared in China in the sixth century A.D., and had spread to Europe by the 12th century. These matches weren't self-lighting; rather, they would light quickly at the touch of any spark. Thus, they were simply very good tinder. Divide fire-starting time by four. Bundle of 20: $5, neg.

Self-Lighting Matches (TL4). In 1680, a scientist invented self-lighting matches by stroking a sulfur-laden match across a paper impregnated with recently discovered phosphorus. The discovery of the reaction didn't lead immediately to commercial self-lighting matches (phosphorus was far too expensive!). However, an alchemist could produce such "lighting paper." Paper good for 50 matches: $75, neg.

Grooming

Comb (TL0). Often made from wood or bone, combs were frequently left in the hair, used for adornment as well as grooming. $3, 0.2 lb.

Razor (TL0). Stone blades were used for cutting hair by 30,000 B.C. Metal blades for shaving, often half-moon-shaped or oval, appeared around 3000 B.C. $18, 0.2 lb.

Bathtub (TL1). The earliest Minoan portable bathtubs were *small,* similar to early modern hip baths. Earthenware tub: $160, 60 lbs. Metal tub: $1,600, 80 lbs.

Brush (TL1). The earliest Egyptian hairbrushes used reed bristles, like a modern broom. Use of stiff animal hair developed later. $6, 0.5 lb.

Strigil (TL1). This tool resembles a dull knife with a badly bent blade. Before the advent of soap, a bather was covered with oil, which was scraped off using the strigil, carrying dirt with it. While usually thought of as a Greco-Roman tool, examples go back to around 3000 B.C. Some strigils come in sets of different sizes to clean different body parts, connected like keys on a ring. Each strigil: $6, 0.5 lb.

Tweezers (TL1). Originated around 2000 B.C., probably to remove body hair. $5, neg.

Soap (TL2). The first soaps, possibly appearing in the first century A.D., were semi-liquid and harsh, made by mixing lye (see *Other Chemicals,* p. 26) with oils. At TL3, as early as the ninth century, Mediterranean soap-makers processed liquid soap with salt water, separating the solid soap – which was pressed into bars – from the harsher impurities. Pint of liquid soap: $20, 1 lb. Bar of solid soap: $27, 1 lb.

Load-Bearing Gear

Carrying Frame (TL0). A rudimentary backpack used by Native Americans, this is a broad board with shoulder straps. The frame doesn't contain anything itself, but gear can be strapped to it. Untying and removing an article takes 1d+10 seconds; tying something on takes 2d+10 seconds. Holds 100 lbs. of equipment. $60, 7 lbs.

Carrying Straps (TL0). Any container – basket, bottle, leather bag, etc. – can have a carrying strap, which may be carried in hand or over a shoulder. This costs an additional $1 for containers up to 10 lbs. full weight, or $5 for anything heavier.

Carrying Yoke (TL2). This consists of two wooden hooks connected like a curving letter W, sometimes used by the Greeks. The frame's center is balanced over a shoulder and baggage is tied into the curve on the rear hook, resting on the hook and against the bearer's back. A hand or more gear on the front hook balances it. This rig holds 80 lbs. of gear, but requires a hand on it at all times to keep it steady. Dropping it is a free action. $70, 3 lbs.

Travel Kits

Hunter-Gatherer's Kit (TL0). A hide bag or a small wicker basket holding a flakable stone core; two hammerstones; two foot-long bones or straight sticks; two tiny punches made of bone, horn, or wood; and several yards of thin cord. If the stone isn't flint, add two fire-making sticks. Many of these items are multipurpose: the hammerstones can be used to produce stone tools, or to crack open nuts and marrowbones; a long stick is good for light digging, or can serve as a shaft for fitting microliths to create a sickle or similar cutting tool. $10, 5 lbs.

Pilgrim's Kit (TL2). A bundle of necessities carried by someone traveling through civilized areas but facing poor accommodations and unpredictable food at inns and/or aboard ship: a straw mattress, a blanket, a coat, a knife and whetstone, a jug of wine, a 5-lb. sack of flour or dried peas, and 1 lb. of spices (intended for medicinal use). $210, 40 lbs.

Luxury Kit (TL4). This compact case of luxuries – carried by a traveling aristocrat – is of little use for survival but indispensible for a wealthy person's comfort! Includes a full set of grooming equipment (razor, brush, comb, soap, fragrances, and cosmetics), a writing box (p. 47), and serving and drinking vessels for tea, coffee, or alcohol (as suits the culture), all neatly arranged in a purpose-built cabinet. Relatively plain model, with unremarkable contents: $225, 25 lbs. Use *Luxury Pricing* (p. 37) to reflect a case holding brandy instead of cheap wine, ivory hairdressing implements rather than wooden ones, etc.

Luxuries

Little evokes the romance of a time and place better than the luxuries available there: giant tapestries depicting ancient heroics, lit by beeswax candles . . . panoplies of gold-chased armor, engraved with sacred verses . . . or smooth silken robes, redolent with the cinnamon and mace that were wrapped in them during their long journey from far-off islands. Luxuries are compact and portable stores of value for hard-headed pragmatists, and make life worth living for everyone else!

Luxuries as such are LC4. However, some societies have *sumptuary laws* that forbid people below a certain Status to own, use, or consume certain luxuries. Treat such goods as LC2, with the "license" being sufficient Status.

Perfumes

Perfumes were originally burned or carried rather than worn. Incense was burned in Mesopotamia and Egypt by 3500 B.C.; around the same time, musk came into use in China. By 1000 B.C., aromatic oils were used in personal grooming. Ancient perfumes were heavy on aromatic woods and their resins, and on spices such as *cassia* (a relative of cinnamon). As chemical extraction methods improved (see *Herbal Extracts,* pp. 151-152), they were applied to scents as well as medicines. While the Egyptians worked with some floral perfumes, flowers didn't become a primary source of fragrances until TL3, when distillation technology matured.

Incense: $6 to $15 (base price) per ounce.
Perfume: Per application: $3 to $20 (base price), 0.1 oz.

Cosmetics

Members of many hunter-gatherer societies adorned their skin with ochre and similar earthen pigments, berry juices, soot and ashes, and perhaps other substances, at least for ceremonial occasions. As cosmetics evolved, their makers mostly concentrated on three colors:

- *White* was used to make skin pale. Powdered chalk saw use in the West and rice in the East. Longer-wearing colors were sometimes made from metallic oxides.
- *Red* highlighted natural flesh tones. Short-wearing reds came from berry juices, but superior reds were compounded from cinnabar (see *Mercury,* p. 21), with wax or fat as a binder.
- *Black* provided outlines and emphasis. As early as 4000 B.C., the Egyptians made an eye shadow, *kohl,* from a variety of substances – including malachite, antimony, and soot. In addition to its aesthetic effects, this may have served as eye protection in the bright sun. Similar compounds were used in warm countries around the Mediterranean and east to India.

Nail colors were invented by 3000 B.C. in eastern Asia, combining flower petals with binders such as wax and egg whites. By 1600 B.C., *henna* was used for elaborate skin decorations, and to color hair.

Common Cosmetics: Made from easily produced materials; e.g., eyeliner from soot, or face paint from chalk or rice powder. Wear off within 2 hours. Per use: $0.25 to $1 (base price), 0.25 oz.

Better Cosmetics: Many "better" low-tech cosmetics were toxic, containing lead or arsenic! Wear off after 4-6 hours. Per use: $2 to $5 (base price), 0.5 oz.

Spices

Even hunter-gatherers flavored food with herbs and spices, although such seasonings probably all came from local plants. While spices weren't the first plants domesticated, they were still relatively early. *Chili peppers,* for example, were domesticated in Central America by 4300 B.C. Most other spices common today – including *cinnamon, ginger, turmeric, saffron, black pepper, cloves,* and *nutmeg* – entered widespread use between the Near East and Southeast Asia from 2000 to 1000 B.C. *Cardamom* was used by the fourth century B.C., but was gathered from the wild rather than cultivated well into TL5. *Vanilla* was domesticated in Mexico by the TL1 Aztecs, and exported to Europe in the 1520s, but couldn't be cultivated outside Mesoamerica until TL5 due to elaborate pollination requirements.

Spices have a base price from $15 to $120 per ounce. Chilies, and rhizomes such as ginger and turmeric, are easy to grow and therefore inexpensive. Saffron, which requires enormous effort to harvest, sits at the top of the scale. Spices are *particularly* subject to *Luxury Pricing* (above). Exotic flavorings imported from across the world could be worth their weight in silver or – in extreme cases – gold!

Drinking and Smoking

Pipe (TL0). An early tobacco pipe was a long wooden tube with a bowl at the end to hold smoldering tobacco: $3, 1 lb.

Luxury Pricing

Many goods famed for their astronomical prices were affordable in their lands of origin, but became enormously expensive when hauled from, say, Indonesia to Holland. Traveling across the world to capitalize on immense price differences is a very real adventure. Transportation costs and risks are complex matters, but as a quick-and-dirty rule, the GM can determine the local prices of luxury imports by setting the Status level (and standard of living; see pp. B265-266) that allows one to use the item on a regular basis, and then multiplying the *base price* as follows:

Status	***-1***	***0***	***1***	***2***	***3***	***4***	***5+***
Cost Multiplier	×0.5	×1	×2	×5	×20	×100	Another ×10/level

Extremely high costs are entirely realistic – in their day, luxury goods such as cinnamon and porcelain could be literally worth their weight in gold!

As smoking was adopted in Europe (TL4), disposable, mass-produced clay pipes were frequently used: $1, 0.25 lb.

Tea, Chocolate, Coffee, and Tisanes (TL0). Herbal preparations boiled in water (*infusions* or *tisanes*), often composed of medicinal substances, go back as early as TL1; see *Herbal Extracts* (pp. 151-152). *Tea* itself entered use in the first millennium B.C., in China; *chocolate* appeared around the same time, in Central America. *Coffee* showed up near the end of the first millennium A.D., in Ethiopia. One pound is enough for 100 cups of tea, eight cups of chocolate, 30 cups of coffee, or 25-100 cups of tisane. $36/lb.

Tobacco (TL0). One pound of tobacco is enough for 30 individual pipes or hand-rolled cigars or cigarettes; such bulk tobacco is $12/lb. A pack of 10 pre-rolled tobacco products, using leaf wrapping through TL3 and often paper thereafter: $10, 0.25 lb. Tobacco flavored with honey or fruit juice (TL3): +2 CF.

Fermented Beverages (TL1). Wine, beer, and other primary products of alcoholic fermentation (fermented milk, rice wine, etc.). These may be filtered or lightly flavored according to the producer's preferences, but don't have concentrated alcohol content. $5/gallon.

Water Pipe (TL2). A water pipe has a bowl for tobacco, a tube connecting the bowl to the bottom of a water reservoir, and a second tube above the waterline, through which the smoker inhales. Water pipes originated in Persia or India around the first century A.D. Before the introduction of tobacco, they were used to smoke medicinal plants. $35, 4 lbs.

Distilled Liquors (TL3). Initially used as medicine, distilled liquors became popular for recreational use as distilling costs dropped. $20/pint at TL3, falling to $16/pint at TL4.

Decorated Equipment

Wealthy people adorn themselves and fill their properties with gilded armor, painted furniture, inlaid game sets, figurative carpets, etc. Such luxuries rarely outperform their less-valuable cousins, but they're prettier. They grant bonuses to reaction and Merchant rolls to impress collectors and buyers, as explained in *Styling* (p. 14).

Many specific embellishments are described below for those who desire more detail than generic "styling." Use *total* CF to gauge bonuses: a net +1 CF gives +1 to impress, +4 CF gives +2, and +9 CF gives +3. Weapons or armor need at least +4 CF all told to count as "presentation quality" (p. B274).

For ensembles of ornate clothing (pp. 97-100) and jewelry (below), the *entire outfit's price* – after adjusting component costs for CF – determines the Status to which it's appropriate:

Total Price	*Status*	*Total Price*	*Status*
$240	0	$4,800	3
$480	1	$24,000	4
$1,200	2	Each ×10	+1

Prices assume formal dress, and *can* run to millions for Status 6-8 regalia (e.g., crown jewels)! However, the bonus to impress never exceeds +3. Of course, buyers may assume that someone *wearing* finery commands matching Status (roll vs. Acting if posing), with the usual effects on transactions.

Beading (TL0). *Soft goods* can be decorated with a pattern of colored beads made of clay or shell (for precious stones, see *Jewelry,* below). Light beading (e.g., along edges or corners): +2 CF. Extensive beading: +8 CF.

Dyeing (TL0). *Cloth* can be dyed an attractive color, or simply bleached white. Black or white: +1.5 CF. A more vivid but still common dye (e.g., dull red from madder or blue-grey from indigo): +6 CF. Expensive dye (red from murex or cochineal, yellow from saffron, etc.): +30 CF.

Embroidery (TL0). *Soft goods* can have a design stitched into them. Minimal trim and simple designs: +2 CF. Elaborate design covering most of the item: +6 CF.

Figurative Painting (TL0). *Any* object can have a design painted or printed onto it after it's made. Limited, simple decoration (e.g., geometric pattern block-printed around a vase's neck): +2 CF. Complex decoration (e.g., multiple, individually drawn figures around a vase's neck) and/or decoration covering most of the item: +5 CF for either or +10 CF for both.

Fringe, Feather, or Fur Trim (TL0). *Soft goods* can be adorned with an eye-catching edge made from a different material. Common feathers or furs (e.g., bluebird feathers or rabbit fur), or dyed string fringe: +1.5 CF. Particularly rare or colorful trim (e.g., peacock feathers, murex-dyed trim, or sable): +4 CF.

Inlay (TL0). As for relief (see below), but the carved or embossed surface is filled in with materials of contrasting colors. Multiply the CF for relief by 2 for simple materials (common woods or stones) or by up to 5 for precious ones (rare woods, semiprecious stones, etc.).

Relief (TL0). *Hard goods* can have a design carved or pressed into the surface. Simple pattern: +1.5 CF. Extensive relief: +4 CF.

Tapestry Weaving (TL0). *Cloth* or *wicker* items can have a design made of colored strands integrated into them. Simple pattern, with commonly available colors: +2 CF. Complex pattern: +5 CF. Figurative design (e.g., writing, or images of people or animals): +10 CF. In all cases, add +1 CF for moderately costly colors or +5 CF for very expensive ones.

Gilding (TL1). *Hard goods* can be covered with a thin layer of precious metal leaf. Mere accents are +0.5 CF in copper, +2 CF in silver, or +20 CF in gold. *Triple* CF to guild the item completely!

Cloth of Gold/Silver (TL2). Long, thin strips of precious metal are wrapped around a fiber core and used to decorate *cloth* items. Multiply the CF for embroidery or a fringe by 3 for silver thread or by 30 for gold thread.

Enamel (TL2): *Metal* items aren't generally painted but are often enameled. Treat as figurative painting (see above) for CF purposes.

Etching (TL2). Any *metal* item can have a design chemically etched into it. Small design: +1.5 CF. Extensive etching: +4 CF.

Jewelry

Most pieces of jewelry are elaborate but functionally identical variations on several basic objects. Final value depends on workmanship and materials. This table lists the cost and weight (in pounds) of basic jewelry types, assuming they're made of *copper* or *bronze.*

Item	*Cost*	*Weight*	*Notes*
Beads (per foot)	$3	0.3	[1]
Bracelet	$7	0.3	
Chain (per foot)	$4	0.03	
Comb	$4	0.1	
Crown	$7	0.5	[2]
Fibula	$6	0.2	[3]
Piercing	$2	0.01	[4]
Plug	$2	0.05	[5]
Ring	$3	0.1	
Torc	$7	0.4	[6]

Notes

[1] String set with decorative beads or small plaques.

[2] Solid metal *circlet* for the head. A basic *tiara* could be considered a lightweight crown or an elaborate comb.

[3] Resembles a large safety pin. Used through Europe as both a fastener and an ornament.

[4] Small decoration on a tiny metal hook to fit through a pierced body part.

[5] Decorative block designed to stretch out a piercing into a larger hole.

[6] Solid metal neckpiece, popular in the Celtic world.

Size

Jewelry can be made larger: increase weight and cost proportionately. Indeed, *most* jewelry is larger; the items on the table are small examples of their kind. Pieces weighing more than 1 lb. are possible but unlikely – they're exorbitantly expensive *and* difficult to wear!

Decoration

Jewelry can have any option from *Decorated Equipment* (pp. 37-38) that suits hard goods or metal items. Apply CF as usual.

Materials

Jewelry may be made from materials other than copper or bronze:

Base Materials: With the general exceptions of chains and fibulas, most items may be made from carved wood, bone, shell, or ceramic, possibly held together by fabric or cord. -0.6 CF.

Precious Metals: Assume that silver costs $1,000 per pound and that gold is $20,000 per pound. That gold price is at the high end of the historical scale, however; a price as low as $7,000 a pound is plausible. For a silver item, multiply weight (in lbs.) by 1.15, and then calculate the metal cost by multiplying that weight by the cost per pound of silver. For a gold item, multiply weight by 2.1; cost is adjusted weight times the cost per pound of gold. Calculate these costs *after* applying decoration CF, and *add* them to the total price – the value of the work on a piece of gold or silver jewelry is vastly less than that of the metal itself!

Example: A large fibula might be twice the regular weight and therefore double cost: $12 and 0.4 lb. A small design etched into it gives +1.5 CF. Thus, it costs $12 × (1 + 1.5) = $30. Made from silver, it ends up weighing 0.4 × 1.15 = 0.46 lb. The silver costs an additional $460. Final cost is $490.

No gold-digging for me;
I take diamonds! We may be
off the gold standard someday.
– Mae West

Stones

Advanced TL0 societies used a few attractive stones, grinding them into ornaments, but widespread use of precious stones started after 5500 B.C. Semiprecious stones such as lapis lazuli, amethyst, turquoise, malachite, and hematite were cut into shapes, and even carved into relief to make seals and cameos.

Typically, harder stones were only polished during this period. Gems appearing through TL3 have naturally rounded or crystalline forms (diamonds, for example, are typically octahedra).

In mid-TL3, jewelers began to put gemstones on settings backed with polished silver foil, making them appear more luminous with reflected light. By the 14th century, they developed cutting wheels that could cleanly cut through gemstones, creating flat facets. Cutting facets in certain ways yielded interesting shapes and improved the reflection of light inside the gem. By TL4, even diamonds could be cut.

Bits of colored glass were frequently used as jewelry. For example, the light-blue "stones" in much ancient Egyptian jewelry were glass. Imitation pearls were made from tiny spheres of iridescent Venetian glass in the 16th century. In the 17th century, a French jeweler created an even more convincing imitation by covering glass spheres with ground fish scales. Treat glass and other imitation jewelry as inlay with semiprecious stones.

Gemstones have a nominal price given by:

$$\text{Price} = (\$1 \times C^2 + \$4 \times C) \times V$$

C is weight in carats. A dome-shaped one-carat stone is about 1/4" across.

V is a factor indicating the gemstone's relative quality and popularity. A *typical* value is 100. Cultural factors could easily change V by a factor of 10 in either direction for any type of stone. Indeed, cultural quirks are paramount in pricing gems. Different cultures preferred particular types or colors of stone, and without good assay tests, ancient gem buyers wouldn't distinguish sharply between minerals so long as they appeared similar. In many periods, a high-quality transparent quartz might fetch the same price as a rough diamond, even though the latter was vastly rarer and, geologically, an entirely different stone. Medieval Arabs were fond of pearls; the value of a matched pair of nigh-identical pearls could easily double beyond the prices of the individual pearls!

Entertainment

Though some moralists through history have denied it, play is one of the fundamental activities of mankind. Even the poorest hunter-gatherers played games and sat in rapt attention listening to storytellers. As societies became more complex, so did the tools they used to have fun.

Games and Toys

Dolls (TL0). Most societies fashioned small figurines from clay or disposable materials. These may have been used as toys. Made of clay: $4, 0.25 lb. Made of cloth, hair, or plant husks: $4, neg.

Board Games (TL1). There's evidence of board games by 2500 B.C., but they were probably played much earlier. Early Western games involved racing around the board, perhaps while capturing others' pieces as in backgammon, while *go* developed very early in China. Boards were typically wooden, with clay or stone pieces. $40, 3 lbs.

Dice (TL1). Dice made from lightly carved bones such as sheep's knuckles may go as far back as 3000 B.C. Most can roll 1-2 (games with "two-sided dice" usually involve rolling a handful and adding up values), but 1-4 and 1-6 weren't hard to find. Twenty-sided dice, invented by the Romans, date to as early as the second century A.D. Set of dice (up to five two-sided dice, or two or three dice with more sides): $6, neg.

Dominoes (TL1). Games played with numbered tiles were independently invented in Egypt and China by 1400 B.C. Set of around 30 tiles: $22, 1.5 lbs. Early cards-like games resembling *mah jong* were played with larger sets of domino-like tiles: $44, 3 lbs.

Kite (TL2). Made of paper or silk on a wooden frame, kites appeared in eastern Asia between 1000 and 500 B.C. In addition to recreational use, kites could be used as signal flags visible from a great distance, or to send small objects aloft and over obstacles. In a favorable wind, a typical kite could lift up to 0.5 lb. Kite a yard across, with 20 yards of string: $33, 2 lbs.

Cards (TL3). Playing cards date to the Middle Ages. Before printing (p. 48), they had to be individually painted: $400, 0.5 lb. Cost dropped when printing allowed them to be mass-produced (late TL4): $50, 0.5 lb.

Public Events and Facilities

Public Spectacles (TL1). Though sporting contests and theatrical performances are probably as old as humanity, purpose-built venues were a product of early civilizations. Nominal prices for an afternoon's entertainment could range from $3 for remote seats to $50 for seats near the action. Civic groups or politicians might buy and distribute *blocks* of seats. The best seating was often reserved for the ruling classes, making admission a benefit of Status.

Automata (TL2). Several empires had upper classes wealthy enough to spend considerable sums on mechanical amusements. Among the earliest such contrivances were small automated displays and vending machines, operated by the energy provided by a falling coin. A Roman hand-cranked theater, invented in the first century B.C., provided small audiences with a show lasting several minutes. The most expensive devices weren't commercial amusements, but were incorporated into temples and palaces to impress visitors: self-opening doors and so on, powered by hydraulics, servants behind the scenes, or occasionally steam (see *Rudimentary Steam,* p. 28). A simple contraption, such as a holy water vending machine, is at least $3,000, 50 lbs.; automated architectural features *start* at $10,000.

Bathhouse (TL2). Since heating water at home was expensive, many sophisticated low-tech societies had bathhouses. For a nominal fee (ranging from $1 for small baths, using individual wooden tubs, to $6 for grand ones, with pool-sized baths and multiple water temperatures), one could purchase a long bath in hot water. Bathhouses were typically segregated by sex either physically (men used one side, women the other) or in time (men and women alternated days). Even the smallest establishments provided other services – such as soap, massages, hairdressing, or snacks – for additional fees. Large ones might host shops, athletic grounds, or even libraries.

Optical Amusements (TL4). Two 16th-century inventions, the *camera obscura* (see ***GURPS Low-Tech Companion 1***) and the *magic lantern,* were mostly curiosities for wealthy scholars, but occasionally used as entertainment. Magic lanterns projected light from an enclosed source through an etched glass panel, casting an image on the wall of a darkened room. Admission to a viewing lasting up to an hour costs about $10 to $20.

Sporting Gear

Many historical sports, from running to wrestling, required no gear whatsoever; some societies even practiced these naked. Other activities, such as chariot racing and archery contests, used equipment, but nothing specialized for the sport; for example, there would be no difference between a bow for an archery competition and one for war. Some sports needed purpose-built gear, however.

Ball (TL0). Small ball for throwing and light stick games: $3, 0.25 lb. Large, soft ball suitable for games resembling soccer and rugby: $9, 1 lb.

Stick (TL0). Variations on the theme of knocking a ball through a goal with a stick have been independently invented across continents. Many sticks have a feature on the end suitable for the sports for which they're designed; e.g., a curved blade for hockey, a paddle or a net for tennis, or a mallet head for polo. $25, 1 lb.

Maya Ball Game Kit (TL1). The Maya practiced a sport involving athletes wearing heavily padded loincloths knocking a large rubber ball around an I-shaped court. Ball: $40, 6 lbs. Uniform: $18, 1.5 lbs. (Variants of the game had the players wear arm and leg protection; treat as leather limb armor.)

Discus (TL2). A Greek throwing discus, made of bronze, might average $30, 6 lbs., but examples from half to double that weight and cost aren't unheard of. An athletic discus isn't designed for point accuracy; combat stats are as for a fighting version (p. 77), but Acc is 0.

Fireworks

Fire-driven noisemakers date to the second century B.C. (some woods, like bamboo, have pockets of air and sap that explode if heated), but real fireworks originated around the 10th century A.D., in China. Knowledge of fireworks spread along with gunpowder, reaching Europe by the later Crusades (see *Black Powder,* pp. 85-87). Static displays, involving figurative frames covered with fireworks, became popular in the West, while noisemaking capabilities were particularly prized in the East. Continuous linked fuses weren't developed until TL5; TL3-4 fireworks were lit individually or in tight clusters by artisans wearing damp clothes or layers of fresh green leaves for protection from sparks.

By late TL3, most fireworks fell into four categories:

Fountain (TL3). A slow-burning powder in a tube that's open at one end, producing a fountain of flame and sparks for 1-2 minutes. Does 1 point of burning damage per second to anyone holding it, but can be used as a jet (Range 3), likewise doing 1 point of burning damage per second to its target. $40, 1.5 lbs.

Ground Rat (TL3). A faster-burning powder in an open-ended tube. Essentially an underpowered rocket, the ground rat skimmed unpredictably over the ground for 20-30 seconds. If held, damage is as for a fountain. $5, 0.1 lb.

Noisemaker (TL3). Gunpowder in an enclosed paper tube. Explodes with a loud noise, doing 1d-3 burning damage if in direct contact with someone when it goes off. $1, 0.05 lb.

Rocket (TL3). A development of the ground rat producing enough thrust to get off the ground. Rockets have a range of up to 75 yards, but are unguided; use Gunner (Rockets) at -5 (maximum skill 9) to hit anything; see *Rockets* (p. 87). $10, 0.5 lb. Exploding rockets (TL4) have a separate compartment that blows up when the rocket reaches its height (1d cr ex, if anything fragile is in the vicinity). $20, 1 lb.

Chapter Four
Information Technologies

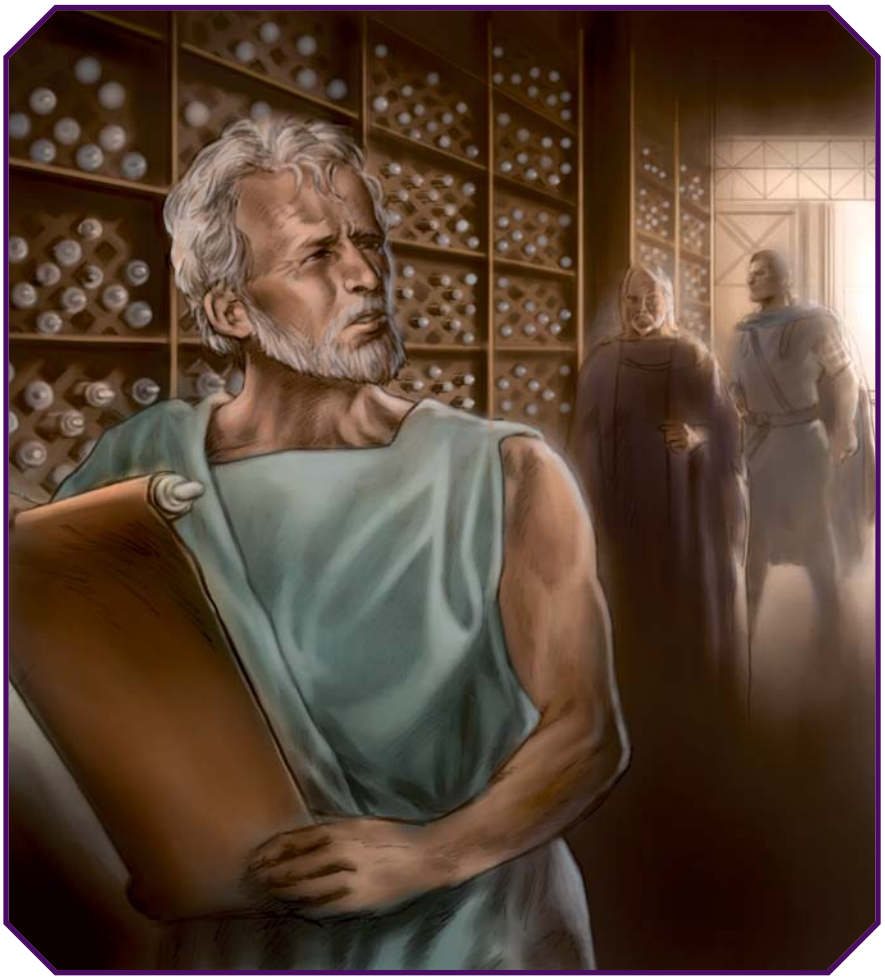
"Xenops," said Aristoboulos, "my young friend would know more of Archimedes' defense of Syracuse against the Roman fleet."

Martialis looked about in amazement. He had never seen so many books; in fact, he had scarcely thought there could be that many in the world. The Museum, he thought, was to knowledge what a king's treasure-house was to the kingdom's wealth. He wondered how they could ever find anything. It was like being in one of the memory houses his tutor had told him of while he was studying oratory – but rather than assemblages of different objects, the room held shelf after shelf of scrolls, each in its own niche.

"For that," the very old Greek answered, "he wants Lucian's account, I think."

Martialis expected him to close his eyes, searching his memory. But instead, Xenops went to a smaller rack of scrolls, looked briefly at one, replaced it, and then searched through another until he found whatever he was looking for.

"Right this way, Captain," he said, and walked to a shelf in another room.



Most present-day technologies for gathering, recording, transmitting, and otherwise working with information are electronic. But useful applications of electricity date back only to TL5, which is also when mechanical calculators entered widespread use. In TL0-4 societies, the main information-processing system is the *mind*. Low-tech information technologies are aids to human perception, memory, thought, and communication. All are LC4.

Observation

The most important observational device in low-tech societies is the *eye*. There are no artificial visual sensors, and there's no way to form images using wavelengths other than visible ones. Optical technologies that aid human vision become theoretically possible with the invention of glass, and the Greeks and Romans had a decent understanding of the optics of mirrors, or *catoptrics*. However, sophisticated optical devices only appear at TL4.

Unless otherwise stated, TL3-4 optical instruments give -2 to Vision and related rolls; see *Defective Vision* (p. 42). As well, vision is limited by the horizon; see *Visual Signals* (pp. 48-49) and the *Horizon Table* (p. 49).

Technologies aiding other senses are largely absent at TL0-4, although TL4 does see the first mention of the ear trumpet (below).

Eyeglasses (TL3)

Eyeglasses were invented in Italy around 1285 A.D. Convex lenses corrected farsightedness, including difficulty in reading with increasing age. Nicholas of Cusa described using concave lenses to correct nearsightedness in a treatise written 1453-1458; glasses for the nearsighted are TL4. Treat either sort as a Mitigator (p. B112) for its form of Bad Sight (p. B123). At TL3-4, glasses are held up to the eyes by the frame or a handle (a *lorgnette* design), occupying a hand, or are clamped to the nose (a *pince-nez* design). Pince-nez fall off on a roll of 12 or less on 3d if the wearer moves faster than a walk; they're often attached to a chain. $100, 0.25 lb.

Defective Vision

At TL4, mirrors and lenses distort the images they deliver. Optical instruments therefore penalize Vision and vision-dependent skill rolls. While multiple lenses or mirrors with different properties can cancel out each other's distortions, this technology isn't perfected until TL5. Nearly all TL4 instruments give penalties:

- *Spherical aberration* occurs because magnifying lenses and mirrors have curved surfaces, which blur the images they form, for -1 (quality). Poorly made specimens may have other geometric irregularities, such as *astigmatism,* that give an additional -1 or -2.
- *Chromatic aberration* occurs because lenses have different focal lengths for light of different wavelengths, turning a point of white light into a tiny blur of different colors. This gives another -1 (quality).
- Lenses demand high-quality glass, without bubbles or uneven density. A lens made from ordinary glass – even if perfectly formed – gives -3 (quality) for poor material, in addition to the above penalties.

Using a device that gives such penalties causes fatigue through eyestrain: 1 FP/5 minutes. For continued use after reaching 0 FP, or for *any* use of optics with a penalty worse than -2, roll vs. HT after every 5 minutes. Failure means moderate pain (p. B428); if use continues, later failures worsen this to severe pain, then terrible pain, and finally agony. Critical failures cause immediate agony! Pain endures until the sufferer regains positive FP through rest, or a minimum of 10 minutes.

Ear Trumpet (TL4)

The ear trumpet has a wide, flaring horn at the end of a conical tube. The narrow end is held to the ear. By gathering sound waves over a large area, it amplifies a faint sound for the listener. Originally developed for use at sea, to hear shouts from other ships, it was later adopted by the hard of hearing to mitigate their disability. Creative spies will think of other uses! Increases the range at which a sound can be heard 8× (see *Hearing,* p. B358). $15, 2 lbs.

Microscope (TL4)

In 1609, Dutch lens grinder Hans Lippershey invented the microscope, which used lenses to see nearby small objects. In 1673, Anton van Leeuwenhoek began reporting his biological discoveries, which included microorganisms and human sperm. Early microscopes have 40× magnification (eliminating -9 in size penalties for an object on a slide). Chromatic and spherical aberration impose Vision and skill penalties of -2 (quality). $200, 2 lbs.

Spyglass (TL4)

The first spyglass was invented in 1608 by Hans Lippershey, who received a large bounty from the Dutch government. A spyglass has two concentric tubes, which hold two lenses set fairly close together; sliding them back and forth adjusts the magnification for different ranges. It's substantial enough to serve as a well-balanced light club, but such abuse means it will never work as a spyglass again!

This model has 4× magnification, allowing the user to ignore -2 in range penalties to Vision rolls while scanning for a particular object. After spotting his target, he can take an Aim maneuver to focus on it; this eliminates -4 in range penalties for *that* target, but gives no bonus to see *other* things. Spyglasses and telescopes also have Bulk scores, like ranged weapons (p. B270); this one has Bulk -2. Bulk penalizes both Holdout rolls and Vision rolls to scan the environment for a particular object. To offset the latter penalty, take extra time to scan (p. B346). $100, 4 lbs.

Measurement

Measurement assigns numerical values to things that can't be counted – lengths, weights, times, etc. – by choosing a unit and counting how many units are equal to the thing being measured. The earliest measurements were rough estimates, such as using a human forearm to measure length; one man's forearm might be longer than another's, but the difference wasn't enough to matter in most TL0 societies. With the growth of trade and the emergence of bureaucracy at TL1, more exact measures were needed; using the wrong measurement might cost someone money! Early governments often prescribed what units should be used in their marketplaces, and inspected measuring devices to make sure they were accurate. The balance (p. 44) became a symbol of justice very early in history.

Angle

Measurement of angles started at TL0 with awareness of how far above the horizon the sun has traveled (which also measures time) and of the four cardinal directions. At TL1, right angles were used in architecture and civil engineering. The ancient Mesopotamians divided the circle into six parts, and subdivided each part into 60 *degrees* (a total of 360 degrees) and each degree into 60 *minutes*. At TL4, minutes were further divided into 60 *seconds*. Instruments for angular measurement were important in surveying and, later, in geometry, astronomy, and navigation.

Level (TL1). An A-shaped frame with a plumb bob hanging from the apex. When it's placed on a flat surface, the plumb line's deflection from a marked center point on the crossbar indicates the slope. $15, 4 lbs.

Surveyor's Cross (TL1). This tall staff (also called a *groma*) has a horizontally balanced cross on top and a sharp spike at the bottom for planting it firmly in the ground. Adjustable plumb bobs on the cross' ends keep it level in a plane. Sighting along the plane lets the user mark spots at the same elevation; sighting with the plumb lines marks an alignment. $75, 6 lbs.

Chorobates (TL2). A long (up to 20'), narrow bench with a water trough and plumb bobs hanging from the bottom. Both the water level and the angle of the bobs provide a level reading. Typically used only on large-scale projects, such as road and aqueduct construction. A 10' chorobates: $540, 145 lbs.

Cross-Staff (TL2). A short (3'-4') staff with a sliding crossbar. The user points the staff at one point and slides the crossbar until it appears to touch another desired point. The distance along the staff indicates the visual angle between the two points. $45, 4 lbs.

Dioptra (late TL2). A tube or set of sights on a platform whose position can be adjusted by screws. The dioptra can give vertical and horizontal angles from the observation point to an object – but only for *stationary* objects, due to the adjustment time (at least 2-3 minutes per observation). $120, 5 lbs.

Astrolabe (TL3). Developed in the second century A.D., the astrolabe came into widespread use in the Muslim Near East. It has four parts. The *mater* is a flat plate 5"-10" in diameter, marked with celestial coordinates for a given latitude, centered on the pole and including the horizon, the meridian, and altitude and azimuth circles. Some astrolabes have interchangeable plates for different latitudes. On top of this is the *rete,* a metal grid with pointers for different stars. On the back is the *alidade,* a rotating pointer with a sighting hole used to point it at a particular star. A *pin* through the center holds the other parts together. The astrolabe doesn't merely measure angles – it can perform hundreds of computations. Treat it as basic equipment for Astronomy. Small astrolabe: $250, 5 lbs. Model with interchangeable plates: $200, 4 lbs., plus $100, 1 lb. per plate.

Kamal (TL3). Used by Muslim navigators to measure a celestial body's height above the northern or southern horizon. A square board is held at a distance where it just spans the visible gap between the body and the horizon; the length of a cord attached to it indicates the angle. $25, 1 lb.

Quadrant (TL3). A piece of solid material in the shape of a quarter circle, with degrees marked along the edge. The user sights on a celestial body along one edge; a plumb bob hangs down vertically, indicating the body's elevation above the horizon in degrees. It can also be used to estimate an object's height via trigonometry. $35, 3 lbs. (Much larger quadrants are used in TL3 astronomical observatories; see ***GURPS Low-Tech Companion 1.***)

Gunner's Quadrant (TL4). Invented in 1545 by Tartaglia, this gadget has a long arm attached to the gun barrel and a short arm at right angles to it. A plumb bob indicates the gun's elevation, from which range can be estimated. $45, 4 lbs.

Length

Primitive units of length are mostly based on the human body. Common examples are the *hand* (4", used to measure the height of horses), the *foot,* and the *cubit* (the distance from elbow to fingertips, typically 18").

Measuring Rod (TL1). Standardized measures of length came into use in the oldest civilizations, including Egypt, Sumer, and the Indus Valley. Egypt had a standard royal cubit, a 21" granite rod to which other measuring rods could be compared. The Egyptian cubit rod was divided into 28 digits, and was often marked with fractions of a digit, from 1/2 down to 1/16. $5, 0.5 lb.

Odometer (TL2). A cart or chariot wheel turns a gear as it rolls; after every mile, a pebble drops into a box, giving a running count of miles traveled. Vitruvius described this mechanism around 15 B.C., but Alexander the Great's chroniclers gave travel distances accurate to better than 1 mile in 250, which were almost certainly mechanically measured. Chinese inventor Zhang Heng (78-139 A.D.) is credited with a similar device. $100, 10 lbs.

Area

There's no *direct* way to measure area. A rectangle's area can be found by measuring its length and width, and multiplying them together. Areas of other shapes can be broken up into rectangles. Geometry started out as formulas for the area of fields of different shapes. Land measurement is the task of surveyors.

Surveyor's Kit (TL2). A well-equipped surveyor from Rome to the Renaissance has a surveyor's cross, a dioptra, two 10' poles, 120' of cord (stiffened with wax to retain its length), and 20 posts to mark points on the ground. $245, 40 lbs.

Volume

Volume *can* be measured directly, by filling a standard container with water or sand and pouring it into a larger container repeatedly. It can also be calculated geometrically – especially when the larger container is full and emptying it isn't convenient. Volume measurement was an outgrowth of large-scale agriculture at TL1.

Measuring Basket or Jug (TL1). A basket, cup, jug, or jar with a standard volume, normally marked on the outside.

Subdivisions are estimated, not measured; early containers are opaque, and gradations on the interior surface would be awkward to read. Sizes vary from tiny cups to 35-cubic-foot barrels, or *tuns* (the origin of the word "ton"). See *Containers and Storage* (p. 34).

Weight

Units of weight originated at TL1, as an outgrowth of trade. The smallest unit of weight is often one grain of the local staple food.

Balance (TL1). The original weighing device, with two pans hanging from opposite ends of a beam that pivots on a central point. One pan holds the thing being weighed; the other holds standardized weights, which are counted when the pans are in equilibrium. Balances come in varied sizes; the ones described here are portable models, with lead weights. They can't weigh anything heavier than the total of their counterweights! Small balance: $25, 1 lb. (set of lead weights: $10, 5 lbs.). Larger balance: $75, 4 lbs. (set of lead weights: $50, 20 lbs.).

Steelyard (TL2). The type of scale that many people have encountered in a doctor's office: The person or object being weighed rests on a platform or in a pan, and a relatively small counterweight is slid along a beam until its leverage balances the weight. The counterweight's position is read as a weight with the help of numbered gradations. This device depends on a good understanding of leverage. A small steelyard was found in the ruins of Pompeii. Steelyard that can weigh up to 300 lbs.: $100, 20 lbs. (weights included).

Time

Time, like length, has a natural starting place for measurements: the apparent movement of heavenly bodies across the sky. Every society knows about the day; most societies use the month and/or the year. Keeping track of time on this scale is done with calendars.

Times shorter than a day become important in TL1 societies, for such purposes as keeping records of how long people have worked. Tracking the sun across the sky offers one way to do this, but a variety of inventions provide more precise measures.

Clocks

A clock measures time on a continuing basis throughout the day. There are two styles of measuring time. One divides day and night each into the same number of hours, and makes daytime hours longer in summer and nighttime hours longer in winter. The other keeps every hour the same length year-round.

Mechanical clocks can be made more accurate with more precise construction. Use the equipment grades on p. B345. Good-quality timepieces are twice as accurate; fine-quality ones are five times as accurate.

Clepsydra (TL1). Invented in Egypt around 1550 B.C., the water clock is a vessel filled with water, which flows out through a small hole in the bottom. In Egyptian clocks, this was drilled through a gem set into a larger opening. Lines at intervals down the inside mark off the hours. Water flows out more slowly as its level falls; a properly designed clepsydra has tapered sides to compensate. The clepsydra measures fixed-length hours. However, it can be built with different scales for different times of year, to give variable hours. Flow speed varies with temperature and humidity; the clepsydra is accurate to the nearest 10 minutes. $500, 15 lbs.

Sundial (TL1). Another Egyptian invention, dating to 1500 B.C., the sundial consists of a vertical projection, or *gnomon,* that casts a shadow onto a painted or carved surface. The shadow's position marks the hours. The sundial measures hours of variable length. Sundials are almost perfectly accurate at the latitude for which they're made. However, they only work during the day – and only if there's enough sunlight to cast a shadow. $300, 95 lbs.

Portable Sundial (TL2). A more advanced Greek invention for telling time: a sundial small enough to be carried easily. To tell time in a new location, it must be aligned to the noonday sun. $100, 2 lbs.

Regulated Clepsydra (TL2). The Greek inventor Ctesibius devised a clepsydra that avoided the flow rate changing as the tank emptied. A float valve in the tank (like the one in a toilet tank) let in more water as the level sank. Time was measured by the water level in a second tank that received the outflow. Accurate to the nearest 2 minutes. $750, 25 lbs.

Graduated Candle (TL3). First mentioned in Chinese writings of the sixth century A.D.; the form described here dates to the reign of Alfred the Great of England (878). Consists of six 12" candles, each of which takes 4 hours to burn down; each candle is divided into 12 20-minute sections. The burning candle is kept in a case with translucent horn sides. This and later clocks measure hours of fixed length. Candles: $40, 6 lbs. Case: $15, 0.7 lb.

Water-Driven Clock (TL3). The Chinese experimented with mechanical clocks that worked like later European weight-driven clocks, but with a water tank rather than a solid weight. A regulated water flow drove a mill wheel that turned gears. The invention never came into common use.

Weight-Driven Clock (TL3). A clock powered by hanging weights, whose fall turns a shaft within the mechanism. Lacking a pendulum or other regulator, it's accurate only to the nearest hour, which it signals by ringing a bell. Some models had dials, but these functioned as astronomical displays rather than for keeping time. Each clock was individually made and should be treated as a prototype, but on average: $450, 100 lbs.

Pendulum Clock (TL4). This was invented by Dutch scientist Christiaan Huygens in 1656, based on the discovery that a pendulum always takes the same amount of time to swing back and forth. Such clocks could achieve an accuracy of 1 minute in a day. Wall or mantel clock: $300, 20 lbs. Longcase ("grandfather") clock: $600, 100 lbs.

Spring-Driven Clock (TL4). In 1660, Robert Hooke and Christiaan Huygens (they had a dispute over priority) invented the *balance spring* as a way of making the *balance wheel* reliable; this performed the functions of a pendulum, but was much smaller. It made possible the first reliable pocket watches, accurate to 10 minutes a day. $100, neg.

Timers

A timer doesn't keep running for as long as a clock – usually an hour or less. It can serve as an improvised clock, but its main use is to measure a rapid process (like the later stop watch) or to monitor the time assigned to a task.

Miniature Clepsydra (TL3). Invented by Chinese artificer Li Lan in 450, this variant on the water clock was made of jade and used mercury as its working fluid. It holds enough mercury to run for two Chinese hours (28 minutes 48 seconds). For its time, it's an ultra-precision instrument, measuring intervals as short as 1/20 of a Chinese hour. $500, 8 lbs.

Sandglass (TL3). The oldest record of this device is a painting by Ambrogio Lorenzetti, dated 1338. A sandglass consists of two glass vessels joined by a narrow neck through which a granular material flows at a steady rate. Despite the name, ordinary sand isn't suitable; fine marble dust works better. Sandglasses – being relatively unaffected by conditions at sea – were used both in navigation (pp. 50-52) and to time watches. Standard half-hour sandglass: $50, 3 lbs.

Temperature and Pressure

Scientific experimenters at TL4 invented devices to measure other aspects of the physical world. These early instruments were often slow and inaccurate, but the very idea of measuring heat or pressure led to a revolution in physics. The thermometer and barometer are experimental prototypes, not commercial products, in this period.

Barometer (TL4). In 1643, Evangelista Torricelli invented the barometer: a column of mercury, the height of which fluctuated with changing air pressure. In 1660, Otto von Guericke used it to predict the weather. This design is a mercury-filled glass tube with height gradations, sealed at the top but open to a pool of mercury at the bottom.

Thermometer (TL4). In 1600, Galileo devised an experimental thermometer that used air as the working fluid. Several other models were developed in the 17th century, culminating with Gabriel Fahrenheit's alcohol thermometer in 1709. A thermometer can ensure accurate temperature measurement for processes such as distillation (see *Distillation,* pp. 11-12).

Writing and Records

Recordkeeping preserves knowledge, compensating for human forgetfulness. Better ways of maintaining records make keeping track of events and relationships easier. This facilitates the division of labor, which in turn lets human societies grow more complex and accumulate specialized lore – notably *technological* know-how. Technological knowledge was itself recorded in such forms as Egyptian medical guides and Greek treatises on artillery.

Prices of records – be they pictures, maps, or written documents – vary a great deal. See ***GURPS Low-Tech Companion 1*** for suggestions.

Pictures

Pictures go back to prehistory; Paleolithic cave paintings are regarded as art treasures today. The ability to draw or paint an image of a person, animal, or object, given suitable pigments, is TL0. The skill involved is Artist (Drawing, Illumination, *or* Painting).

In the Renaissance (TL4), a more sophisticated technique entered general use (though some Greek painters anticipated it at TL2): *perspective.* This projects space onto a flat surface to achieve a more convincing illusion – for example, the sides of a road coming together at the horizon. Renaissance painters delighted in tricks of perspective, such as Mantegna's *Dead Christ* (1466), with its feet toward the viewer.

Maps and Globes

People began drawing – or *building* – maps at TL0. These emphasized directions and the paths joining different places. Land-area measurement at TL1, enabled by tools such as the surveyor's cross (p. 43), led to the practice of drawing maps to scale.

All flat maps of the Earth are inaccurate, because there's no way to project a sphere onto a plane without distortion. The best maps are *globes.* Globes entered use at TL2, after Greek geometer Eratosthenes realized that solar rays at different latitudes struck the ground at different angles because the Earth's surface is curved. The first globe was made by Crates of Mallus around 150 B.C.; the oldest surviving one is part of a statue, the Farnese Atlas, sculpted in 140 A.D. Muslim scholars began making globes in the ninth century. Europeans resumed the practice (appropriately!) in 1492; globes became widespread at TL4.

The mathematics of map projections was developed in the ancient world by Marinos of Tyre, and popularized by Claudius Ptolemaeus. Systematic study of map projections took off at TL4. The best-known approach, the *Mercator projection,* was first used in 1569. See *Navigation* (p. 52) for more on maps.

With the development of printing at TL4, the publication of *atlases* made maps widely available.

Writing Media

Writing was invented at TL1, in the cities of the ancient Near East, China, and Mesoamerica. Only the Peruvians attained urbanization without written records (they relied on knotted cords, called *quipu,* as memory aids). Written records can be kept using a variety of media.

Hard Solid Media

Practically any solid material can have writing impressed on it. Leather, wood, ivory, and stone can be cut into letters; early Chinese writing survives on carved bones and pieces of tortoise shell. With metals, it's more efficient to prepare a mold and pour in molten metal.

Stonecutting (TL1) is the most common way of recording text, because stone lasts longer than organic materials while being easier to work with than metal. Inscriptions take a long time and are limited to short texts; each line of text is a day's work.

Small pieces of carved stone can be used to press a design into clay or molten wax to seal a document, or as a signature.

Cylinder Seal (TL1). Invented in ancient Sumer, cylinder seals were rolled over moist clay – and later, wax – to leave the impression of a short inscription, often a signature. Typical cylinder seals are carved from semiprecious stones. $20, neg.

Signet Ring (TL2). Performs the same function as a cylinder seal, but the image is carved into the flat face of the stone of a ring. The wearer makes a fist and presses the ring into the wax that seals a letter. $30, neg.

Soft Solid Media

Soft solid media are erasable and reusable by smoothing their surfaces out. They're often used to take notes and prepare drafts, which can be corrected before being transferred to permanent media. Writing is done using a stylus.

Clay Tablet (TL1). The oldest writing medium, developed in ancient Mesopotamia around 3200 B.C. Clay tablets have limited reuses, because they dry and harden when exposed to air. Size varies, but a *typical* tablet is 12" high, 6" wide, and 1" thick; holds 100 words; and weighs 5 lbs. The tablet itself normally costs nothing.

Stylus (TL1). A rigid tool – usually reed or wood – used to make impressions in a soft surface. One end is sharp for writing; the other is blunt for rubbing out mistakes. $3, neg. A *metal* stylus (TL2) can be used as an improvised dagger (see *Improvised Weapons,* p. 63): $6, neg.

Wax Tablet (TL2). This was the standard medium for Roman clerical workers. A very shallow box holds a layer of wax, which can be written on with a stylus. Two or more tablets can be linked together by hinges. Small tablet (5"×6") that holds about 60 words: $7, 0.2 lb. Large tablet (8"×12") that holds about 200 words: $20, 0.5 lb. Wealthy people use tablets backed with ivory instead of wood: +4 CF.

Flat Media

Flat media are written on not by cutting into their surfaces, but by applying pigment to them. Normally this is ink, applied with a brush or a pen.

Barkcloth (TL0). Mostly used for clothing, but can be drawn upon. Gives -2 (quality) to legibility. One pound costs $8 and is 25 letter-sized sheets.

Leather (TL1). Leather can be dyed, painted, drawn on, or written on, but it isn't ideal for writing; -2 (quality) to legibility. One pound costs $8 and is 25 sheets.

Papyrus (TL1). A standard medium in ancient Egypt. Sheets can be glued together to form a long strip usable in a scroll. Normally, only one side is written on. Papyrus survives nearly indefinitely in desert climates, but breaks down after a century in moister areas. One pound costs $12 and is 50 sheets.

Potsherds (TL1). The ancient Egyptians first used broken pieces of pottery for note-taking and school exercises; the Athenians later used them as ballots. Potsherds are free anywhere pottery is used. A potsherd big enough for 100 words weighs 0.75 lb.

Leaves, Stems, and Bark (TL2). Many plant materials were used as media without being processed into paper; e.g., palm leaves in India, bamboo strips in China (typically 9"×1/2"), and birch-bark strips for Buddhist texts in India. These are free in the regions where they're used; roll vs. Naturalist, Professional Skill (Scribe), or Survival to locate a supply. Bamboo strips bound together into "pages" are about 1/8" thick, and $0.25, 0.1 lb. per page.

Parchment and Vellum (TL2). Parchment and vellum are animal skins treated to produce superior writing materials. Writing on vellum gives +1 (quality) to legibility. One pound of parchment costs $12 and is 20 sheets; one pound of vellum costs $60 and is 50 sheets.

Paper (TL3). Invented in China by the first century B.C., paper spread worldwide as a medium for writing and later for printing, reaching the Near East by 800 A.D. and Europe over the next few centuries. At TL4, the Chinese developed a less-expensive paper based on bamboo, which helped make books cheaper in China than in Europe. One pound costs $6 and is 100 sheets. *Halve* cost for inexpensive paper at TL4.

Palimpsests

Parchment and vellum (above) are expensive; discarding a botched copying job leaves the scribe out a lot of money. Scribes developed methods of recycling used parchment. A parchment sheet that has been erased and reused is called a *palimpsest.* Hasty cleaning costs 20% of the original price, and produces poor-quality writing material (-2 to legibility). Thorough cleaning costs 50% of the new price, and produces fair-quality writing material (-1 to legibility).

Writing Tools

Brush (TL1). A stick with animal-hair bristles tied to it. $2, neg.

Ink (TL1). This water-based solution contains a pigment (e.g., soot) and a binder to keep it from settling out (e.g., gum arabic or lacquer). Western inks are stored in liquid form; a pint is $2.50, 1 lb. Asian inks are produced in sticks, used with an ink stone and water; enough for a pint of ink is $2.50, 1 oz. These prices purchase black or brown ink. Other earth tones or red: +1 CF. Rarer colors, such as violet: +4 CF.

Ink Stone (TL1). A shallow stone dish for use with ink sticks. The scribe pours a bit of water into the dish and grinds an ink stick into it until it reaches the desired darkness. $20, 2 lbs.

Pen (TL1). This is a tube with a slit and small hollow near the tip to hold ink. At TL1, pens are typically reeds; metal pens appear at TL2, and quills at TL3. Reed or cheap quill pen that will last for 20 pages: $0.25, neg. High-quality quill pen that can be resharpened every 20 pages up to 100 pages: $0.75, neg. Metal pen that won't wear out: $4, neg.

Pumice (TL1). Lightweight volcanic stone used as an eraser. $3, 0.5 lb.

Stylus (TL2). A metal stylus (see *Soft Solid Media,* p. 46) can be used to trace faint lines on flat media. Lead, copper, silver (+4 CF), and gold (+99 CF) are all used. Silver is preferred, because its lines can't be rubbed off. Works best with paper treated with clay or organic primers.

Pencil (TL4). The discovery of a large graphite deposit in Borrowdale, England in 1564 led to the use of graphite sticks for writing. The manufacture of wooden pencils began in Nuremburg, Germany in 1662. A dozen pencils: $4, 0.25 lb.

Scribal Equipment

Egyptian Scribe's Palette (TL1). Ancient Egyptian scribes carried a case with two depressions for different inks (usually black and red) and a compartment for several pens. While writing, the scribe slung the cord over his shoulder, resting the ink compartments on his chest. $9, 1.5 lbs.

Medieval Scribal Kit (TL3). Medieval and Renaissance European scribes used tools to keep their writing aligned. A typical kit included a ruler, a square, and adjustable calipers. $24, 3 lbs.

Writing Box (TL4). Early scribes wrote on their laps, but during the Middle Ages, special furniture was designed for writing, and by the Renaissance it became portable. The writing box provides a sloping surface on which to write and drawers on the sides to hold paper, ink, and writing tools, but closes up into a small rectangular case. $50, 2 lbs.

Written Documents

Advances in writing include not only new media, but also innovative ways of organizing a document and novel tools for locating and searching it.

Document Formats

From the beginning of writing at TL1 until the emergence of hypertext at TL8, three main document formats have been used:

Tablet (TL1). The oldest form of document, dating to the early Bronze Age: a flat piece of material – such as clay – with characters marked on it or cut into it (see *Soft Solid Media,* p. 46). Each page is separate. Tablets are mostly used for administrative records, where one tablet suffices to hold all the information on a particular case. Royal scribes may build up archives containing a king's letters to and from other rulers, chronicles of his reign and conquests, or even literary works such as the story of Gilgamesh (recorded around 1200 B.C.). Such documents may extend over several tablets that must be kept together.

Scroll (late TL1/TL2). A piece of flexible material – a foot wide or less, but many feet long – attached to two cylinders and rolled up on them. Typical materials are papyrus and parchment. The reader picks up the scroll with all the material wrapped around one cylinder, pulls the cylinders apart to expose the start of the text, and rolls it onto the other cylinder as he reads. A typical scroll is 12" wide and 200" long, and has room for about 5,000 words (about as long as a book chapter).

Codex (late TL2/TL3). Developed in the Roman Empire, the codex has been the standard form of book ever since. It consists of a stack of rectangular sheets of paper or a similar material, fastened together along one edge, inside a thick, usually rigid protective cover. This format can hold the equivalent of dozens of scrolls.

Search Tools

Even within a single book, it can be tricky to locate a specific piece of information – that's why ***GURPS*** supplements have indexes! In an archive, finding the book with the right piece of information can be even more challenging. Searching written material generally requires a success roll.

Modifiers to ***all*** *rolls to search written material:* -6 for Broken written comprehension of the language of the material, or -2 for Accented; +3 if Single-Minded (p. B85), except when reading just a *single* tablet, page, or loose file; modifiers for *Time Spent* (p. B346), if taking more or less than the listed base time – but with Speed-Reading (p. B222), your base time is the standard base time divided by 1 + (skill/10).

- Finding a piece of information in a single document requires only an IQ roll to read the document. You can substitute an Administration roll for an administrative document, but at -2 if it isn't a type with which you're familiar. Base time is a minute for a tablet or standard form; an hour for a scroll, book chapter, or long article; or a day for a codex.
- Finding a tablet, a form or other loose page, or a folder in an entire archive requires a Research roll. You can substitute Administration in an administrative archive, but at -2 for unfamiliarity if you don't use that specific kind of archive regularly. This assumes an archive with a catalog; roll at -5 for an organized archive without a catalog, or at -10 for a pile of random documents. Base time averages 4 hours. Actually reading the document takes negligible time, and neither requires a success roll nor modifies the archival search roll.
- Finding information in a scroll or book that's stored in an archive follows the same basic rules. However, it's also necessary to read the book! Rather than asking for two or more rolls, the GM should decide what kind of book is typical of the archive, add the base time for reading it to the base time for searching the archive, and apply any quality modifiers for a typical book (see below) to the modifiers for the archive to determine the overall difficulty of finding the information. Critical success means the researcher finds the exact location of the information in the document, and doesn't need the extra time to read the document; critical failure means he finds a really fascinating book that tells him nothing about his original question.

For documents that aren't specially prepared to aid searches, all rolls are made at -5 (quality), in addition to any applicable modifiers above. Scribes have invented numerous "devices" to assist searches and reduce or eliminate this penalty:

Colophon (TL1). A short line in the upper margin of a tablet or a page, identifying its contents. This may be a short title, the first words of the text, the name of a person it refers to, or an identifying number. Colophons on tablets or loose pages give -2 (quality) when searching an archive for the right document. Colophons on bound pages in a codex give -2 (quality) when searching for a specific topic.

Catalog (TL2). A list of books or other documents in an archive, in the form of either a codex or loose records. At TL2-4, catalogs aren't standardized; a new archive's catalog gives -2 for unfamiliarity. With a familiar catalog, the roll is unmodified.

Line Numbers (TL2). A number in the margin of a scroll, a page in a codex, or a loose page such as a legal document. Not useful in searching for a topic, but can be used to find the same topic again. Roll vs. IQ to remember the line number; if you wrote it down, or someone gives it to you, success is automatic.

Table of Contents (TL2). A list of the main sections into which a long document is divided, placed at the beginning. It usually has line or page numbers. A reader can identify the right section and search only that section, saving time. Any table of contents in a scroll, or a table of contents without page numbers (below) in a codex, gives -2 (quality) to the search roll; a table of contents with page numbers gives an unmodified roll. At TL4, a book may have an *analytical table of contents,* with a detailed description of what's in each chapter; this gives +1 (quality) to searches for information in the document.

Page Numbers (late TL2/TL3). A number in a standard place on the pages of a codex. This gives the same benefits as line numbers for locating a previously found topic, but for codices rather than scrolls. Page numbers make a table of contents more useful and make an index (below) possible.

Index (TL3). Usually placed at the back of a codex, an index is a detailed list of topics discussed, with page numbers. Benefits are similar to those from a table of contents, but even greater: the researcher need only search 2d pages in the book. An index allows unmodified rolls to search a book; an exceptionally well-prepared index in an expensive scholarly book gives +1 (quality) to the roll, cumulative with the benefit of an analytical table of contents, if any.

Printing

At TL3, the Chinese developed block printing, in which a page of writing was carved into a block of wood. The oldest surviving printed book is a Tibetan sutra dated to 868 A.D. Europeans began using block printing around 1400.

A Chinese inventor, Bi Sheng, developed movable type – made from carved wood – in 1051. This didn't enter widespread use until the 1400s, and coexisted with block printing long after. In Europe, movable type was invented independently, probably by Johannes Gutenberg in 1450, and became the standard printing method, although woodblocks remained in use for material such as drawings, maps, and playing cards (see *Games and Toys,* p. 40).

Printing Blocks (TL3). A printing block is a sheet of wood, or occasionally another material, carved into the design of a printed page. The printer rubs ink onto the design's raised parts with a brush, lays paper on top, and runs a dry brush over the back of the paper to make it pick up the ink. This method can produce 1,500 copies per day. Each block must be carved separately, typically from pear wood. *Both* sides may be carved – with designs for different pages – to save money. $15, 2 lbs.

Hand-Screw Press (TL4). The real strength of this early press isn't its speed but its ruggedness – it requires nothing more than a weighty box of type, a large hand screw, and a wooden frame. A press can turn out 250 pages per hour, but only if everything is working right; the historical average was around 1,000 pages per day. With typecase box: $2,500, 1,000 lbs.

Signals and Messages

Human societies operate on a scale larger than face-to-face encounters. Signals and messages constitute the force that binds them together. Advancing technology provides improved methods for communicating at a distance.

Visual Signals

Visual signals need a line of sight between sender and receiver. An observer whose viewpoint is at a given height above ground level can see to the range specified in the *Horizon Table* (p. 49). Use the *Size Modifier Table* (p. B19) to convert between height and SM.

For two individuals, *add* the ranges for their respective SMs. If the distance between them is less than this, they can see each other. The same applies to an observer looking for a tall mast, lighthouse, mountain, etc.

Spotting a visual signal requires a Vision roll (p. B358).

Modifiers: Range modifiers (p. B550); +10 for a deliberate, unmistakable signal, as it counts as "in plain sight"; at TL4, the benefits of telescopic magnification (see *Spyglass,* p. 42); bonus for extra time (p. B346), if scanning slowly.

The following types of signals are available.

Beacon Fire (TL0). Customarily built in a high place. A TL1 society may set up a line of beacons on mountain peaks to relay a signal long distances. A typical beacon is a yard high and roughly hemispherical; add its SM +1 to Vision rolls. At night, fires become *more* visible; reverse the sign of the darkness penalty, giving a Vision *bonus* to see the fire. A beacon can carry only one message – usually "Here I am!" or "Danger!"

Smoke Signal (TL0). The most famous example of smoke signals is their use by Native American tribes. Sent by building a smoky fire with green or wet wood; covering it with a blanket can interrupt the smoke, generating short puffs or long plumes, to carry several different messages. Smoke typically rises to 500-600 yards, giving a horizon of 45 miles.

Lantern Balloons (TL3). Made from oiled rice paper on a bamboo frame, the lantern balloon was carried aloft by the heat from a wax candle burning inside it. In 15 minutes of flight, it could attain an altitude as great as 1,000 yards (SM +16; horizon 65 miles). It was used for military signaling at night, when it would get +10 to visibility. $10, 0.75 lb.

Signal Flags (TL3). Improvised use of flags and other colored signals goes back at least to TL2; for example, Greek legend tells of ships using different-colored sails as signals. In the ninth century A.D., Byzantine emperor Leo VI discussed using signal flags at sea. Western European fleets in the later Middle Ages began to use similar codes. The British admiralty standardized naval signals in 1647. A typical flag is smaller than the man carrying it (add its SM -1 to Vision rolls), but stands out from the background (+10). Prices and weights vary. Flag one man can easily carry: $50, 3 lbs.

Horizon Table

SM	*Horizon*	*SM*	*Horizon*
-10	0.4 mile	+1	3.5 miles
-9	0.5 mile	+2	4.5 miles
-8	0.6 mile	+3	5.5 miles
-7	0.8 mile	+4	6.5 miles
-6	1 mile	+5	8 miles
-5	1.2 miles	+6	9.5 miles
-4	1.5 miles	+7	12 miles
-3	1.75 miles	+8	15 miles
-2	2 miles	+9	18 miles
-1	2.5 miles	+10	21 miles
0	3 miles		

Auditory Signals and Musical Instruments

Loud noises can carry quite far, offering a means of signaling. Auditory signals *aren't* limited to line of sight; sounds can diffract around bends, corners, or the curvature of the Earth, although this may distort them.

Each sound source has a standard *audibility range* (about 8 yards for a shout). This is the range at which it can be heard with an unmodified Hearing roll (p. B358).

Modifiers: -1 per *doubling* or +1 per *halving* of distance, relative to audibility range; +1 for a high-pitched sound (the equipment statistics below already account for this); -1 if the listener has no line of sight to the source; +1 for multiplying the number of sources set off at once by 10, +2 for 100 sources, and so on; *half* the extra time bonus (p. B346), rounded down, for repetitions (+1 for at least four, or +2 for 15 or more).

A loud or monotonously repeated noise can function as an alarm. Varying rhythms or melodies can carry genuine messages: military orders, guidance for mounted hunters, etc.

Musical Instruments

This list emphasizes instruments useful for *signaling*. Most of these – and many others – are also used for entertainment! See ***GURPS Low-Tech Companion 1*** for a discussion of Musical Instrument skills.

Talking Drum (TL0). The instrument used to send messages through the African jungle. It's held under one arm and struck with the other hand; pitch is adjusted by squeezing it. Played with Musical Instrument (Tuned Drum). Audibility range: 32 yards. $40, 2 lbs.

Harp (TL1). The classic bardic instrument. Played with Musical Instrument (Harp). Audibility range: 4 yards. $600, 7 lbs.

Shofar (TL1). The horn of a sheep, used as a trumpet, as described in the Bible. Played with Musical Instrument (Horn). Audibility range: 16 yards. $80, 5 lbs.

Fife (TL2). A shrill, flute-like instrument, used by the Spartans – and by military marching bands of later centuries. Played with Musical Instrument (Flute). Audibility range: 16 yards. $100, 1 lb.

Trumpet (TL2). An early brass instrument, often long and straight rather than coiled up. Played with Musical Instrument (Horn). Audibility range: 32 yards. $200, 2 lbs.

Bagpipe (TL3). Best known in the Scots version, but forms of this instrument are found worldwide. Played with Musical Instrument (Bagpipe). Audibility range: 32 yards. $150, 8 lbs.

Church Bell (TL3). Cast from bronze, and used to summon people to worship – or to signal emergencies. No skill roll required; roll vs. ST+2 to ring *loudly.* Audibility range: 128 yards. Bells come in varied sizes; a 36" specimen is $20,000, 900 lbs. For other sizes, multiply cost and weight by the cube of bell height in yards. (*Example:* A 48" bell is 1.33 yards tall; the cube of 1.33 is 2.35. Cost is $20,000 × 2.35 = $47,000; weight is 900 lbs. × 2.35 = 2,115 lbs.) Doubling or halving height doubles or halves range.

Hunting Horn (TL3). Made of brass, and carried by huntsmen to signal the progress of a hunt. Played with Musical Instrument (Horn). Audibility range: 16 yards. $200, 2 lbs.

Kettledrums (TL3). Not the orchestral instrument, but a smaller one designed to be carried on a horse's shoulders and played by the rider. Played with Musical Instrument (Tuned Drum). Audibility range: 32 yards. $250, 28 lbs.

Calculation and Computation

Any literate society can record numbers by writing them down as words – assuming they *have* words for numbers, beyond "one, two . . . many." But literate societies have separate systems for writing down numbers; e.g., "144" or "CXLIV" instead of "one hundred forty-four." These come in three broad types:

Tallies (TL0) involve making a mark, commonly a line, for each object in a collection or each event in a series. Objects dating to the Paleolithic carry such marks, possibly tracking phases of the moon. A number larger than seven or eight can't be seen at a glance, but must be counted off line-by-line. Tallies can also be matched up with objects, such as a herd of sheep, even by people who can't count.

Nonpositional numerals (TL1) – such as Roman numerals – use signs for various numbers, which are added up (or sometimes subtracted) to get the total number that they stand for. These may be letters of the alphabet (as in the Roman, Greek, and Hebrew systems) or signs for number words (as in the Chinese system). Nonpositional numerals are useful for recording numbers, but awkward for calculation; roll vs. Accounting or Mathematics (Applied or Statistics) to solve any problem more complex than adding on your fingers.

Positional numerals (TL3) – such as Arabic numerals (actually invented in India), Babylonian cuneiform numerals, and Mayan numerals – use the same symbol for different numbers (1, 10, 100, . . ., or 1, 60, 3,600, . . .) depending on where it's placed; such systems have a symbol for zero as a "placeholder." This notation makes arithmetic relatively straightforward, so that it doesn't require use of a computational skill.

It isn't historically accurate to treat positional numerals as "more advanced" (higher TL) than nonpositional ones; both the Maya and the Babylonians went straight to positional notation at TL1. But historical ***GURPS*** campaigns will be set in Western civilization more than any other – and the West acquired positional numerals only at TL3. Treat civilizations that went straight to positional numerals as "advanced in mathematics."

For a more-detailed treatment of computation, see ***GURPS Low-Tech Companion 1.***

Aids to Calculation

Many societies have tools for making arithmetic faster or more accurate. Using these devices requires a computational skill and familiarity with the specific device.

Abacus (TL2). A frame, usually wood, that holds beads strung on wires. The beads are moved back and forth to represent calculations. Positional relationships are built into it. People who use nonpositional systems, such as Roman numerals, can calculate on an abacus without a skill roll if they have points in Accounting or Mathematics (Applied). Anyone experienced with an abacus can calculate faster than with pencil and paper, in any notation. $50, 2 lbs. A collection of pebbles laid out on a flat surface can be used as an improvised abacus at *no* cost, but is much slower to use due the care needed to avoid mixing up pebbles.

Cube Root Extractor (TL2). Ancient Greek engineers designing catapults (see *Mechanical Artillery,* pp. 78-83) needed to take the cube root of a stone's weight to determine the engine's dimensions. The cube root extractor is a mechanical device invented in the third or fourth century B.C. to solve this problem. It has several rods set at angles to each other, one of which slides back and forth. By making a rough initial guess and positioning the rods accordingly, the exact cube root could be measured. Using it requires Mathematics (Applied). $25, 2 lbs.

Napier's Bones (TL4). This is a set of numbered rods, one for each digit from 0 to 9, showing the multiplication table for that digit, plus an 11th rod for the multiplier. By arranging the rods, it's possible to read off the product of a multi-digit number by any single-digit number. Several sets may be needed if the multi-digit number has repeated digits! Not as fast as a slide rule (***GURPS High-Tech,*** p. 18), but able to produce results with any desired number of digits. Only works with positional numerals. Using it requires Mathematics (Applied or Statistics). One set, with a wooden box (5"×2.5"×1"): $25, 0.5 lb.

Navigation

Navigation is the scientific approach to finding your way, used mainly at sea in low-tech societies. The skill of determining a ship's position or of setting its course on a map or a chart – or in geometrical coordinates, such as latitude and longitude – is Navigation (Sea); see p. B211. Coastal and open-sea navigation use this skill somewhat differently.

Few TL0 societies use abstract concepts of location. Instead of Navigation, they rely on Area Knowledge (pp. B176-177) – that is, personal familiarity with a specific body of water. (River and harbor pilots in present-day societies *still* employ this skill!) This can't substitute for *all* applications of Navigation. Notably, it's seldom useful out of sight of land; thus, most TL0 societies avoid such voyages. Treat TL0 peoples with long-distance seafaring, such as the ancient Polynesians, as "advanced in a science" for this purpose.

A ship's navigator may have to deal with four different questions:

1. Where are we? A ship's location can be defined either by its visible surroundings ("San Francisco Bay") or in terms of map coordinates ("37°46' N, 122°14' W"). Area Knowledge can substitute for Navigation in the first case but *not* the second. This roll is most often needed when a ship has sailed off course (e.g., during a storm).

2. Where are we going? If a ship's voyage has a known destination, a navigator can identify this. Doing so depends on the available reference materials, not on a Navigation roll. Navigational information for an obscure destination may require a Research roll – or be the starting point for an adventure!

3. How do we get there? Plotting courses is a navigator's primary job. If the point of departure and the destination are *both* known, a successful Navigation roll identifies the fastest route. Add 10% to travel time per point of failure. Critical failure means the ship encounters a navigational hazard or gets lost.

For an unknown point of departure *or* an unknown destination, make a Navigation roll at -4 to guess the best heading. Success means the ship ends up in a known or worthwhile location (e.g., it makes landfall after being lost at sea); critical success may send the ship to a rich port, an island paradise, or a hidden pirate haven, if the GM wishes! Failure indicates the ship gets nowhere in particular. Critical failure means it encounters a hazard – or gets lost, if it wasn't already. If the ship starts at an unknown point, any success *also* identifies its location.

The basic difficulty of these Navigation rolls depends on the voyage's hazards:

Weak opposing current; single rock or shoal: 0

Strong opposing current; weak current carrying you toward a hazardous shore; several widely spaced rocks or shoals: -1

Strong current carrying you toward a hazardous shore; multiple closely spaced rocks or shoals; narrow passage between bodies of open water: -2

Multiple closely spaced rocks or shoals; narrow passage with weak currents carrying you out of the safe channel: -3

Multiple closely spaced rocks or shoals; narrow passage with strong currents carrying you out of the safe channel: -4

In unknown waters, extra care must be taken to identify hazards. If this isn't done, *double* these penalties!

In all cases, coastal navigation is easier than open-sea navigation, as there are only two headings to choose from. Make these rolls at +2.

4. Are we on course? Normally this requires no skill roll; any trained navigator can answer this automatically. If a ship has no trained navigator, roll against Seamanship.

There are several methods of performing these tasks. Equipment modifiers often apply to these.

Landmark Recognition

This is the oldest form of Navigation, practiced since TL1, and the only one for which Area Knowledge can substitute at TL0. Position is identified by landmarks, usually visually. Such Navigation is often *Per*-based, and Vision modifiers – including the use of a spyglass (p. 42) – can aid or hinder it. While normally limited to coastal navigation, it can be applied to open-sea navigation if there are predictable currents, winds, or changes in the water.

Landmark recognition involves only rough measurement of distances (by days of travel) and headings (from the sun, stars, or prevailing winds). Courses can't be charted with any precision; Navigation is at -3, and has no Astronomy default. If the sky can't be seen at all, Navigation is at -5.

Astronomical Aids (TL1)

Merkhet (TL1). An ancient Egyptian device, made from a slitted palm-leaf. Used in good weather to observe the pattern of stars moving across a plumb line, it reduces the Navigation penalty to -2 by determining direction more accurately. $10, neg. Easily broken (DR 0, HP 1, and Fragile), it's normally carried in a hardwood case: $10, 1 lb.

Windrose (TL2). A rectangular box with 30 compass points around its exterior, each corresponding to the rising or setting of one of 15 fixed stars. Different models are required for the northern and southern hemispheres. Reduces the Navigation penalty to -1 in good weather. $25, 1 lb.

Sunstone (TL(3+1)). The Viking expansion (700-1100 A.D.) relied on extraordinarily skilled navigation. Some readers have interpreted a few lines from the sagas as hints at an unusual technology: use of the naturally polarized mineral *cordierite* to determine the sun's location on cloudy or foggy days, or when the sun is just below the horizon (for about a quarter-hour after sunset). The Navigation penalty under these conditions is -3 rather than -5. $30, 1 lb.

Reference Materials (TL1)

Stick Chart (TL1). Developed in the Marshall Islands by the ancient Polynesians, these charts used curved and diagonal sticks to represent currents, and cowry shells to signify islands. They weren't actually taken to sea, but were used to train navigators in memorizing vital information. Studying one reduces the penalty for an uncharted destination to -2. For a navigator with Eidetic Memory, there's *no* penalty. $300, 10 lbs.

Periplus (TL2). Used by the Phoenicians, Greeks, and Romans, this is a scroll that describes destinations and landmarks, and approximate distances between them, along a shore. A *rutter* (TL3) is similar, but in the form of a bound book. A typical periplus or rutter reduces the penalty for an uncharted destination to -2; one of good or fine quality makes that -1 or 0. As with all books, price and weight are variable.

Sounding Pole (TL1)

Used in ancient Egypt, the sounding pole provides a way to judge depth in shallow waters. It's thrust into the water at the prow of a boat to feel the depth of the bottom. This avoids the doubling of hazard penalties – but only in shallow rivers and lakes. It remains useful in more-advanced forms of navigation. A 12' pole: $40, 4 lbs.

Lead Line (TL2)

Developed in the ancient Mediterranean, this is a 50-yard line with a wax-coated lead weight at the end. It's thrown over the side to determine depth by length markings along the rope. Together with keeping a lookout, this avoids doubled hazard penalties in unfamiliar waters. The wax coating sticks to the bottom material, bringing up samples; examining these gives +1 to Navigation to identify a vessel's location, *if* references describing bottom materials are available. It remains useful in more-advanced forms of navigation. $175, 30 lbs.

Dead Reckoning

Dead reckoning (short for "deduced reckoning") is the first *quantitative* navigation method. It becomes possible at TL2 and is in general use by TL3. It allows Navigation rolls with *no* penalty for lack of precision, and can be used to identify a ship's position on a grid of latitude and longitude.

Dead reckoning requires keeping track of a ship's heading and speed, and the duration of each leg of a voyage, and figuring out how far it traveled and in which direction. This information is used to plot its position on a chart. There's still no Astronomy default.

Basic equipment for dead reckoning includes a reliable timekeeping device (usually a sandglass; see *Timers,* p. 45), a compass, a chip log, charts (like the *portolan,* below), and a set of dividers.

Dividers (TL2)

A "compass" in the geometer's sense: two rods connected by a stiff elbow joint at the top, held at a specific angle and used to trace circles and arcs. In navigation, it's used to calculate distances on a chart. It's part of basic equipment for dead reckoning. $5, neg.

Compass (TL3)

First developed in China and later introduced to the Near East and Europe, a compass has a magnetic needle that points to magnetic north (or, in China, magnetic south). There are two versions:

- Magnetized needle to float in water (requires a bowl or dish of water). Allows unmodified Navigation rolls. $5, neg.
- Magnetized needle on a pivot. Gives +1 to Navigation rolls. $25, 1 lb.

It's possible to judge headings astronomically without a compass, if the sky is visible: -1 to Navigation to steer by the pole star, or -2 by other stars or by the sun.

Portolan (TL3)

Developed in medieval Europe, a portolan is a large, bound reference book holding not only descriptive text, but charts of coasts with cities marked on them (see *Maps and Globes,* p. 45). From each city, lines marked with compass headings go out to other cities; thus, use requires a compass (above). A typical portolan eliminates the penalty for an uncharted destination; one of good or fine quality gives a bonus of +1 or +2. Many navigators treated their portolans as secret documents, not wanting to share the information with rivals. Without one or more such charts, dead reckoning can't be used to sail to a known destination, although it can still be used to chart a voyage to an unknown one (-4 to Navigation). As always for books, price and weight are variable.

Chip Log (TL4)

Invented around 1500, this is a long cord on a reel, with knots every 42' and a wooden float at the end that's weighted with lead so that it always floats the same way up. The float is tossed off the stern and the cord is allowed to unreel. The number of knots that unreel in 30 seconds is the ship's speed in nautical miles per hour, or "knots." Used to estimate speed; forms part of basic equipment for dead reckoning. $175, 55 lbs.

As early as TL1, cruder measurements were made by throwing a piece of wood off the stern and estimating its distance by eye. This is free but less accurate: -1 to Navigation.

Celestial Navigation

Celestial navigation uses precision instruments to determine a ship's exact position by observing the sun and stars. This is Navigation as defined on p. B211, with a default to Astronomy-5. It emerges at TL3 with the development of instruments to measure latitude – although it isn't fully developed until TL5, when invention of the ship's chronometer allows precise measurement of longitude (see ***GURPS High-Tech*** for relevant gear and rules).

The limited form of celestial navigation used at TL3 is "running down the line." If the ship's current location and destination are known, the Navigation roll is at +2 because – as with coastal navigation – there are only two directions to choose between. If either is unknown, the penalty is -2, not -4, for the same reason, and a successful roll determines the ship's exact latitude as well as setting a course. The navigator requires the equipment for dead reckoning and one of the following instruments, which further modifies the roll:

Astrolabe (TL3). See p. 43 Used with a cross-staff (p. 43). Gives -1 (quality) to skill for celestial navigation.

Kamal (TL3). See p. 43. Gives -1 (quality) to skill for celestial navigation.

Sun Shadow Board (TL3). A crude version of a quadrant, developed by the Vikings (700-1100): a semicircle of wood mounted on a handle. Gives -2 (quality) to skill for celestial navigation. $20, 10 lbs.

Quadrant (TL4). See p. 43. Used as a navigational tool since the 1400s; Columbus' log records using one. Counts as basic equipment for celestial navigation. (The *sextant,* which appears at TL5, gives +1 (quality) to skill.)

Chapter Five
Weapons

Martialis looked up at the walls of the Museum, wondering if he was taking too much of a risk to prove his point. Twenty men with polished bronze shields stood atop them, waiting for the signal. Martialis would have to cross the two stadia to reach the walls before they could bring the reflected sun to bear on him.

His head ached from the symposium of the night before, when he had challenged the truth of Archimedes' use of mirrors as a weapon. Lucian's claims were all very well, he had said, but if he believed in setting ships on fire, would they next ask him to believe in flying to the heavens?

And now here he was, hazarding his skin, and perhaps his life, on the soundness of his judgment. ***Well,*** *he reflected,* ***it's an officer's duty to make decisions and accept the risk.*** *But who among Rome's officers had ever taken this particular risk?*

Aristoboulos gave the signal, and a trumpet sounded. The first shields turned toward him, the glare on their surfaces threatening to dazzle him. He began to run, like a sailor crossing a shifting deck to reach the enemy.

As he hoped – and as he had predicted – the blinding glare ceased to trouble him before all the reflected solar rays could converge. Against a running target, the men on the wall couldn't adjust their aim quickly enough. No more than two or three shields at a time struck at his sight with their polished surfaces.

Breathing hard – he had been sprinting at top speed – Martialis reached the gate of the Museum and passed through, raising his sword to signal his victory.

Through history, people have killed each other using armaments ranging from simple clubs to complex devices incorporating elements of many *other* weapons. As technology marches on, so does the machinery of death.

Weapon Legality

For weapons, Legality Class (pp. B267, B507) is a complex issue that varies broadly by culture. Some *rough* guidelines:

LC4 – Weapons commonly used as tools (e.g., knives); hunting weapons (e.g., spears or rifles), in societies where everybody hunts for food.

LC3 – Militia weapon that common people are expected to own (e.g., English longbow), if the state keeps track of them by requiring everybody to have one rather than by restricting them; hunting weapons, in most societies where hunting is an aristocratic privilege.

LC2 – Aristocratic weapons (e.g., swords or lances), which *might* extend to hunting weapons in some highly stratified societies; small, concealable weapons.

LC1 – Heavy weapons (e.g., catapults or cannon).

LC0 – Few TL0-4 weapons qualify – although small, concealable weapons *might,* if stigmatized as "murderers' weapons."

Melee Weapons

Below is a glossary of muscle-powered TL0-4 melee weapons. It *isn't* exhaustive, but includes both common and especially unusual weapons from around the world. An entry in SMALL CAPS indicates a weapon that appears in the weapon tables on pp. B271-276 or pp. 64-71. Other entries are functionally similar enough to one of these weapons to use the same statistics, even if they differ radically in appearance. For details, read the entry!

A weapon's name often varies by culture. Many entries below list alternative names.

Several weapons here count as *combination weapons,* including the martel-de-fer (see PICK), poleaxe, and versions of the kusarigama, kusarijutte, tomahawk, and warhammer. Rules for designing such weapons appear in ***GURPS Low-Tech Companion 2.***

Ahlspiess – *Germany.* A pole weapon that's roughly equal proportions handle and long metal spike, with a rondel (round handguard) where the halves meet. Used primarily for dueling. Treat as a SPEAR (pp. 69, B273), but it can't be thrown and is considered a solid-metal (DR 6) sword for breakage; see pp. B483-485.

Ankus – *Africa, Asia.* An elephant goad (see *Elephants,* p. 135) used as a weapon. Treat as a BATON (pp. 67, 69, B273) with a blunt hook that enables the rules under *Hook* (below). Some are tipped with a sharp spike, which converts thrusting damage to impaling.

AXE (pp. 65, 70, B271) **–** *Universal.* A wedge-shaped blade on a wooden handle, for use in one hand and not balanced for throwing. It has a sufficiently long handle that it can be comfortably wielded two-handed; use the stats listed under Two-Handed Axe/Mace, which differ from holding the weapon in the Defensive Grip defined in ***GURPS Martial Arts.*** Includes the *epsilon axe* (Sumer) and *masakari* (Japan). Axes come in many shapes and sizes, such as the SMALL AXE (p. 65), which is only slightly larger than a HATCHET (pp. 56, B271), and the LONG AXE (pp. 58, 70).

BACKSWORD (pp. 65, 66) **–** *England.* A single-edged THRUSTING BROADSWORD (pp. 66, 70, B271) with a basket hilt.

BALISONG (p. 67) **–** *Philippines.* A tangless folding knife with a pair of hollow handles that pivot forward to sheathe the blade or back to serve as a grip. Sometimes called a *butterfly knife.* Traditional low-TL balisongs such as described here require a Ready maneuver to open; they can't be "flipped" open with Fast-Draw (Balisong).

BASTARD SWORD (pp. 65, 66, 70; B271, B274) **–** *Universal.* A sword manageable enough to wield one-handed but with a grip long enough for two. It can be wielded two-handed normally (using Two-Handed Sword skill) or in the Defensive Grip defined in ***GURPS Martial Arts.*** A sharp point was standard – use the THRUSTING BASTARD SWORD (pp. 66, 70, B271, B274) in historical campaigns. Often called a *hand-and-a-half sword,* post-TL4. Includes smaller versions of the *nodachi* (Japan).

BATON (pp. 67, 69, B273) **–** *Universal.* A short, balanced club, usually wooden or metal. Includes the *chung bong* (Korea), *dhot* (Burma), *muchan* (India), and *mutton* (Philippines), and the slender metal *segu* (Indonesia). Some batons are only knife-sized; use the SHORT BATON (pp. 67, 69) statistics for these. Short batons include the *dan bong* (Korea).

Bayonet – *Europe.* A knife designed to be attached ("fixed") to a gun, converting it into a spear. Early designs were *plug bayonets,* inserted into a firearm's muzzle; TL4 guns were rarely consistent in muzzle size, so each bayonet was fitted to a specific weapon. A fixed plug bayonet prevents successful firing. Late in TL4, *socket bayonets* appear; these fit into a special socket outside the muzzle, allowing the firearm to be fired with bayonet fixed.

Hook

A weapon with a hook or similar projection can be used to snag a foe's head, limb, weapon, or shield. To hit, roll against weapon skill-5 or the Hook technique (***GURPS Martial Arts,*** p. 74), modified as explained below. Your adversary may defend normally.

When hooking the *head* or a *limb,* apply standard hit location penalties. If you succeed, then on subsequent turns you may try to pull your victim off-balance, even to the ground. Roll a Quick Contest of ST. Victory means you drag your opponent into a kneeling posture; if he's kneeling or crouching, he falls down. If you lose or tie, nothing happens. If you critically fail, you drop your weapon! Your foe may attempt to break free normally.

Hooking a *weapon* is a disarm attempt (p. B401). Apply the usual penalty to hit that weapon, but ignore the -2 for using a non-fencing weapon. You get +2 in the ensuing Quick Contest, in addition to the usual modifiers. If you lose the Contest, your opponent retains his weapon and escapes your hook.

When hooking a *shield,* roll to hit at -4 *plus* its DB. If you succeed, you may attempt to pull it out of line. Again, this is a disarm attempt, but your rival gets *+4* in the Quick Contest if his shield is strapped to his arm. You get +2 if hooking with a two-handed weapon. Victory means the shield becomes unready – it's still on your foe's arm but he can't block with it or benefit from its DB until he breaks free and takes a Ready maneuver to reorient it.

Hooking doesn't *usually* inflict damage, but if your weapon has an edged hook, it inflicts the listed damage in addition to the above effects.

While using a weapon to hook a foe, you can't use it to attack or parry. You can always *drop* it as a free action on your turn, however.

However, a fixed socket bayonet disturbs the gun's balance and alters barrel vibrations (-1 to Guns), and makes a muzzleloader slower to load (multiply reloading time by 1.1 and round up). Either kind of bayonet adds its weight to the firearm's weight, making it heavier. Fixing a bayonet takes four Ready maneuvers: one to draw the bayonet, one to change grips, one to mount the blade, and one to ready the firearm as a melee weapon. Fast-Draw (Knife) can reduce this to three seconds. Use Spear skill to stab with a fixed bayonet; damage is thr+3 impaling, and most TL4 long arms afford Reach 1, 2*. Lack of familiarity with a particular gun-bayonet combination gives -2 to hit; see *Familiarity* (p. B169). People receiving a bayonet charge may need to make a Fright Check, at the GM's option! For more on bayonet fighting, see ***GURPS Martial Arts.*** Treat a bayonet as an unthrowable Large Knife (pp. 67, B272) for cost and weight purposes, and when used by itself with Knife skill.

Bill (p. 68) **–** *Europe.* A bladed polearm with a hook on the back that lets the wielder use the rules under *Hook* (p. 54), typically to unseat a horseman. Initially a battlefield weapon, it was sometimes given a shorter haft for individual combat, resulting in the Dueling Bill (p. 68), which includes the *forest bill* (England) and *guisarme* (France).

Blackjack (pp. 65, B271) **–** *Universal.* A small, weighted truncheon made of cloth or soft leather, designed to deliver a beating without obvious bruising (Diagnosis-2 to notice the injury on a casual examination). Every culture has its own name: *cosh, sap,* etc.

Bladed Hand (p. 65) **–** *Exotic.* A set of joined, nearly parallel blades – of close to equal length – worn on the hand and used to claw like an animal. Some are short and knife-like; others are long and rake-like. Includes the *bagh-nakh* (Indian; sometimes translated as "tiger claws") and *neko-de* (Japan).

Bokken (pp. 66, 70) **–** *Japan*. A katana-sized wooden sword (p. 64). Usually has a wood or leather handguard, but not always. Also called a *bokuto.*

Bolas (p. 66, 76) **–** *Universal.* This throwing weapon and the related Bola Perdida (pp. 66, 72) can function as improvised one-handed flails in melee combat.

Brass Knuckles (pp. 65, B271) **–** *Universal.* A fist load that covers the knuckles. As likely to be horn, iron, steel, or lead-reinforced leather as brass. The wearer ignores *Hurting Yourself* (p. B379) when punching and gets +1 to punching damage, but also suffers from Bad Grip 3 (p. B123). Includes the *tekko* (Japan, Okinawa).

Broadsword (pp. 65, B271) **–** *Universal.* A term for what medieval European warriors called an *arming sword,* coined by 17th-century writers to distinguish robust military swords from narrow-bladed civilian ones. Typically 30"-40" long. Traditionally straight-bladed, double-edged, and *pointed;* use the Thrusting Broadsword (p. B271) statistics. Also use those for slightly curved and/or single-edged versions. Almost every culture has some form of broadsword, often referred to simply as a "sword" in the local language. Includes the *longsax* (Scandinavia), *spatha* (Ancient Rome), and larger examples of the *katzbalger* (Europe) and *pedang* (Indonesia).

Caestus or Cestus (p. 65) **–** *Ancient Rome.* A studded or spiked leather hand covering; treat as a gauntlet (DR 4). Elbow-length versions were common: 2× base cost and 4× weight; provide DR 4 to the arm on 1-3 on 1d; and add their +1 damage to an Elbow Strike (pp. B230, B404) as well as a punch.

Cane – *Universal.* The walking stick is an accessory of gentlemen worldwide. Treat as a Light Club (pp. 65, B271). Many are topped with a crook (adds no cost or weight), which allows use of the rules under *Hook* (p. 54). Lighter canes, suitable for use with Rapier or Smallsword skill, are also available; treat as a Short Staff (pp. 69, B273).

Pike and Shot and Bayonet

As guns became more common on the battlefield, tactics changed to reflect their deployment. Firearms were needed to defeat the enemy, but soldiers armed with them were vulnerable to shock action. To stand and fight, they required protection. The best defense against enemy cavalry was a close formation of pike-armed infantry.

Early tactics combined firearms- and pike-armed troops. The pikes provided shelter from enemy cavalry while the guns killed the opposition from afar. This is commonly referred to as *pike and shot.*

Later, the *bayonet* was developed. This allowed every soldier to serve as his own pikeman. Instead of a portion of the formation being dedicated to shooting and a portion to melee, every man could do both. This dramatically increased the formation's lethality at each task, and eliminated the need for specialized melee and fire troops.

Using the Pike

Long polearms such as the pike enable a new perk, *Two-Man Pike Training* (pp. 9-10), and the following new maneuver:

Planting a Spear: This is a variant on a stop thrust (p. B366) wherein a spear or an impaling polearm with Reach 2+ is braced for a charge, butt pressed against the ground to absorb the impact of collision. Planting a weapon requires a Ready action; thereafter, the wielder must Wait until he decides to unbrace his weapon. A planted weapon can't parry and can only be used to attack someone entering the hex occupied by its tip from one of its front hexes. As with any Wait, this maneuver can be converted into an Attack – or into an All-Out Attack, if the wielder made no active defense on his turn. Make the usual attack roll to hit. On a successful hit, impaling damage is the *better* of that for a stop thrust *or* that for a couched lance (p. B397). To find the latter, compute collision damage based on the *target's* HP and relative velocity, and add the weapon's damage bonus.

Cavalry Saber (pp. 66, B271) – *Europe.* A curved sword optimized for one-handed use from horseback. Resembles the fencer's Saber (pp. 61, B273) in profile, but is heavier and wielded more like a Broadsword (pp. 55, B271).

Chain Whip (p. 67) – *China.* A whip made of chain or short metal bars (usually seven or nine of them) joined by chains. Used to lash foes and to entangle like a Kusari (pp. 58, B272). Also called a *kau sin ke* (China).

Claymore – *Scotland.* A term for either a Scottish Backsword (pp. 65, 66) or Thrusting Greatsword (pp. 70, B274), depending on the time period.

Combat Fan (p. 65) – *China, Japan, Korea.* A metal version of the folding fan carried by men and women alike. Folds partially or not at all. Used as a backup weapon and symbol of authority. Called a *tessen* ("iron fan") in Japan.

Cutlass (pp. 65, 69, B273) – *Europe.* A short, single-edged sword with an open-framed basket hilt, favored by sailors and pirates. Some lack the basket hilt; use the Shortsword (pp. 69, B273) stats. The $300 price tag in the ***Basic Set*** reflects a mass-produced cutlass made by a large imperial power; use the cost listed here for less-widely manufactured weapons.

Dagger (pp. 67, 77, B272, B276) – *Universal.* In ***GURPS*** usage, a short, point-only knife. Includes the *hishi* (Japan). Historically, the term described a double-edged knife with a crosspiece and a pommel – a tiny sword. In casual usage, it might instead mean a Rondel Dagger (p. 67), a Stiletto (p. 67), or any knife from Small Knife (pp. 67, 77, B272, B276) to Long Knife (pp. 67, 69) size.

Dao (p. 66) – *China.* A heavy-bladed sword with an extra-long handle, used one-handed for chopping and stabbing. Includes the *dha* (Burma).

Deer Antlers (p. 67) – *China.* Two interlocked, crescent-shaped blades with a handle in the center of one of the blades, creating a four-pointed cutting weapon capable of trapping weapons between its points. Usually used in pairs.

Dusack (p. 69) – *Europe.* A shortsword-sized wooden sword (p. 64).

Estoc (p. 66) – *Europe.* An edgeless thrusting sword with a triangular, circular, or diamond cross section, designed to pierce chinks in plate armor. The specialized design removes -2 of the penalty for targeting chinks in armor (p. B400). Also called a *tuck* (England).

Falchion (p. 65, 69) – *Universal.* A medieval European term applied loosely to almost any single-edged sword, but most often to one that's flared, heavy, and/or curved forward at the tip, which favors cutting over thrusting. Most ironworking cultures developed such a blade; hunters and soldiers worldwide valued it as a tool (for butchering game, cutting brush, opening coconuts, etc.) and a weapon. Normally sharp-tipped, but blunt examples exist; change thrusting damage to crushing. Typically shortsword-sized, falchions include the *bolo* (Philippines), *dan sang gum* (Korea), *falcata* (pre-Roman Iberia), *parang* (Indonesia), *sica* (Ancient Rome), *sickle sword* (Universal), and *trombash* (Congo) – and the *butterfly sword* (China), which sports a knuckle guard. The Large Falchion (p. 65) is broadsword-sized, and includes the largest *parangs* and the *ring sword* (China).

Flail (pp. 70, B274) – *Universal.* A two-handed weapon – seen almost anywhere grain flails are used – consisting of iron bars, spiked balls, or similar weights attached to a long haft by a chain or a cord. Includes the *chigiriki* (Japan).

Gada (p. 70) – *India.* This giant mace symbolizes strength. Wielded two-handed, it can be swung or gripped near the head to "punch." The listed gada is *small;* larger versions aren't uncommon. See ***GURPS Low-Tech Companion 2*** for rules for scaling up weapons.

Garrote (pp. 66, B272) – *Universal.* Any length of cord, wire, or rope used to strangle.

Glaive (pp. 68, B272) – *Europe.* A polearm consisting of a pointed cleaver on a long haft, which evolved from the Heavy Spear (p. 69) in ancient times. A shorter version, the Dueling Glaive (p. 68), was used for individual combat in the Middle Ages – and as a combination axe/musket rest, the *bardiche,* from the mid-1500s in Eastern Europe. Includes the *fauchard* (France); *jedwart* or *jeddart stave* (Scotland), often equipped with a hilt; and *Lochaber axe* (Scotland), often equipped with a hook. For hooks and hilts, see ***GURPS Low-Tech Companion 2.***

Great Axe (pp. 70, B274) – *Universal.* A massive two-handed axe, weaponized from the executioner's axe. Double-bitted and overly large, it's uncommon outside fantasy – few if any historical fighting axes used this design! For a realistic two-handed axe, use the Glaive (pp. 68, B272), Long Axe (p. 70), or Poleaxe (pp. 68, B272).

Greatsword (pp. 70, B274) – *Europe.* A true two-handed sword. It usually has a sharp tip (a Thrusting Greatsword, pp. 70, B274). A typical European greatsword has a *ricasso* – an unsharpened, sometimes leather-wrapped length of blade just above the sword's hilt for the wielder to grasp – that ends in two protruding spikes that protect the user's hand. Includes large-sized *nodachi* (Japan) and the *zweihänder* (Germany).

Haladie – *India, Sudan, Syria.* A knife with blades above and below the grip. Treat as a Large Knife (pp. 67, 77, B272, B276) that lets the user choose freely between the rules for a normal grip and a Reversed Grip (see ***GURPS Martial Arts***), as best suits the task at hand. It cannot pummel and gives -1 to skill. $80, 1.5 lbs.

Halberd (pp. 68, B272) – *Europe.* A heavy polearm with an axe-like head that sports both a back-spike (used with *Hook,* p. 54) and an axial spike (used like a spear). The battlefield version may be shortened to a Dueling Halberd (p. 68) for individual combat. Includes the *ji* (China) and *voulge* (Switzerland).

Hatchet (pp. 65, 77, B271, B276) – *Universal.* A light, short-hafted axe suitable for throwing. Also known as a *francisca* (Norman) and a *nata* (Japan).

Hook Sword (pp. 65. 66) – *China.* A blunt weapon shaped like an inverted "J," with an edged handguard for punching. The crook enables use of the rules under *Hook* (p. 54) – and the inside *is* edged, ostensibly for crippling horses! Usually used in pairs.

Horse-Cutter (p. 68) – *China.* A polearm with a heavy chopping blade similar to that of a Dao (above), intended for use by footmen against horsemen. The Heavy Horse-Cutter (p. 68) is half again the length and mass of the Light Horse-Cutter (p. 68). Also called a *pudao* (China). The heavy version includes the *bisento* (Japan, Okinawa).

Optional Rule: Sheaths

As noted on p. B270, knives and swords are assumed to come with a good sheath or scabbard. Other edged weapons (axes, spears, etc.) include a cover for the edge. Hafted weapons have a loop of leather or cord for securing them. Optionally, the GM may trade simplicity for realism and treat sheaths as explicit articles of equipment.

Swords and Knives

Listed sword and knife weights are *roughly* 2/3 weapon and 1/3 sheath; e.g., a 1-lb. large knife is a 0.7-lb. blade in a 0.3-lb. sheath, and a 3-lb. broadsword is a 2-lb. blade in a 1-lb. sheath. This reduces bare weapon weight, which matters when parrying heavy weapons (p. B376) and calculating HP (pp. B557-558). It's simplest to leave things alone and regard the listed weapon weights as abstract measures of durability. If the GM finds this unsatisfactory and is willing to do the extra math, though, he can use *bare* weapon weights with those rules.

The above proportions assume a rigid scabbard of bamboo, wood, metal, or reinforced leather. If such a sheath weighs at least 1 lb., it can serve as a baton. Being hollow, it counts as *cheap* quality for breakage.

Adventurers may carry knives and swords in flexible sheaths of canvas, soft leather, etc. Sheath weight is negligible; thus, carried weapon weight is 2/3 of listed weight. However, such sheaths can't act as batons, and penalize HT and Fast-Draw rolls (see below).

A replacement sheath costs 1/5 the price of a good-quality weapon if rigid or 1/10 good-quality price if flexible.

Other Blades

For other edged weapons, listed weight includes a flexible leather cover with negligible weight. For instance, a 4-lb. axe actually weighs 4 lbs. A replacement sheath costs 1/10 the price of a good-quality weapon.

Rigid covers are available but uncommon for spears. They add 25% of good-quality weapon price to cost and 1 lb. to carried weight. They otherwise function as rigid sword scabbards.

Sheaths, Fast-Draw, and Decay

A blade with only a flexible sheath has -1 on Fast-Draw rolls, and on HT rolls to avoid corrosion and incidental damage (p. B485). One with *no* sheath has -2, and the GM may require DX rolls to avoid self-inflicted injury!

Exotica

Rigid sheaths can be designed for parrying (count as *good,* not cheap), or even as snorkels or blowpipes. *Triple* cost for a reinforced sheath or one with special options.

Iklwa – *Zulu.* A Short Spear (p. 69) with a long, broad head, unbalanced for throwing.

Javelin (pp. 69, 77, B273, B276) **–** *Universal.* A slender spear, balanced for throwing but also useful as a light melee weapon. Includes the *assegai* (Africa), *frakka* (Viking), *pelta* (Ancient Greece), *spiculum* (Ancient Rome), and *yarinage* (Japan).

Jian (pp. 66, 68) **–** *China.* A straight, one-handed sword with a long, narrow blade that's light enough for fencing but strong enough for cutting. A tassel often decorates the handle.

Jitte – *Japan.* A sharp, spearhead-like blade with two side prongs for disarming. Treat as a Sai (pp. 66, 67). The name of this weapon and that of the Jutte (below) are occasionally exchanged, or used for both weapons – the result of a shift in transliteration practices.

Jo (pp. 65, 69, 70) **–** *Japan.* A 4'-5' stick normally used with two-handed staff techniques. Similar weapons include the *hanbo* (Japan) and *tapado* (Philippines).

Jutte (p. 66, 67) **–** *Japan.* A blunt baton with a single prong for catching parried blades for disarming. Confusingly, some sources swap the name of this weapon and that of the *jitte* (above), or use the same term for both.

Kakute (p. 67) **–** *Japan.* A ring with small teeth or "horns," used to get a firm grip on an opponent and assail pressure points. A pair – one on the ring finger, one on the thumb – gives +1 to rolls to prevent a grappled foe from breaking free and +1 to Pressure Points skill while grappling, but Bad Grip 1 (p. B123) with weapons. Twisting the rings into position for grappling or out of the way for other tasks takes a Ready maneuver.

Katana (pp. 66, 70, B271, B274) **–** *Japan.* A slightly curved, single-edged sword designed for one- or two-handed use. It can be used two-handed normally (using the stats under Two-Handed Sword) or in the Defensive Grip defined in ***GURPS Martial Arts.*** Includes the *jang gum* (Korea). The ***Basic Set*** describes an early Tokugawa-era weapon in transition from the two-handed *nodachi* (treat as a Greatsword, p. B274) to a blade short enough to wear thrust through a sash. Use the Late Katana (pp. 66, 70) statistics for later-era swords.

Katar (p. 67) **–** *India.* A blade with a perpendicular handle equipped with hand or arm guards, awkward for slashing but ideal for thrusting. Grip mechanics permit the use of armed *or* unarmed combat skills to parry, as with the Tonfa (p. 64). Typically knife-sized, but the Large Katar (p. 69) is shortsword-sized, while the Pata (p. 65) is broadsword-sized and features an integrated gauntlet.

Khopesh (p. 65) **–** *Ancient Egypt.* A curved, sickle-like slashing sword with a question mark-shaped blade, sharpened on the *outside* edge. Although it's called a "sword," it functions much like an all-metal axe, used to chop and for the attacks under *Hook* (p. 54). It can be wielded using either Axe/Mace or Broadsword skill. Similar weapons were known in other cultures, including India.

Knife (pp. 67, 69, 77, B272, B276) – *Universal.* Any one-handed blade smaller than a sword, built for effective cutting *and* stabbing. Lightest is the Small Knife (pp. 67, 77, B272, B276), which may be balanced well enough to throw; examples include the *bhuj* (India), *kozuka* (Japan), and *pisau* (Indonesia). The next size up is the Large Knife (pp. 67, 77, B272, B276), which is often purpose-built for combat but rarely throwable; such weapons include the *ballock knife* or *bollocks dagger* (Europe), *dan gun* (Korea), *dirk* (Europe), *kard* (Persia), and chisel-pointed *tanto* (Japan). Largest – at a total length between 15" and 23" – is the Long Knife (p. 69), which is only marginally less substantial than a Shortsword (p. 61, B273) and never throwable. Long knives include the longest versions of the dirk, kard, and tanto. Some terms, like *puñal* (Philippines), describe a knife of any size. The arrow-like *emeici* (China) and *siangkam* (Indonesia) can likewise be of any size, but can only make thrusting attacks. For dedicated thrown weapons, see Throwing Knife (p. 77).

Knife-Wheel (p. 67) – *China.* A Slashing Wheel (p. 67) with knife blades protruding from either side. Traditionally used in pairs.

Knobbed Club (p. 65) – *Universal.* A club with an enlarged striking head. Includes the *knobkerrie* (Africa), the S-shaped *otta* (India), and the *quauhololii* (Aztec).

Kris – *Indonesia.* A wavy-bladed knife of any size, believed by some to possess magical powers. The blade is slotted loosely into the handle, which is usually curved; quality is often *cheap*. Treat as a Small Knife (pp. 67, B272), Large Knife (pp. 67, B272), or Long Knife (p. 69), as appropriate. Not balanced for throwing.

Kukri (p. 67) – *Nepal.* A heavy chopping blade, curved to a 45° angle in the middle. The listed kukri is knife-sized; treat a larger one as a Small Falchion (p. 69) or even a Falchion (p. 69).

Kusari (pp. 67, B272) – *Japan.* A chain weighted at both ends, also called a *kusari-fundo* or *manrikigusari* ("ten-thousand-power chain"). It's possible to "snap" a kusari at the foe end-first. Damage becomes *thrust* crushing, but the attack avoids two of the drawbacks on p. B406: It works even at close quarters and has no chance of hitting you in the face on a critical miss. The Rope Dart (p. 61, 67) can also be used as a kusari in melee.

Kusarigama (p. 67) – *Japan*. A *kama* (Sickle, pp. 62, 65) with a two-yard Kusari (p. B272) attached to the handle's butt. Requires a hand on the handle and a hand on the chain, and counts as a weapon in either hand. The wielder snares the enemy with the kusari (see p. B406 or the Entangle technique in ***GURPS Martial Arts***) and then finishes him with the kama. Treat these as normal kusari and kama attacks, but use the first line of kusarigama statistics for the two-yard kusari. Cinematic warriors sometimes swing the kama by the chain, like an edged flail – use the third stats line – but the GM may forbid this in a realistic game. Some versions affix a four-yard kusari to the butt or a two-yard kusari *atop* the handle, opposite the blade (permits one-handed use but counts as only one weapon, either a kusari *or* a kama – choose each turn); these count as combination weapons.

Kusarijutte (p. 67) – *Japan.* A Jutte (p. 66. 67) with a two-yard Kusari (above; p. B272) attached to the handle. One hand goes on the handle, the other on the chain. Use the standard jutte and kusari rules, except that the short kusari uses the statistics listed for the kusarijutte. Some versions hide the kusari *inside* the jutte and release it out the tip of the weapon (see *Disguised,* p. 14).

Lajatang (p. 68) – *Indonesia.* A polearm with crescent-shaped blades on both ends.

Lance (pp. 67, B272) – *Europe.* "Lance" loosely describes any long spear, but the ***Basic Set*** weapon is a heavy spear sturdy enough to deliver the energy of a horseman equipped with stirrups and a high-backed saddle. It usually has a grip and a handguard, unlike an infantry spear. Specialized *tournament* lances are blunt and shatter on impact; see p. B397.

Light Club (p. 65, B271) – *Universal.* Any *balanced* wooden club, whether a dedicated weapon (good quality or better) or a handy branch, table leg, etc. (cheap). Known by a bewildering array of names, including *cudgel* (Universal) and *shillelagh* (Ireland). *Every* culture has some kind of club, and most languages have a word for the concept.

Long Axe (p. 70) – *Universal.* An Axe (p. 54, B271) with a long handle, designed for two-handed use but occasionally wielded one-handed by strong warriors. Includes the *Dane-axe* or *Danish axe* (Denmark), *English axe* (England), largest *masakari* (Japan), and *Viking axe* (Scandinavia). Historical weapons called "long axe" were sometimes smaller (treat as an Axe, pp. 65, B271) or almost ceremonially large (treat as a Great Axe, pp. 70, B274).

Longsword (pp. 66, 70) – *Germany.* A light Thrusting Bastard Sword (pp. 54, B271, B274) designed for two-handed thrusting. It can be used two-handed normally (use the stats under Two-Handed Sword) or in the Defensive Grip defined in ***GURPS Martial Arts.*** To facilitate this tactic, only the tipmost 6" of the blade was customarily sharpened.

Mace (pp. 65, 70, 77, B271, B276) – *Universal.* Any unbalanced, one-handed war club with a massive stone, wooden, or metal crushing head. The smooth-headed Round Mace (p. 65, 70) is ancient, but modern martial artists still use "melon head hammers" and similar weapons – sometimes even in pairs. The standard Mace (pp. 65, 70, 77, B271, B276), with flanges or spikes for bashing through plate armor, is a classic weapon of medieval Europe. Both represent *large* examples of maces, with handles long enough for comfortable two-handed use; use the stats under Two-Handed Axe/Mace, which differ from using the weapon in the Defensive Grip defined in ***GURPS Martial Arts.*** However, most historical examples were smaller, lighter weapons: the Small Round Mace (pp. 65, 77) and Small Mace (pp. 65, 77, B271, B276). A thrown mace is a deadly projectile; the attacker lobs it rather than hurling it in a straight line.

Machete – *Universal.* A chopping blade used to harvest fruit and clear brush. Treat as a Kukri (p. 67) or a Falchion (p. 69), depending on size – but it may little resemble either, and is often cheap-quality.

Weapons of Quality

Buyers of weapons can apply several modifiers to adjust weapon appearance, balance, sharpness, and toughness. These are "stackable" except as noted – although some are restricted by weapon type. Each has a cost factor (CF); see *Custom-Made Equipment* (p. 14) for rules.

Below, a *thrown weapon* is hurled in its entirety, while a *missile weapon* is a blowpipe, bow, crossbow, etc. that propels a *projectile* such as an arrow, bolt, dart, or pellet.

Balanced:* +1 to skill with any melee weapon, thrown weapon, or projectile; +1 Acc for a missile weapon. All weapons but sticks and improvised weapons: +4 CF.

Cheap†: +2 to odds of breakage (see p. B376). All weapons: -0.6 CF.

Fine†: -1 to odds of breakage; also +1 to damage for any cutting or impaling weapon, or +20% to range for a missile weapon. Projectiles, and crushing- or impaling-only melee or thrown weapons: +2 CF. Fencing weapons, knives, swords, and missile weapons: +3 CF. Other cutting melee or thrown weapons: +9 CF.

Ornate: All weapons but improvised weapons, projectiles, and sticks can use *Styling* (p. 14). Specify details using *Decorated Equipment* (pp. 37-38). Wavy-bladed weapons often count as ornate due to intrinsic shape and design.

Poorly Balanced:* -1 to skill with any melee weapon, thrown weapon, or projectile, or -1 Acc for a missile weapon: -0.6 CF.

Silver†: Metal melee weapons, thrown weapons, and projectiles can be made of solid silver to exploit supernatural monster Vulnerability, but have +2 to odds of breakage: +19 CF. Silver coating for these weapons doesn't worsen breakage but isn't as effective (see p. B275): +2 CF. While valuable, not all silver qualifies as ornate.

Very Fine†: -2 to odds of breakage; also +2 to damage for any cutting or impaling weapon. Crushing-only melee and thrown weapons: +14 CF. Fencing weapons, knives, and swords: +19 CF. Other melee or thrown weapons, and projectiles: +49 CF.

* Balanced and poorly balanced are mutually exclusive.

† Cheap, fine, very fine, and solid silver are mutually exclusive.

Example 1: Prince Boris wants a superb sword. He commissions a thrusting broadsword that's balanced (+1 skill, *+4* CF), very fine (-2 breakage, +2 damage, +19 CF), *and* ornate (+3 reactions, +9 CF). Total CF is *+32*, multiplying cost by 1 + *32* = *33*. Applying this to the sword's $600 list price makes final cost $19,800!

Example 2: Leif the Impoverished seeks a bargain blade. The shortsword he finds is cheap (+1 breakage, -0.6 CF) and poorly balanced (-1 skill, -0.6 CF). Total CF is -1.2. As this is below the minimum CF of -0.8, CF is set to -0.8. This multiplies the $400 list cost by 1 - 0.8 = 0.2. The resulting $80 cost buys a truly lousy weapon.

Macuahuilzoctli (p. 69) – *Aztec.* A shortsword-sized version of the Macuahuitl (below).

Macuahuitl (p. 65, 69, 70) – *Aztec.* A wooden club with pieces of obsidian glued into place to create an edge. It usually has a loop to secure it to the wrist. While capable of cutting blows, its obsidian blades are vulnerable to shattering and loosening. If it parries or is parried by any weapon, or is used to strike DR 2+, it suffers -1 to cutting damage until repaired (see *Blade Composition,* p. B275). In addition, on *any* successful attack or successful parry against an armed attack, roll 1d; on 1-2, the edge breaks, reducing the macuahuitl to a club that does swing+1 crushing damage. Fortunately, the weapon has *two* edges – the user can reverse it (a free action) and use the other side until it, too, breaks! Sizes range from the short-sword-length Macuahuilzoctli (above) to the Two-Handed Macuahuitl (p. 70).

Main-Gauche (p. 67) – *France, Italy.* A stiff knife with a large basket hilt and broad crosspiece, designed primarily as a parrying weapon. Used alongside a rapier. Not throwable.

Maul (pp. 70, B274) – *Universal.* A heavy, two-handed hammer.

Miséricorde – *France.* Translates as "mercy," either in the sense of "beg for mercy" or the "mercy" shown by finishing a wounded foe. Describes any stabbing-only knife – typically a Dagger (pp. 67, 77, B272, B276), Rondel Dagger (p. 67), or Stiletto (p. 67) – and refers to its use to attack chinks in the armor of fallen knights.

Monk's Spade (p. 68) – *China.* A polearm with a sharp, spade-like head on one end and a crescent-shaped blade on the other.

Morningstar (pp. 66, B272) – *Europe.* A one-handed flail consisting of a handle linked to a spiked striking head by a chain. Some sources use the term for a Mace (pp. 58, B271) with a spiked striking head.

Myrmex (p. 65) – *Ancient Greece.* Leather hand wrapping with sharp edges that inflict shallow cuts when punching. Gives DR 1 to the hand – but also Bad Grip 1 (p. B123).

Naginata (pp. 68, 70, B272-274) – *Japan.* A staff-length polearm with a sword-like head. The *nagamaki* (Japan) and *rhomphaia* (Ancient Thrace) have a longer blade and a shorter staff, but can use the same stats. Includes bladed versions of the *ngao* (Thailand).

Net (p. B276) – *Ancient Rome.* A weighted net designed for combat. The Melee Net (p. 76) is a one-handed thrown or melee weapon, used by Roman gladiators in conjunction with the Trident (p. 64). It offers a Block defense of (skill/2) + 3, but provides no DB – and as it's Diffuse (p. B380), it will only stop 1-2 points of damage if used to block a missile. The Large Net (p. 76) requires two hands and is only for throwing, but is also harder to escape from; see p. B411 for rules. A fighter with a net can trail it in front of him to trip foes.

The hex containing the net is bad footing. Furthermore, the wielder can try to yank the net out from under the enemy. Roll a Quick Contest of ST. If the user wins, his opponent falls. Otherwise, nothing happens . . . but if his ST roll is a critical failure, *he* falls instead!

Nunchaku (pp. 66, B272) **–** *Okinawa.* A flail consisting of two lengths of wood linked by a chain or cord, the length of which varies but is usually short. Sometimes wielded in pairs. Includes the *sang-jyel-bong* (Korea).

Oar (p. 68) **–** *Universal.* A *large* oar, used as a makeshift polearm. Small-craft oars have been used as improvised weapons worldwide. Includes the *eku* (Okinawa) and *taiaha* (Maori).

Partisan – *Europe.* A spear with triangular spikes ("ears") at the base of a broad head. This prevents impaled foes from running themselves through to close with the wielder (***Martial Arts,*** p. 106). Otherwise, treat as an unthrowable Spear (pp. 69, B273). Also known as a *Bohemian ear-spoon, ranseur, spetum,* or *spontoon* (Europe), or a *magari-yari* (Japan). The *boar spear* (Europe) – used for hunting – has blunt spikes, but is otherwise identical.

Pata (p. 65) **–** *India.* A broadsword-sized Katar (pp. 54, 67), commonly used by horsemen. It has an integrated armored gauntlet to protect the hand. This acts as an enclosed basket hilt, giving the hand DR 4 but making it impossible to wear a metal gauntlet on that hand. The pata is too long for effective parrying using unarmed skills. Treat shorter versions as a Katar with an enclosed basket hilt (see ***GURPS Low-Tech Companion 2***).

Pick (pp. 65, B271) **–** *Universal.* A one-handed war club with a beaked head mounted at right angles to the handle. It's designed to penetrate armor; the narrow tip removes -2 of the penalty for targeting chinks in armor (p. B400). Also known as the *zaghnal* (India). The *martel-de-fer* (France) is a pick with a hammer head on the peen.

Pike (p. 69) **–** *Ancient Greece, Europe.* A *very* long spear, designed for use in formation. The weapon table lists a five-yard pike; shorter and longer ones are available. A four-yard pike: Reach 3, 4*, Weight 10 lbs., ST 11†. A six-yard pike: Reach 5, 6*, Weight 15 lbs., ST 13†. Treat a three-yard or shorter pike as a Long Spear or a Spear (pp. 69, B273). Includes the *nagae-yari* (Japan) and *sarissa* (Macedon).

Poleaxe (pp. 68, B272) **–** *Europe.* A large axe head on a long pole, backed by a hammer head. Few, if any, historical weapons resembled this combination – but some *fantasy* weapons might! For a more elaborate dueling weapon, see the Pollaxe (below); for simpler and shorter large axes, use the Great Axe (pp. 70, B274).

Pollaxe (p. 68) **–** *Europe.* A dueling polearm with an axe *or* hammer head, a beaked peen, a top spike, a spiked butt, and a metal-reinforced shaft. Purpose-built for duels between armored knights, the pollaxe is optimized for the Defensive Grip defined in ***GURPS Martial Arts.*** Even in games that don't use that option, the GM with ***Martial Arts*** should allow it with *this* weapon. The weapon on the table has a hammer head; if equipped with an axe head instead, it's identical to the Dueling Halberd (p. 68). Not to be confused with the Poleaxe (p. B272). Includes the *bec de corbin* (France).

Qian Kun Ri Yue Dao (pp. 65, 69) **–** *China.* The "heaven and earth, sun and moon sword" is a 4'-5' metal bar with a sickle-like blade at either end. The wielder holds it across his body with his hands inside a pair of handguards – each with *another* crescent-shaped blade on it. He can cut and thrust with one end, "punch" in close combat, or use both ends at once for a Dual-Weapon Attack against two adjacent foes. Attacks with this complex weapon are at -1.

Quadrens (pp. 66, 67) **–** *Ancient Rome.* A very unusual gladiator's "dagger." Evidence of its use is sketchy. Instead of a single blade, it has four thin thrusting spikes arranged in a square pattern. Used with Jitte/Sai skill, it can disarm like a *jitte* (p. 57).

First Encounter With a New Way to Die

Weapons technology isn't static. Conquering armies and intrepid explorers often encounter peoples unfamiliar with their weaponry – and who have exotic arms of their own. This can be surprising, even *scary,* for the unprepared!

Melee Weapon skills are assumed to include the ability to adapt rapidly to new tools and threats. Warriors with such skills can use all weapons listed for them on weapon tables – even completely alien ones – at no penalty. The initial surprise of *facing* unfamiliar weaponry likewise wears off quickly. The essential nature of combat is unchanged.

The GM who desires extra detail can assess optional modifiers when warriors use or confront unusual weaponry, however. The simplest option is to assess -2 to skill when wielding an unfamiliar weapon. This is a straightforward application of *Familiarity* (p. B169).

If this is true, then it follows that *facing* an unfamiliar weapon should also be challenging. Optionally, a fighter has -2 to skill whenever he directly engages a weapon that he has neither seen before nor trained against. This doesn't affect his attack rolls, but it *does* penalize him in Quick Contests (to disarm, feint, etc.) and give -1 to parry the unusual weapon. Usually, *both* fighters will suffer these penalties; in that case, ignore the effect on Quick Contests (it cancels out) and keep only the -1 to parry.

Unfamiliar ranged weapons – especially explosives, guns, and surprisingly long-ranged missiles – can be downright *scary.* The fear is often disproportionate to the danger. Optionally, the GM can require a Fright Check (p. B360) from those facing such potentially fearsome weapons. ***GURPS Martial Arts*** offers other useful rules – notably *Fear* (***Martial Arts,*** p. 113) and *Fear and Martial Artists* (***Martial Arts,*** p. 130).

Quarterstaff (pp. 69, 70, B273-274) – *Universal.* A balanced 5'-7' wooden pole, wielded two-handed, often in a central grip. It enjoys worldwide praise for its defensive utility and ability to deal combat-winning blows. Includes the *bo* (Japan), *jang bong* (Korea), *kettukari* (India), *panthiruchan* (India), bamboo *plong* (Thailand), *rokushakubo* (Okinawa), and *toya* (Indonesia). The GM with ***GURPS Martial Arts*** should let it benefit from *Parrying with Two-Handed Weapons* (***Martial Arts,*** p. 123), even if he doesn't otherwise use that rule. Soldiers regularly learned staff fighting to ensure that they could defend themselves if their polearm lost its head. A broken polearm uses the Long Staff (p. 69) stats – as do the traditional 8'-9' medieval European quarterstaff and the *pikestaff* (England). Drag limits a long staff's striking power, and it requires the Defensive Grip defined in ***Martial Arts*** to be useful at close range.

Rapier (pp. 66, 68, B273) – *Europe.* A long, one-handed sword with a stiff, narrow blade built for stabbing (but not for parrying – rapierists often carried a secondary weapon or a cloak for defense). Despite modern misconceptions, the rapier *isn't* flimsy or fragile; it's simply longer and thinner than a military cut-and-thrust sword of similar weight, as befits a civilian weapon designed to combat lightly armored foes. There are many variations. The Light Rapier (p. 68) is a later-era weapon well on its way to becoming a Smallsword (below, p. B273). Early rapiers generally had sharp edges and enough weight for cutting, and later blades sometimes emulated this. These are the Edged Rapier (p. 66, 68) and Light Edged Rapier (p. 68), respectively.

Rondel Dagger (p. 67) – *Europe.* A heavy dagger with broad discs as its pommel and handguard. The pommel design lets the user drive a blow home with the other hand, erasing -2 of the penalty for targeting chinks in armor (p. B400). If the wielder is wearing gauntlets (any gloves with DR 4+), the discs lock the weapon in place point-down: the user gets +2 to resist disarming (and if using ***GURPS Martial Arts,*** *must* wield the dagger with a Reversed Grip).

Rope Dart (p. 67) – *China.* A small metal throwing spike on the end of a rope. This lets the user retrieve the projectile after hurling it. The dart is smooth and bullet-shaped – not barbed – and can't snag and reel in the *target*. Light, ranged, and retrievable, the rope dart is a useful backup weapon for cavalry. Also known as the *sheng biao* (China).

Saber (pp. 68, B273) – *Europe.* A light, one-handed cut-and-thrust sword built for fencing. Includes the *krabi* (Thailand).

Sai (pp. 66, 67, 77) – *Asia.* A three-tined metal truncheon with a long central spike and a pair of short side prongs. Both side prongs typically point forward, but sometimes one is reversed (no game effect). Most sais had *sharp* points, but improvised ones might be blunt. Similar weapons exist throughout Asia; several predate the sai. The *tuja* (Okinawa) is a small fishing trident, used one-handed. Treat as a sai with a (0.5) armor divisor.

Scimitar – *Asia.* A blanket term for a curved, one-handed slashing sword from Eastern Europe, Turkey, the Middle East, or South Asia, such as the *kiljic* (Ottoman Empire), *podang* (Indonesia), *shamshir* (Persia), *shasqa* (Russia), *talwar* or *tulwar* (India), or *yataghan* (Turkey). A light one is a Shortsword (pp. 69, B273); a heavier one is a Cavalry Saber (pp. 66, B271) if steeply curved, a Thrusting Broadsword (pp. 65, B271) otherwise. A curved *chopping* sword, also common in these parts, is a Falchion (p. 69) or a Large Falchion (p. 65).

Scythe (pp. 70, B274) – *Universal.* A two-handed cutting implement used to harvest grain and mow grass. Rarely a dedicated weapon, but weaponized versions exist. Includes the *ogama* (Japan) and two-handed versions of the *falx* (Dacia).

Shield (pp. 116, B273, B287) – *Universal.* Shields of all sizes appear worldwide. Some are designed for offense. For details, see *Shields* (pp. 113-117) and associated rules in ***GURPS Low-Tech Companion 2.***

Fighting in Style

A common myth is that weapons and armor are all about efficiency – that if a weapon or a piece of armor gains prominence, it *must* be superior to whatever it's replacing. This is only sometimes true. Politics, economics, and fashion also play important roles.

Politics customarily takes the form of prejudice: Effective *foreign* weapons – especially those of a hated enemy – are dismissed in favor of less-capable arms of local design or manufacture. Economics works against adoption of weapons that are costly to make or maintain, or that require expensive or lengthy training. And fashion can lead to a perfectly good weapon that the ruling class regards as a tool of the hoi polloi (or vice versa) being cast aside in favor of a "better" one.

For example, in late-16th-century England, the rapier began to overtake the broadsword among the elite. The rapier was *fashionable,* its use taught to nobles by exotic foreign instructors. While proponents of the broadsword made a good case that it was the more appropriate battlefield weapon, its popularity waned as the rapier's popularity waxed. Later on, though, when smallswords became the fashion, it wasn't *stylish* to wear a rapier – even when it better suited your needs!

Short Staff (pp. 69, B273) – *Universal.* A balanced stick, between 25" and 36" long, made of rattan (often fire-hardened) for training, hardwood for fighting. Often used in pairs. Other names include *chung bong* (Korea), *escrima stick* (Philippines), and *tongkat* (Indonesia).

Shortsword (pp. 69, B273) – *Universal.* A one-handed cut-and-thrust sword between 18" and 24" long. Examples include the *cuttoe* (Europe), *daab* (Thailand), *gladius* (Ancient Rome), *hanger* (Europe), *katzbalger* (Europe), *pedang* (Indonesia), *seax* (Scandinavia), and *wakizashi* (Japan). This represents a weapon intended for war. Blades made as tools are cheaper, less-effective weapons; reduce cost to $350 and apply -1 to thrusting damage. For cut-optimized swords of this size, see Falchion (p. 56).

Shotel (p. 65) – *Abyssinia.* A heavily curved, double-edged sword about 40" in length. Primarily used to stab with the tip around shields or parrying weapons. Its heavy curve makes it tricky to handle (-2 to hit), but parries and blocks against it are at -1. Although edged, it cuts very poorly. Extremely curved examples of the *falx* (Dacia) and other sickle-shaped swords also use these stats.

Sickle (p. 65) – *Universal.* A weaponized farmer's tool. The blade on a weapon-quality sickle is often straight, not crescent-shaped. This allows hooking and swung impaling attacks. Includes the *arit* (Indonesia), *falx* (Dacia), and *kama* (Japan).

Slashing Wheel (p. 67) – *China.* A semicircular blade, sometimes toothed, gripped by a crossbar and used to cut opponents. Often wielded in pairs. The similar *fire wheel* (China) has identical stats.

Smallsword (pp. 69, B273) – *France.* This one-handed thrusting sword is speedy on attack *and* defense, but its light weight and short reach are serious liabilities. The Dress Smallsword (p. 69) is even lighter and shorter, but can pass as a fashion accessory.

Sodegarami (p. 69) – *Japan.* A metal-reinforced staff with barbs along its length and a barbed head that's either forked or T-shaped. The design is intended to snag clothing; see *Hook* (p. 54) for its standard attack. The related *sasumata* ends in a wide, blunt fork intended to enclose the opponent's torso. Use the same statistics, but remove the thrust+2 crushing attack. However, a sasumata wielder can shove (p. B372) a standing foe using the Staff skill, or pin (p. B370) him if he's prone or against a wall – both at Reach 1, 2. This weapon includes the *mancatcher* (Europe). The pole-lasso, or *uurga* (Mongolia), has a rope loop at the end of a pole, and is used like a polearm but can entangle like a lasso (p. B411): Reach 2, 3*, Cost $40, Weight 6 lbs.

Spear (pp. 69, 77, B273, B276) – *Universal.* A pole with a pointed stabbing head, prized for its versatility: long, useful in one hand or two, often throwable, and uniformly deadly. The spear is a truly universal weapon; examples include the *bolg* (Ancient Celts), *chiang* (China), *hasta* (Ancient Rome), *ngao* (Thailand), *sibat* (Philippines), and *yari* (Japan), to name only a few. Many variants sacrifice some flexibility for special-purpose effectiveness. For instance, the yari sometimes has an L-shaped head; this adds $10 and 0.5 lb, and enables the rules under *Hook* (p. 54), but renders the spear unthrowable. Other spears have a crescent-shaped or semi-circular head instead of a pointed tip; damage becomes cutting, but other stats are unchanged. The Short Spear (p. 69) – short, one-handed, and unthrowable – is a poor man's stabbing sword; an example is the *rochin* (Japan). The Long Spear (pp. 69, B273) is exclusively a melee weapon, employed with or without a shield for formation fighting. The Heavy Spear (p. 69) is similar, but has an extra-wide head for disemboweling; it's so massive that it *requires* two hands. Heavy spears include the *dory* and *kontos* (both Ancient Greece).

Stiletto (p. 67) – *Italy.* A thin, stiff dagger that can penetrate links of mail and the joints of plate armor. The narrow blade removes -2 of the penalty for targeting chinks in armor (p. B400).

Tachi – *Japan.* Treat this cavalry sword as a Cavalry Saber (p. 66, B271) or a Katana (pp. 66, 70, B271, B274), depending on size. The main difference from the katana is that it's slung, not thrust through a sash.

Tebutje – *Polynesia.* A wooden club with shark's teeth affixed using vegetable-fiber thread to create an edge. Treat as a Macuahuitl (p. 65) made of bone (p. 71), but it can also stab for thrust-1 impaling damage.

Tepoztopilli – *Aztec.* A wooden Spear (above; pp. B273, B276) with pieces of obsidian inserted around the perimeter of the head. If used to strike DR 2+, it suffers -1 to thrusting damage until repaired; see *Blade Composition* (p. B275). This *doesn't* happen on a parry, which is done using the shaft and not the fragile obsidian head.

Tetsubo (p. 70) – *Japan.* The name means "iron staff," but it's actually a two-handed *wooden* club with an iron-studded cap. Usually used in the Defensive Grip defined in ***GURPS Martial Arts.*** Also known as the *kanabo* (Japan).

Thonged Club (p. 66) – *Universal.* A small truncheon with an attached cord. Use the listed statistics when swinging it by the cord; otherwise, treat as a cheap-quality Blackjack (pp. 65, B271).

Three-Part Staff (p. 70) – *China.* Three short staffs linked by rope or chain, used two-handed – traditionally with the Defensive Grip defined in ***GURPS Martial Arts.*** The wielder can grasp it at one end and swing it as an extra-long flail, or employ both ends like clubs or nunchaku for a Dual-Weapon Attack on adjacent foes. A difficult weapon; all attacks are at -1. Also known as the *san jie gun* (China).

Tip Slash

If your weapon can thrust for impaling damage, you can swing it so that its tip pierces and rips across the target laterally. This Tip Slash is a *cutting* attack for all purposes: wounding modifiers, Injury Tolerance, etc. It's useful when impaling damage doesn't affect your target much!

Tip Slash is an attack at full skill, distinct from other attacks on the weapon table. Cutting damage equals the weapon's impaling damage at -2, unless otherwise specified. Weapon quality affects this normally. Where rules distinguish between thrusts and swings (e.g., parrying unarmed), Tip Slash is a *swing,* despite using thrust damage.

Tip Slash uses the weapon's current maximum Reach. If holding the weapon in a grip that permits two or more different attacks, use the *longest* Reach. Parry and ST are unaffected.

Examples: A Tip Slash using a dagger (thrust-1 impaling) inflicts thrust-3 cutting at Reach C. A Tip Slash with a long spear held two-handed (thrust+3 impaling) delivers thrust+1 cutting at Reach 2 *or* 3, depending on how you hold it.

For more information, see ***GURPS Martial Arts,*** p. 113.

Improvised Weapons

A real weapon is preferable to an improvised one – but an improvised one is much better than nothing. Below are some common items that can stand in for actual weapons at skill and/or damage penalties. Required skills or techniques appear in brackets. The Improvised Weapons perk (p. 9) for a skill lets you ignore penalties to that skill but *not* to damage. Numerous tools can function as weapons, too; notes on damage, skill, etc. appear in many entries in ***Low-Tech.***

Treat an improvised weapon as *cheap* for all purposes. If it uses an unarmed skill or technique, the user can still parry with his hand. If it uses a weapon skill, it *can't* parry. Exceptions are specifically noted. Glass objects break on 1-3 on 1d on any strike or parry; on a 1, you also suffer thrust cutting damage to the hand.

Abacus: Punch at +1 damage [Brawling-2]. Cannot parry.

Arrow or Bolt: Strike as dagger at full damage, maximum 1d-4, but *fragile* – breaks on 1-3 on 1d on any successful strike or parry. Apply any special features of the arrowhead (see *Alternate Arrows,* p. 73), such as barbs or damage-type changes, to the attack.

Belt: Choke as rope garrote at -1 damage [Garrote-1]. Strike with buckle as thonged club at -1 damage [Flail-1]. Strike or entangle as one-yard whip at -1 damage [Whip-2].

Book or Codex: Strike as blackjack at -2 damage [Brawling-2]. Cannot parry – but held two-handed, acts as small shield [Shield-1].

Bootlaces: Choke as rope garrote at -1 damage [Garrote-2].

Boots, Shoes, or Sandals: Held in hand, strike as blackjack at -1 damage [Brawling-2]. Swung by laces, strike as thonged club at -1 damage [Flail-2]. May be *thrown* by laces as bola perdida at -1 damage and half range [Sling-2].

Bottle, Broken: Strike as small knife at full damage but with armor divisor (0.5) [Knife-2].

Bottle, Intact: Strike as knobbed club at -2 damage [Axe/Mace-2]. If it breaks, treat as "Bottle, Broken." Can parry.

Caltrop: As fist load, strike for thrust-2 impaling damage [Brawling-2]. Can be *thrown* as spike shuriken at -1 damage and half range [Thrown Weapon (Shuriken)-2].

Chain, Unweighted: Strike as kusari at -1 damage [Kusari-1] or entangle as kusari [Kusari-4]. Cheap chain is $6, 2 lbs. per yard.

Chair or Stool: Swing as maul at -1 damage [Two-Handed Axe/Mace-2]. Can parry. Held in one hand, acts as medium shield [Shield-1]. Collapsible chairs or stools are flimsier, and do -2 damage.

Chopstick: Punch as yawara [Hammer Fist-1].*

Comb or Brush: Punch as yawara [Hammer Fist-1].*

Key, Skeleton: Punch as yawara [Hammer Fist-1].*

Mug or Stein: Strike as knobbed club at -1 damage [Axe/Mace-2]. A *large* mug or stein strikes as small mace at -1 damage [Axe/Mace-2].

Musket or Rifle: If swung like a large club while gripping the barrel, strike as maul at -1 damage [Two-Handed Axe/Mace]; TL4 long arms are built for this, unlike high-tech ones. Striking with the end of the butt inflicts thrusting damage as quarterstaff [Staff].

Pan, Iron: Strike as round mace at -1 damage [Axe/Mace-2]. In one hand, can be used as iron small shield [Shield-1]. An unwieldy but solid weapon – breakage is as for *good* quality!

Pen or Stylus: Stab as dagger at -2 damage (-1 for a *huge* pen) [Knife-1].

Pistol: Large pistols in this era, such as horse pistols and naval pistols, are often designed for attacks with the butt; strike as small mace at -1 damage [Axe/Mace]. Smaller pistols can reinforce a punch; read Bulk as a positive number and add it to punch damage [Brawling or DX].

Pitchfork: Strike as trident at -1 damage [Spear-2]. Can parry.

Purse, Coin (Filled): Strike as blackjack [Brawling-1]. If it breaks, its contents spill out!

Rake: Strike as warhammer at -1 damage and with armor divisor (0.5) [Two-Handed Axe/Mace-2]. Can parry.

Rim of Bottle, Cup, or Glass: Punch as yawara [Hammer Fist-1].*

Rings, Heavy: Sufficient large and heavy rings worn on the knuckles can reinforce a punch; add +1 to punch damage. Cannot be combined with brass knuckles or gauntlets.

Scarf: Choke as rope garrote at full damage [Garrote-1]. Knotting something heavy into an end creates a weighted scarf that strikes at full damage [Flail-1].

Scroll, Rolled: Strike as baton at -1 damage [Shortsword-2]. Can parry.

Shovel: Strike as maul at -1 damage [Two-Handed Axe/Mace-2]. Can parry.

Spindle, Spike, or Spit: Depending on the size, strike as dagger at -2 damage (small spit), dagger at -1 damage, or large knife at -1 damage (*long* spit or spindle), all [Knife-2]. Can parry.

Strigil: Punch as yawara [Hammer Fist-1]* or use with *Hook* (p. 54) [Knife-1]. Can parry.

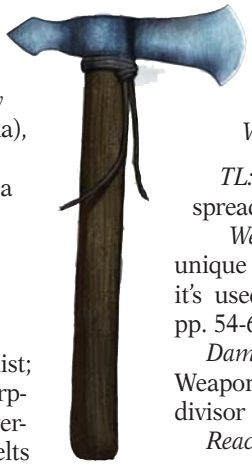
* See *Yawara* (p. 64) for more on Hammer Fist. Warriors who know Pressure Secrets (p. B215) may instead use such an item to punch at no penalty beyond the standard -2 for that skill. This gives +1 on the ensuing Pressure Secrets roll. The load still grants the yawara's +1 to damage. An edged article, like the strigil, enables Pressure Secrets to act as a *cutting* attack instead of an impaling one, if the attacker prefers.

Throwing Axe (pp. 65, 70, 77, B271, B276) – *Europe.* An Axe (pp. 54, B271) balanced for throwing. It comes in many varieties. The full-sized version has a sufficiently long handle that it can be comfortably wielded two-handed; use the stats under Two-Handed Axe/Mace, which differ from holding the weapon in the Defensive Grip defined in ***GURPS Martial Arts.*** The Small Throwing Axe (pp. 65, 77) is halfway between a full-sized axe and a Hatchet (pp. 65, 77, B271, B276) in size. Cruciform throwing axes (and hatchets) that lack proper handles give -2 to skill as melee weapons but cost $10 less.

Tomahawk – *American Indian.* A Hatchet (pp. 65, 77, B271, B276), Small Axe (p. 65), or Small Throwing Axe (pp. 65, 77), depending on size and balance. Often sports a back spike (pick); treat such variants as combination weapons.

Tonfa (pp. 65, 70) – *Okinawa.* A side-handled Baton (pp. 54, B273), often used in pairs. Held in a Reversed Grip (see ***GURPS Martial Arts***) to aid Karate parries and enhance punches, or quickly spun to strike as a club. Includes the *mae sun-sawk* (Thailand).

Trident (p. 69) – *Universal.* A three-tined fork based on a fishing spear. Used with a Net (pp. 59, B276) by Roman gladiators. Multiple tines make it tip-heavy (-2 to hit) and easy to intercept (+1 to target's Block or Parry), and distribute the force of impact (armor divisor (0.5)), but are tricky to evade (-1 to enemy's Dodge). Includes the *cha* (China), *fuscina* (Ancient Rome), *military fork* (Europe), and *southern-tiger fork* (China), and forked versions of the *ngao* (Thailand).



Truncheon – *Universal.* A generic term for a club of Blackjack (pp. 55, B271) to Baton (pp. 54, B273) size.

Urumi (p. 70) – *India.* A one-handed sword with a long, flexible blade, used to whip the target. Cutting damage assumes that one or both edges are sharp. Blunt urumi exist; these can only make crushing attacks. Sharpness doesn't affect cost or weight. Shorter versions are possible; they're worn like metal belts and are consequently known as *belt swords:* Damage sw-2 cr or sw-2(0.5) cut, Reach 1, 2, Cost $300, Weight 2 lbs., ST 7. These get +1 to Holdout, but lack of a useful handguard gives an *additional* -1 to Parry.

Warhammer (pp. 70, B274) – *Europe.* A long, two-handed Pick (pp. 60, B271). Often given a heavy hammer behind the spike; treat as a combination weapon.

Weighted Scarf (p. 66) – *India.* A scarf with a weight in one or both ends. Famously used as a Garrote (p. B272) by the Thuggee cult, but also a serviceable light flail.

Whip (pp. 70, B274) – *Universal.* A length of braided leather that allows the wielder to deliver lashes or snare the enemy (see p. B406 or the Entangle technique in ***GURPS Martial Arts***). At 2 lbs. per yard, it's both weighted *and* studded. The Light Whip (p. 70) lacks such enhancements, and is used primarily for entangling.

Wooden Stake (pp. 67, 77, B272, B276) – *Universal.* A pointed stick. Better than nothing. Includes the *liangtjat* and *paku* (both Indonesia).

Wooden Sword – *Universal.* Any sword might have a wooden version. An example is the Japanese Bokken (p. 55) or *bokuto,* a wooden katana. Shortsword-sized weapons include the German Dusack (p. 56) and the *rudis* (Ancient Rome). A wooden sword of any size is also known as a *waster* (England).

Yawara – *Japan.* A short stick held in the fist with its ends protruding, used as a fist load and a lever. Cost and weight are as Brass Knuckles (pp. 65, B271) – but instead of giving +1 to damage with ordinary punches, it gives +1 to damage with the Hammer Fist technique in ***GURPS Martial Arts.*** This punch is at -1 to skill *and* -1 to damage (the +1 for a yawara cancels this out, giving normal punching damage), but uses 1/10 damage instead of 1/5 damage for *Hurting Yourself* (p. B379). A yawara also grants +1 to follow-up rolls with Judo holds and locks (to injure, prevent escape, etc.). The similar *dokko, kubotan,* and *tenouchi* use identical rules.

Melee Weapon Table

The following table includes not just the melee weapons on pp. 54-64, but also those from the ***Basic Set,*** some of which have revised statistics. Each weapon appears once per skill that can be used to wield it. Weapons capable of several different attacks get one line per basic attack. In all cases, "–" means the statistic doesn't apply, "var." means the value varies, and "spec." indicates that special rules apply; see the footnotes. Other terms and notation are as defined in *Weapon Statistics* (pp. B268-271). For quick reference:

TL: The tech level at which the weapon became widespread in the real world.

Weapon: The name of the specific weapon if it's unique to a particular culture, or of the *class* of weapon if it's used in many places (see the appropriate entry on pp. 54-64).

Damage: The ST-based damage that the weapon inflicts. Weapons that are poor at penetrating armor have an armor divisor of (0.5), which multiplies DR by 2.

Reach: The weapon's reach, in yards. "C" indicates a weapon for close combat (see p. B391). A weapon with multiple reaches (e.g., "1, 2") can strike at any of those reaches – but an asterisk (*) means that changing reach requires a Ready maneuver.

Parry: The modifier to parry when using the weapon with the indicated skill. "F" means the weapon is a fencing weapon (see p. B404). "U" means it's unbalanced and can't parry on the turn it attacks. "No" means it *can't* parry!

Cost: The price of a new weapon, in $.

Weight: The weapon's weight, in lbs. Realistic low-tech weaponry can span a range of weights; the number on the table is for a common example. Weight includes a sheath, carrying loop, and/or cover; for details, see *Optional Rule: Sheaths* (p. 57).

ST: The minimum ST needed to wield the weapon properly; fighters with lower ST suffer -1 to skill per point of ST deficit. Effective ST for damage purposes can't exceed triple the listed ST. "†" means the weapon requires two hands; "‡" means it requires two hands and becomes *unready* after an attack unless you have at least 1.5 times the listed ST.

Notes: Any special notes, including applicable footnotes at the end of the table.

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
AXE/MACE (DX-5, Flail-4, or Two-Handed Axe/Mace-3)								
0	Axe	sw+2 cut	1	0U	$50	4	11	
0	Hatchet	sw cut	1	0	$40	2	8	[1]
0	Knobbed Club	sw+1 cr	1	0	$20	2	8	
0	Round Mace	sw+2 cr	1	0U	$35	5	12	[1]
0	Small Axe	sw+1 cut	1	0U	$45	3	10	
0	Small Round Mace	sw+1 cr	1	0U	$25	3	10	[1]
0	Small Throwing Axe	sw+1 cut	1	0U	$50	3	10	[1]
0	Throwing Axe	sw+2 cut	1	0U	$60	4	11	[1]
1	Khopesh	sw+1 cut	1	0U	$450	3	10	
	or	thr-2 cut	1	0U	–	–	10	Hook. [2]
1	Sickle	sw cut	1	0	$40	2	8	
	or	sw imp	1	0U	–	–	8	[3]
	or	thr-2 cut	1	0U	–	–	8	Hook. [2]
2	Mace	sw+3 cr	1	0U	$50	5	12	[1]
2	Small Mace	sw+2 cr	1	0U	$35	3	10	[1]
3	Pick	sw+1 imp	1	0U	$70	3	10	[3, 4]
BOXING, BRAWLING, KARATE, or DX								
1	Brass Knuckles	thr cr	C	0	$10	0.25	–	[5]
1	Myrmex	thr cr	C	0	$20	0.25	–	[5, 6]
2	Cestus	thr cr	C	0	$50	1	–	[5, 6]
BRAWLING or DX								
1	Blackjack	thr cr	C	0	$20	1	7	[5]
3	Combat Fan	thr cr	C	0	$40	1	7	[5]
	or	thr-2 cut	C	0	–	–	6	-2 to hit.
3	Hook Sword	thr-1 cut	C	0	$200	3	–	Hilt punch. [5, 6]
3	Qian Kun Ri Yue Dao	thr-1 cut	C	0	$250	3	–	Hilt punch. [5, 6]
4	Backsword	thr cr	C	0	$550	3	–	Hilt punch. [5, 6]
4	Cutlass	thr cr	C	0	$500	2	–	Hilt punch. [5, 6]
BRAWLING, KARATE, or DX								
3	Bladed Hand	sw-2 cut	C	0	$100	1	6	[5]
	or	thr imp	C	0	–	–	6	[5]
3	Tonfa	thr cr	C	0	$40	1.5	–	Butt jab. [5]
3	Shuriken	thr-2 cut	C	0	$3	0.1	–	Used to claw. [1, 5]
BROADSWORD (DX-5, Force Sword-4, Rapier-4, Saber-4, Shortsword-2, or Two-Handed Sword-4)								
0	Jo	sw cr	1	0	$10	2	9	
	or	thr cr	1	0	–	–	9	
0	Light Club	sw+1 cr	1	0	$5	3	10	
	or	thr+1 cr	1	0	–	–	10	
0	Macuahuitl	sw+2(0.5) cut	1	0	$500	3	10	
	or	thr+1 cr	1	0	–	–	10	
1	Khopesh	sw+1 cut	1	0U	$450	3	10	
	or	thr-2 cut	1	0U	–	–	10	Hook. [2]
2	Broadsword	sw+1 cut	1	0	$500	3	10	
	or	thr+1 cr	1	0	–	–	10	
2	Large Falchion	sw+2 cut	1	0U	$625	4.5	11	
	or	thr-1 imp	1	0U	–	–	11	
2	Pata	sw cut	1	0	$650	3.75	10	[6]
	or	thr+3 imp	1	0	–	–	10	
2	Shotel	thr+1 imp	1	0	$200	3	11	-2 to hit. [7]
	or	sw-1 cut	1	0U	–	–	11	
2	Thrusting Broadsword	sw+1 cut	1	0	$600	3	10	
	or	thr+2 imp	1	0	–	–	10	
3	Bastard Sword	sw+1 cut	1, 2	0U	$650	5	11	
	or	thr+1 cr	2	0U	–	–	11	

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST	Notes
BROADSWORD *(Continued)*								
3	Bokken	sw+1 cr	1	0	$40	3	10	
	or	thr+1 cr	1	0	–	–	10	
3	Dao	sw+2 cut	1	0U	$700	5	11	
	or	thr imp	1	0U	–	–	11	
3	Estoc	thr+2 imp	1	0	$500	3	10	[4]
	or	sw+1 cr	1	0	–	–	10	
3	Hook Sword	sw+1 cr	1	0	$200	3	10	[6]
	or	thr+1 cr	1	0	–	–	10	
	or	thr-2 cut	1	0	–	–	10	Hook. [2, 8]
3	Jian	sw cut	1	0	$700	3	10	
	or	thr+1 imp	1, 2	0	–	–	10	
3	Katana	sw+1 cut	1, 2	0	$650	5	11	
	or	thr+1 imp	1	0	–	–	11	
3	Longsword	sw+1 cut	1	0	$700	4	10	
	or	thr+2 imp	1, 2	0	–	–	10	
3	Thrusting Bastard Sword	sw+1 cut	1, 2	0U	$750	5	11	
	or	thr+2 imp	2	0U	–	–	11	
4	Backsword	sw+1 cut	1	0	$550	3	10	[6]
	or	thr+1 imp	1	0	–	–	10	
4	Cavalry Saber	sw+1 cut	1	0	$500	3	10	
	or	thr+1 imp	1	0	–	–	10	
4	Edged Rapier	sw cut	1, 2	0	$1,000	3	10	
	or	thr+1 imp	1, 2	0	–	–	10	
4	Late Katana	sw+1 cut	1	0	$550	3	10	
	or	thr+1 imp	1	0	–	–	10	

FLAIL (DX-6, Axe/Mace-4, or Two-Handed Flail-3)								
0	Bola Perdida	sw cr	1	-2U	$10	1	6	[1, 9]
0	Bolas	sw+1 cr	1	-2U	$20	2	7	[1, 9]
0	Thonged Club	sw-1 cr	1	-2U	$5	0.5	5	[9]
0	Weighted Scarf	sw cr	1	-2U	$10	1	6	[9]
3	Morningstar	sw+3 cr	1	0U	$80	6	12	[9]
3	Nunchaku	sw+1 cr	1	0U	$20	2	7	[9]
GARROTE (DX-4)								
0	Garrote	spec.	C	No	$2	neg.	–	[10]
0	Weighted Scarf	spec.	C	No	$10	1	–	[10]
JITTE/SAI (DX-5, Force Sword-4, Main-Gauche-4, or Shortsword-3)								
2	Quadrens	thr+1(0.5) imp	C, 1	0	$200	2	8	[11]
3	Jutte	sw cr	1	0	$40	1	6	[11]
	or	thr cr	1	0	–	–	6	
3	Sai	sw cr	1	0	$60	1.5	7	[1, 11]
	or	thr imp	1	0	–	–	7	

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST	Notes
JUDO, SUMO WRESTLING, WRESTLING, or DX								
3	Kakute	spec.	C	No	$10	0.1	–	+1 vs. break free.
KNIFE (DX-4, Force Sword-3, Main-Gauche-3, or Shortsword-3)								
0	Large Knife	sw-2 cut	C, 1	-1	$40	1	6	
	or	thr imp	C	-1	–	–	6	[1]
0	Short Baton	sw-1 cr	C, 1	-1	$10	0.5	5	
	or	thr cr	C	-1	–	–	5	
0	Small Knife	sw-3 cut	C, 1	-1	$30	0.5	5	
	or	thr-1 imp	C	-1	–	–	5	[1]
0	Wooden Stake	thr(0.5) imp	C	-1	$4	0.5	5	[1]
1	Dagger	thr-1 imp	C	-1	$20	0.25	5	[1]
1	Long Knife	sw-1 cut	C, 1	0	$120	1.5	7	
	or	thr imp	C, 1	0	–	–	7	
2	Katar	sw-3 cut	C, 1	-1	$50	1	6	[4, 6, 12]
	or	thr+1 imp	C	-1	–	–	6	
2	Kukri	sw-1 cut	C, 1	0	$50	1.5	7	
	or	thr-1 imp	C	0	–	–	7	
2	Quadrens	thr+1(0.5) imp	C, 1	0	$200	2	8	
3	Balisong	sw-3 cut	C, 1	-1	$50	0.5	5	+1 Holdout.
	or	thr-1 imp	C	-1	–	–	5	
3	Deer Antlers	thr+1 cut	C	0	$75	1.5	5	[6, 8]
3	Knife-Wheel	thr+1 cut	C	0	$75	1.5	5	[6]
	or	thr-1 imp	C	0	–	–	5	
3	Rondel Dagger	thr imp	C	-1	$40	1	6	[4]
3	Slashing Wheel	thr+1 cut	C	0	$60	1	5	[6]
3	Stiletto	thr-1 imp	C	-1	$20	0.25	5	[4]
4	Main-Gauche	sw-3 cut	C, 1	0	$50	1.25	6	[6]
	or	thr imp	C	0	–	–	6	
KUSARI (DX-6, Monowire Whip-3, Two-Handed Flail-4, or Whip-3)								
2	Rope Dart	sw-1 cr	1-4	-2U	$30	0.5	5†	[9, 13]
	or	thr-1 imp	1-4	-2U	–	–	5†	[9, 13]
3	Chain Whip	sw+(1-4) cr	1-4*	-2U	$50/yd.	3/yd.	var.†	[9, 14]
3	Kusari	sw+2 cr	1-4*	-2U	$70	5	11	[9]
	or	thr+2 cr	1-4*	-2U	–	–	11	[9]
3	Kusarigama	sw+2 cr	1, 2*	-2U	$80	4.5	10†	[9]
	or	thr+2 cr	1, 2*	-2U	–	–	10†	[9]
	or	sw+2 cut	1, 2*	-2U	–	–	11†	[9, 15]
3	Kusarijutte	sw+2 cr	1, 2*	-2U	$80	3.5	8†	[9]
	or	thr+2 cr	1, 2*	-2U	–	–	8†	[9]
LANCE (DX-5 or Spear-3)								
2	Lance	thr+3 imp	4	No	$60	6	12	[16]
MAIN-GAUCHE (DX-5, Jitte/Sai-4, Knife-4, Rapier-3, Saber-3, or Smallsword-3)								
3	Deer Antlers	thr+1 cut	C	0F	$75	1.5	5	[6, 8]
3	Jutte	sw cr	1	0F	$40	1	6	
	or	thr cr	1	0F	–	–	6	
3	Knife-Wheel	thr+1 cut	C	0F	$75	1.5	5	[6]
	or	thr-1 imp	C	0F	–	–	5	
3	Rondel Dagger	thr imp	C	0F	$40	1	6	[4]
3	Sai	sw cr	1	0F	$60	1.5	7	[1]
	or	thr imp	1	0F	–	–	7	
3	Slashing Wheel	thr+1 cut	C	0F	$60	1	5	[6]
3	Stiletto	thr-1 imp	C	0F	$20	0.25	5	[4]
4	Main-Gauche	sw-3 cut	C, 1	0F	$50	1.25	6	[6]
	or	thr imp	C, 1	0F	–	–	6	

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST	Notes
POLEARM (DX-5, Spear-4, Staff-4, or Two-Handed Axe/Mace-4)								
0	Oar	sw+3 cr	1, 2*	0U	$40	8	12‡	
1	Glaive	sw+3 cut	2, 3*	0U	$100	8	11‡	
	or	thr+3 imp	1-3*	0U	–	–	11†	
2	Naginata	sw+2 cut	1, 2*	0U	$100	6	9†	
	or	thr+3 imp	2	0	–	–	9†	
3	Bill	sw+3 cut	2, 3*	0U	$125	8	11‡	
	or	thr+3 imp	1-3*	0U	–	–	11†	
	or	thr-1 cut	1-3*	0U	–	–	11†	Hook. [2, 8]
3	Dueling Bill	sw+2 cut	1, 2*	0U	$100	6	9†	
	or	thr+3 imp	1, 2*	0	–	–	9†	
	or	thr-1 cut	1, 2*	0U	–	–	9†	Hook. [2, 8]
3	Dueling Glaive	sw+2 cut	1, 2*	0U	$80	6	9†	
	or	thr+3 imp	1, 2*	0	–	–	9†	
3	Dueling Halberd	sw+4 cut	1, 2*	0U	$120	10	12†	
	or	sw+3 imp	1, 2*	0U	–	–	12†	[3]
	or	thr+3 imp	1, 2*	0	–	–	11†	
3	Halberd	sw+5 cut	2, 3*	0U	$150	12	13‡	
	or	sw+4 imp	2, 3*	0U	–	–	13‡	[3]
	or	thr+3 imp	1-3*	0U	–	–	12†	
3	Heavy Horse-Cutter	sw+5 cut	2, 3*	0U	$150	12	13‡	
	or	thr+3 imp	1-3*	0U	–	–	12†	
3	Lajatang	sw+2 cut	1, 2*	0U	$100	7	10†	
	or	thr+2 cut	1, 2*	0	–	–	10†	
3	Light Horse-Cutter	sw+4 cut	1, 2*	0U	$120	8	11‡	
	or	thr+3 imp	1, 2*	0U	–	–	11†	
3	Monk's Spade	sw+1 cut	1, 2*	0U	$100	6	9†	
	or	sw+2 cr	1, 2*	0U	–	–	9†	
	or	thr+2 cut	1, 2*	0	–	–	9†	
3	Poleaxe	sw+4 cut	2, 3*	0U	$120	10	12‡	
	or	sw+4 cr	2, 3*	0U	–	–	12‡	
3	Pollaxe	sw+4 cr	1, 2*	0U	$120	10	12†	
	or	sw+3 imp	1, 2*	0U	–	–	12†	[3]
	or	thr+3 imp	1, 2*	0	–	–	11†	

RAPIER (DX-5, Broadsword-4, Main-Gauche-3, Saber-3, or Smallsword-3)								
3	Jian	sw cut	1	0F	$700	3	10	
	or	thr+1 imp	1, 2	0F	–	–	10	
4	Edged Rapier	sw cut	1, 2	0F	$1,000	3	10	
	or	thr+1 imp	1, 2	0F	–	–	10	
4	Light Edged Rapier	sw-1 cut	1	0F	$700	2.25	8	
	or	thr+1 imp	1	0F	–	–	8	
4	Light Rapier	thr+1 imp	1	0F	$400	2	8	
4	Rapier	thr+1 imp	1, 2	0F	$500	2.75	9	
SABER (DX-5, Broadsword-4, Main-Gauche-3, Rapier-3, Shortsword-4, or Smallsword-3)								
4	Saber	sw-1 cut	1	0F	$700	2	8	
	or	thr+1 imp	1	0F	–	–	8	
SHIELD (DX-4)								
0	Shield Bash	thr cr	1	No	var.	var.	–	
1	Shield Bash w. Long Spike	thr+1 imp	1	No	var.	var.	–	
1	Shield Bash w. Sharp edge	sw-2 cut	1	No	var.	var.	–	
1	Shield Bash w. Spike	thr+1 cr	1	No	var.	var.	–	

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST	Notes
SHORTSWORD (DX-5, Broadsword-2, Force Sword-4, Jitte/Sai-3, Knife-4, Saber-4, Smallsword-4, or Tonfa-3)								
0	Baton	sw cr	1	0	$20	1	6	
	or	thr cr	1	0	–	–	6	
0	Macuahuilzoctli	sw+1(0.5) cut	1	0	$350	2	8	
	or	thr cr	1	0	–	–	8	
0	Short Baton	sw-1 cr	C, 1	-1	$10	0.5	5	
	or	thr cr	C	-1	–	–	5	
1	Long Knife	sw-1 cut	1	0	$120	1.5	7	
	or	thr imp	C, 1	0	–	–	7	
1	Shortsword	sw cut	1	0	$400	2	8	
	or	thr+1 imp	1	0	–	–	8	
2	Dusack	sw cr	1	0	$30	1.5	7	
	or	thr cr	1	0	–	–	7	
2	Falchion	sw+1 cut	1	0	$400	3	10	
	or	thr-2 imp	1	0	–	–	10	
2	Large Katar	sw-1 cut	1	0	$400	2	8	[4, 6, 12]
	or	thr+2 imp	1	0	–	–	8	
2	Large Quadrens	thr+2(0.5) imp	1	0	$400	3	9	
2	Small Falchion	sw cut	1	0	$200	2	8	
	or	thr-2 imp	1	0	–	–	8	
4	Cutlass	sw cut	1	0	$500	2	8	[6]
	or	thr+1 imp	1	0	–	–	8	
SMALLSWORD (DX-5, Main-Gauche-3, Rapier-3, Saber-3, or Shortsword-4)								
0	Short Staff	sw cr	1	0F	$20	1	6	
	or	thr cr	1	0F	–	–	6	
4	Dress Smallsword	thr imp	C, 1	0F	$300	1	5	
4	Smallsword	thr+1 imp	1	0F	$400	1.5	5	
SPEAR (DX-5, Polearm-4, or Staff-2)								
0	Spear	thr+2 imp	1*	0	$40	4	10	[1]
	two hands	thr+3 imp	1, 2*	0	–	–	9†	
1	Heavy Spear	thr+4 imp	2, 3*	0U	$90	6	11†	
	or	thr+3 cut	3	0U	–	–	11†	Tip Slash.
1	Javelin	thr+1 imp	1	0	$30	2	6	[1]
1	Short Spear	thr+1 imp	1	0	$30	2	6	
	or	thr cut	1	0	–	–	6	Tip Slash.
2	Long Spear	thr+2 imp	2, 3*	0U	$60	5	11	
	two hands	thr+3 imp	2, 3*	0	–	–	10†	
2	Pike	thr+3 imp	4, 5*	0U	$80	13	12†	
2	Trident	thr+3(0.5) imp	1*	0U	$80	5	11	-2 to hit. [8, 17]
	two hands	thr+4(0.5) imp	1, 2*	0	–	–	10†	-2 to hit. [8, 17]
STAFF (DX-5, Polearm-4, or Spear-2)								
var.	Dueling Polearm	sw+2 cr	1, 2	0U	var.	var.	var.†	Blunt pole. [18]
	or	thr+2 cr	1, 2	0	–	–	var.†	Blunt tip. [18]
0	Jo	sw+1 cr	1	+2	$10	2	6†	
	or	thr+1 cr	1	+2	–	–	6†	
0	Long Staff	sw+2 cr	2, 3	+2	$15	5	10†	
	or	thr+2 cr	2, 3	+2	–	–	10†	
0	Quarterstaff	sw+2 cr	1, 2	+2	$10	4	7†	
	or	thr+2 cr	1, 2	+2	–	–	7†	
3	Qian Kun Ri Yue Dao	sw+1 cut	1	+2	$250	3	7†	-1 to hit. [6]
	or	thr+1 imp	1	+2	–	–	7†	-1 to hit.
	or	thr cut	1	+2	–	–	7†	-1 to hit. [19]
3	Sodegarami	sw+2 cr	1, 2	0	$100	4	7†	
	or	thr+2 cr	1, 2	0	–	–	7†	
	or	thr-1 cut	1, 2	0U	–	–	7†	Hook. [2]

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
TONFA (DX-5 or Shortsword-3)								
3	Tonfa	sw cr	1	0	$40	1.5	7	[12]
	or	thr cr	C, 1	0	–	–	7	
TWO-HANDED AXE/MACE (DX-5, Axe/Mace-3, Polearm-4, or Two-Handed Flail-4)								
0	Axe	sw+3 cut	1	0U	$50	4	10†	
0	Maul	sw+5 cr	1, 2*	0U	$80	12	13‡	
0	Round Mace	sw+3 cr	1	0U	$35	5	11†	[1]
0	Throwing Axe	sw+3 cut	1	0U	$60	4	10†	[1]
1	Gada	sw+6 cr	1, 2*	0U	$100	15	16‡	
	or	thr+2 cr	1*	0	–	–	15†	
1	Great Axe	sw+4 cut	1, 2*	0U	$100	8	12‡	
1	Scythe	sw+3 cut	1	0U	$15	5	11‡	
	or	sw+1 imp	1	0U	–	–	11‡	[3]
	or	thr-1 cut	1	0U	–	–	11†	Hook. [2]
2	Long Axe	sw+3 cut	1, 2*	0U	$75	6	11‡	
2	Mace	sw+4 cr	1	0U	$50	5	11†	[1]
2	Tetsubo	sw+5 cr	1, 2*	0U	$100	10	13‡	
	or	thr+2 cr	1, 2*	0	–	–	12†	
3	Warhammer	sw+4 imp	1, 2*	0U	$100	7	12‡	[3, 4]
TWO-HANDED FLAIL (DX-6, Flail-3, Kusari-4, or Two-Handed Axe/Mace-4)								
2	Flail	sw+4 cr	1, 2*	0U	$100	8	13†	[9]
2	Three-Part Staff	sw+3 cr	1-3	0U	$60	5	11†	-1 to hit. [9]
	or	sw+1 cr	1	0U	–	–	11†	-1 to hit. [9, 19]
TWO-HANDED SWORD (DX-5, Broadsword-4, or Force Sword-4)								
0	Jo	sw+1 cr	1	0	$10	2	8†	
	or	thr+1 cr	1	0	–	–	8†	
0	Quarterstaff	sw+2 cr	1, 2	0	$10	4	9†	
	or	thr+1 cr	2	0	–	–	9†	
0	Two-Handed Macuahuitl	sw+3(0.5) cut	1, 2	0	$650	5	12†	
	or	thr+2 cr	2	0	–	–	12†	
2	Naginata	sw+3 cut	2	0U	$100	6	9†	
	or	thr+3 imp	2	0	–	–	9†	
2	Tetsubo	sw+3 cr	1, 2	0U	$100	10	13†	
	or	thr+2 cr	2	0	–	–	12†	
3	Bastard Sword	sw+2 cut	1, 2	0	$650	5	10†	
	or	thr+2 cr	2	0	–	–	10†	
3	Bokken	sw+2 cr	1	0	$40	3	9†	
	or	thr+1 cr	1	0	–	–	9†	
3	Greatsword	sw+3 cut	1, 2	0	$800	7	12†	
	or	thr+2 cr	2	0	–	–	12†	
3	Katana	sw+2 cut	1, 2	0	$650	5	10†	
	or	thr+1 imp	1	0	–	–	10†	
3	Longsword	sw+1 cut	1	0	$700	4	9†	
	or	thr+3 imp	1, 2	0	–	–	9†	
3	Thrusting Bastard Sword	sw+2 cut	1, 2	0	$750	5	10†	
	or	thr+3 imp	2	0	–	–	10†	
3	Thrusting Greatsword	sw+3 cut	1, 2	0	$900	7	12†	
	or	thr+3 imp	2	0	–	–	12†	
4	Late Katana	sw+2 cut	1	0	$550	3	9†	
	or	thr+1 imp	1	0	–	–	9†	
WHIP (DX-5, Kusari-3, or Monowire Whip-3)								
1	Light Whip	sw-5(0.5) cr	1-7*	-2U	$20/yd.	0.5/yd.	var.	[20]
1	Whip	sw-2(0.5) cr	1-7*	-2U	$20/yd.	2/yd.	var.	[20]
3	Urumi	sw-1 cr	1-3	-2U	$400	4	8	[13]
	or	sw-1(0.5) cut	1-3	-2U	–	–	8	[13]

Notes

[1] Can be thrown. See *Muscle-Powered Ranged Weapon Table* (pp. 75-78).

[2] Hook enables the rules under *Hook* (p. 54), and may also damage the victim.

[3] May get *stuck;* see *Picks* (p. B405).

[4] Reduce penalty for targeting chinks in armor (p. B400) by -2.

[5] Attack receives damage bonuses for whichever of Boxing (p. B182), Brawling (p. B182), or Karate (p. B203) is used to deliver it – exactly as if it were an unarmed strike. Claws *don't* improve damage with such weapon-assisted blows.

[6] Gives the hand (only) DR. A myrmex offers DR 1 and a cestus affords DR 4; both are gloves of a sort, and mutually exclusive with other gloves. For other weapons, this indicates a metal hilt that provides DR 4, cumulative with glove DR – although the hilt is too cramped to accommodate *metal* gauntlets. Deer antlers, hook swords, katars, qian kun ri yue dao, and wheels don't enclose the hand completely; DR applies only on a roll of 1-3 on 1d.

[7] Target at -1 to Block or Parry.

[8] Can strike to disarm (p. B401) *without* -2 to hit for using a non-fencing weapon.

[9] Attempts to *parry* flails and kusaris are at -4; fencing weapons ("F" parry) can't parry at all! Attempts to *block* such weapons are at -2. Halve these penalties for the bola perdida, bolas, nunchaku, thonged club, and weighted scarf.

[10] Counts as a rope garrote; see *Garrotes* (p. B405).

[11] Gets +2 to disarm when wielded with Jitte/Sai skill; see pp. B208, B401.

[12] Use Brawling or Karate parry if better than usual weapon parry.

[13] Can only lash the target for damage; none of the special whip rules apply.

We use the latest in scientific technology and state-of-the-art weaponry and you, if I understand correctly, poke them with a sharp stick.

– Maggie Walsh in
Buffy the Vampire Slayer,
"A New Man"

[14] Specify maximum reach (1-4 yards) when bought. Damage is swing, +1 per yard of maximum reach. Cost and weight are *per yard.* ST is 8, +1 per yard.

[15] When swinging the kama on the end of the chain, the kusarigama can't disarm or entangle like a regular kusari (p. B406).

[16] Damage increases in a mounted charge; see *Cavalry Weapons* (p. B397). Also review *Lance* (p. 58) and *Riding Gear* (p. 134) for important rules.

[17] Target at -1 to Dodge, +1 to Block or Parry.

[18] The butt of a two-yard polearm – dueling bill, dueling glaive, dueling halberd, light horse-cutter, naginata, or pollaxe – used as a staff. Cost, weight, and ST are as listed for that weapon under the Polearm skill.

[19] Use these statistics when using both ends for a Dual-Weapon Attack.

[20] Specify maximum reach (1-7 yards) when bought. Cost and weight are *per yard.* The light whip requires ST 3, +1 per yard. The whip requires ST 5, +1 per yard. Many special rules apply; be sure to see *Whips* (p. B406).

Weapon Composition

Tips and blades for melee and thrown weapons, and projectiles, have been made from many materials. Several low-tech options appear below. See *Blade Composition* (p. B275) for additional possibilities.

Wood (TL0)

A wooden blade or tip changes a *cutting* attack to *crushing;* base damage is unaffected. *Impaling* attacks have -1 to damage and armor divisor (0.5). This assumes fire-hardening; unhardened wood gives another -1 (total -2) to impaling damage. Base cost is 10% of that listed for a good-quality weapon; weight is unchanged.

For wooden *training* weapons, see ***GURPS Low-Tech Companion 2.***

Horn/Tooth (TL0)

Horns can be carved into weapons, or used to tip shafts with a killing point. Animal teeth are sometimes used as well. Either changes a *cutting* attack to *crushing;* base damage is unaffected. *Impaling* attacks do normal damage but with armor divisor (0.5).

Tooth-edged clubs are possible; these do cutting damage equal to a steel weapon, but with armor divisor (0.5). On *any* successful attack or successful parry against an armed attack, roll 1d; on 1-2, the edge breaks, reducing the weapon to a club that does crushing damage. Double-edged models can be reversed (a free action) to use the other side until it, too, breaks!

Base cost for either is 20% of that listed for a good-quality weapon; weight is unchanged.

Bone (TL0)

Bone is fragile when dry but can be used for weapons. Damage is -1 for *all* attack modes. Otherwise, treat it as horn/tooth, but even more breakable: On the 1d roll for breakage, 1-2 means the *entire weapon* breaks!

Base cost is 5% of that listed for a good-quality weapon (or *free,* for a bone used as an improvised club); weight is unchanged.

Bows, Slings, and Thrown Weapons

Even the most primitive ranged weapon affords a potent capability: that of striking distant targets. Most low-tech missile weapons use the operator's direct muscle power (or *lung* power!) to impel the projectile. Low-tech artillery – while sometimes muscle-powered – gets its own treatment under *Mechanical Artillery* (pp. 78-84).

Atlatl (pp. 77, B276) **–** *Aztec.* A stick used to launch javelins. The name is Nahuatl (Aztec), but many similar weapons exist worldwide. The user fits the javelin into a notch and then launches it with a one-handed swing of the stick.

Blowpipe (pp. 76, B275) **–** *Universal.* A long, narrow tube that lets the user launch breath-propelled darts. The projectiles are too tiny to be effective against large animals or humans without poison. It can be used for blowing powders into an opponent's face. Also known as the *fukiya* (Japan).

Bola Perdida (pp. 66, 76) **–** *Argentina.* A rock (or other weight) fastened to a thong. The name hails from Argentina but the weapon is universal. Used for throwing – like a one-shot sling that tosses both sling *and* stone – and as a flail. Sometimes called a *bola loca.*

Bolas (pp. 66, 76, B275) **–** *Universal.* Two or more weights attached to cords and knotted together. Used by hunters to entangle the legs of animals, but also a serviceable flail. Often called a *boleadora.* The TL3 *mijin* (Japan) consists of three short chains weighted with iron balls, linked to a central ring. The statistics don't change; metal is denser and pricier than leather and stones, but there's far less of it.

Boomerang (p. 77) **–** *Australia.* An angled, more aerodynamic Throwing Stick (p. 75) designed for hunting. Doesn't return; returning versions are unsuitable as weapons and in any event wouldn't return if they hit. The GM may make an exception for martial artists with Throwing Art! Treat as a Baton (p. B273) if used as a club.

Bow (pp. 76, B275) **–** *Universal.* A flexible stave, bent and kept under tension by fastening a string between its ends. This creates a spring that enables the user to shoot arrows by placing them against the string and drawing and releasing it. The properties of bows depend on their composition: The *self bow* (p. 73) is entirely wood, the Composite Bow (below) has layers of different materials glued together (this includes so-called "laminate" bows), and the Tubular Bow (p. 75) is a hollow metal tube, usually steel.

Chakram (p. 77) **–** *India.* A metal throwing ring, edged on the outside. It can be hurled in a variety of ways – even spun around the finger on the inside rim and released!

Composite Bow (p. B275) **–** *Universal.* A Bow (above; p. B275) made from layers of different materials glued together. This greatly improves strength and energy storage, allowing the bow to exceed the draw length of a similar-sized *self bow* (p. 73) without breaking. A Straight Composite Bow (p. 76) is shaped much like a self bow. A *recurve bow* has a natural backward curve at the end of the bow limbs, and is under higher initial tension when strung; drawing it against this tension stores more energy, giving superior range and damage. A Reflex Bow (p. 76) takes this to an extreme; when unstrung, the limbs bend entirely away from the archer. Most composite bows are recurve or reflex bows. A typical design has roughly as much power as a Longbow (p. 73) but less Bulk, making it a convenient weapon for charioteers and cavalrymen. Includes the *dai-kyu* (Japan).

Composite Crossbow (p. 76) **–** *Europe.* Developed around 1100 A.D., this weapon replaces the wooden *self bow* (p. 73) of the Crossbow (below; p. B276) with a layered composite of horn, wood, and sinew.

Crossbow (pp. 76, B276) **–** *Asia, Europe.* A flexion-powered weapon, designed to have the string drawn back by hand as described on p. B410. The familiar Western version was developed mainly during the Middle Ages, but a Chinese version dates to 600 B.C.

Discus (p. 77) **–** *Ancient Greece.* A wooden or metal throwing disc. The ring-shaped *quoit* (Europe, Middle East) uses the same stats.

Flying Dart – *China.* A throwing blade with a ring handle and a length of cloth as a stabilizer. Treat as a Small Throwing Knife (p. 77) or a Large Throwing Knife (p. 77), depending on size. Also known as the *fei biao* (China).

Gastraphetes (p. 76) **–** *Ancient Greece.* The source for Greek and Roman mechanical artillery, this is basically an outsized Composite Bow (p. B275), too powerful for a normal man to cock. It's treated as an early variant on the Composite Crossbow (above), with a built-in cocking mechanism (see *Belly Brace,* p. 79). A typical gastraphetes has rated ST 13.

Harpoon (pp. 77, B276) **–** *Universal.* A barbed hunting spear with a line attached. *Not* an entangling weapon; pulling on the line tends to yank it out (see footnote 8, p. B276). In melee, treat it as a clumsy Heavy Spear (p. 69) with Reach 1, 2* and -2 to skill.

Hungamunga (p. 77) **–** *Sub-Saharan Africa.* A flat "throwing iron" with multiple sharp points – typically between five and eight – and a handle. Most hungamungas require Thrown Weapon (Knife), but the Large Hungamunga (p. 77) uses Thrown Weapon (Axe/Mace). At TL2, hungamungas are soft iron and may bend on impact. Roll 1d after a throw; on 1-3, the weapon bends and is useless. Straightening it takes 10 seconds and an Armoury+3 roll. Ignore this rule for steel weapons at TL3+. Also called a *mongwanga.*

Metsubushi – *Japan.* Ninja and police favor this all-in-one delivery system for powders (usually blinding agents). It consists of a mouthpiece with a removable cap. A tube at the other end contains one dose of powder. It takes only a second to *ready,* but it's too fussy to *reload* in combat.

Alternate Arrows

In addition to standard arrows with regular or bodkin points (p. B277), archers have several special options:

Barbed: Yanking out a barbed arrow inflicts *half* the injury it delivered going in. No effect on cost or weight (most war arrows are barbed by default).

Blunt: Converts damage to *crushing.* Used for training or for hunting fowl. Half cost, normal weight.

Cutting: Head is leaf-shaped (*willow leaf*), or C-, U-, or Y-shaped and edged on the inside of the curve (*frog crotch*). Converts damage to *cutting.* There's no effect on other stats. A *barbed* cutting arrow – or *bowel-raker* – further gives -1 to Acc and subtracts 5 from both Range multipliers (e.g., ×15/×20 becomes ×10/×15), but yanking it out inflicts *half* the injury it delivered going in. Neither version affects cost or weight.

Fire Arrow: This Chinese improvement on the improvised flaming arrow (p. B410) features a fused tube of gunpowder. This avoids the -2 to hit (there's no distracting flame!) but is awkward: -1 to Acc and subtract 5 from both range multipliers. Lighting the tube requires a Ready maneuver and a fire source. The underlying arrow's damage is unchanged. The gunpowder charge inflicts 1d-1 cr ex. Fire arrows are very vulnerable to rain and damp – unless protected properly, they may spoil. Otherwise, treat as a flaming arrow. Costs $5 extra, double weight.

Fire-Cage: This dedicated version of the improvised flaming arrow (p. B410) has a short, pointed tip ahead of a "cage" designed to carry a payload, usually an oil-soaked rag. The tip can injure, but is meant to lodge in a wooden structure to give the arrow time to set it alight; convert damage to *small piercing.* While the payload is tiny, it's still larger than the improvised kind; fire damage is 1d-3 burn. Like standard flaming arrows, a lit fire-cage arrow has -2 to hit; it further has -1 to Acc and subtracts 5 from both range multipliers. Otherwise, treat as a flaming arrow. No effect on cost or weight.

Flight: A flight arrow sacrifices hitting power for range. *Halve* damage out to 1/2D; past 1/2D, it inflicts *no* damage! *Double* both range multipliers, however. Normal cost, half weight.

Humming Bulb: Has a hollow, fluted tip that whistles in flight. Used to signal or to flush game. Some such heads can carry a tiny payload – often an oil-soaked rag (treat as a flaming arrow). Gives -1 to Acc and subtracts 5 from both range multipliers. Damage becomes *crushing,* with armor divisor (0.5). No effect on cost or weight.

Treat as a Blowpipe (pp. 76, B275) that can only shoot powders at one yard – see *Blowpipe* (p. B180) for rules.

Pilum – *Ancient Rome.* Plural is *pila.* A throwing spear. Its head has an unhardened iron portion that bends on a hit, preventing the enemy from hurling it back or easily removing it from a shield. If a thrown pilum hits, it becomes useless except as a staff until straightened. Should it strike a nonmetallic shield – deliberately or on a block – it will stick and deform, penalizing Shield skill: -1 for any pila, -2 if total projectile weight is at least half shield weight, or -4 if total weight equals or exceeds shield weight. Removing each pilum requires a Ready and a ST roll at a penalty equal to its damage roll. In either case, unbending the head requires a free hand and a foot, and takes three Ready maneuvers and a ST roll. Treat as a Spear (pp. 69, 77. B273, B276) in all other respects. The *angon* (Franks) is a barbed derivative of the pilum; use the same stats.

Pistol Crossbow (pp. 76, B276) **–** *China.* A Crossbow (pp. 72, B276) small enough to wield one-handed. Can be hidden in a sleeve or built into a stirrup (see *Disguised,* p. 14).

Prodd (pp. 76, B276) **–** *Europe, Middle East.* "Prodd" or "prod" means the bow assembly of any Crossbow (pp. 72, B276). It's also the name of a bird-hunting crossbow that launches lead pellets instead of bolts. Special prodds that lobbed primitive naphtha grenades were used in the Near East. These have Acc 1 and Range –/×5, and can't shoot pellets. See *Molotov Cocktails and Oil Flasks* (p. B411) for the effects of a hit.

Repeating Crossbow (p. 76) **–** *Asia.* A Chinese Crossbow (pp. 72, B276) variant with an ammunition hopper that holds 10 bolts. It's operated by working a handle backward and forward manually; its rated ST can't exceed the user's ST. The shooter must take a Ready maneuver before each shot, but can shoot every other second. Known in China as the *chukonu* or *zhuge nu.*

Self Bow – *Universal.* A Bow (pp. 72, B275) made entirely of wood. The Short Bow (p. 76) might be made of little more than a handy bough, although strong ones aren't, and typifies the earliest bows. The Regular Bow (p. 76) is longer and more powerful. The Longbow (p. 76) – famed weapon of English archers – is the pinnacle of single-material bow technology, and at least 6' long. The finest longbows are made of yew, whose natural properties resemble those of some composite materials.

Shuriken (pp. 65, 77, B276) **–** *Japan.* An entire class of metal throwing weapons – small enough to conceal in clothing or hair – hurled with a flick of the hand or a snap of the wrist. Historically, they were samurai weapons as much as "ninja weapons." The best-known are Star Shuriken (p. 77), which are disc-, cross-, or star-shaped, with sharp edges or spikes. Most have three to nine points, with four or eight being usual. A few are S-shaped. Any might have holes cut in them to make a distinctive sound in flight – as a psychological ploy, for signaling, or merely to show off. Spike Shuriken (p. 77) resemble needles. Sharp at one end, the other end may be blunt, sharp, or have a fin-like tail. Variations beyond "star" or "spike" don't affect statistics. It's possible to claw with any shuriken held in the hand; see the *Melee Weapon Table* (p. 65). Includes the *piau* (Indonesia).

Sling (pp. 76, B276) **–** *Universal.* A thong or cord with a pouch or cup for a missile. The wielder loads the pouch, grasps both ends of the cord in one hand, whirls the loaded sling overhead (horizontally) or next to him (vertically), and releases one end to launch the projectile. Attaching a sling to a stick wielded in two hands improves leverage, thereby increasing power and range; this is the Staff Sling (p. 76), also known as the *fustibal* (Europe). The Heavy Sling (p. 76) is designed to lob larger projectiles a short distance. It requires two hands to load and operate; the slinger employs a technique similar to a hammer throw. Any of these three types of sling can lob stones or lead bullets – or even primitive Molotov cocktails (see *Molotov Cocktails and Oil Flasks,* p. B411), at Acc 0 and 40% normal range. The Dart Sling (p. 76) is designed to hurl foot-long finned darts; it otherwise resembles a standard sling, but the two cannot share ammunition, nor can the dart sling launch Molotov cocktails.

Slurbow (p. 76) **–** *Europe, Ottoman Empire.* A Composite Crossbow (p. 72) with a rather unusual arrow guide (p. 78) built in that can be loaded with one small dart or, remarkably, *several.* Statistics are given for two medium-sized darts or five smaller ones.

Steel Crossbow – *Europe.* Invented around 1400 A.D. – very late in TL3 – but classed as an early TL4 weapon. It takes advantage of a higher grade of steel, known at the time as "crossbow steel." Models include the Fowling Crossbow, Hunting Crossbow, Military Crossbow, and Siege Crossbow (all on p. 76). These are sturdier than the standard Crossbow (pp. 72, B276); treat them as *rugged* (p. 14). Steel's stiffness allows a compact bow to have a high rated ST for its length, but short draw length and high weight make it less efficient; use *half* the rated ST to determine range and damage. (*Example:* A siege crossbow has a cranequin with a power ratio of ×3. A ST 12 crossbowman can crank a siege crossbow with rated ST 36. Damage and range are commensurate with ST 36/2 = 18.)

Stone-Launching Stick (p. 77) **–** *Mesoamerica.* A stick for lobbing stone projectiles. It comes in two forms. One is a simple straight stick. Its ammunition is rounded, flat stones with a hole bored in the middle, which are fitted to the end of the stick and flicked off at the target. The other is a slotted stick with a Y-shaped end. Similar stones are fitted into the notch and flung; these don't need holes. Either requires two hands to load but just one to attack. While these weapons launch stones, the motion is very similar to that of the Atlatl (p. B276); thus, they use the Spear Thrower skill.

Throwing Dart (p. 77) **–** *Universal.* A long dart, a projectile similar to a heavy arrow, or a short javelin, meant to be hurled by hand. Some are finned, feathered, or end in a tassel to aid in flight and ensure that they hit point-first. These aren't the same darts used in the Atlatl (pp. 72, B276)! Includes the *jarid* (Turkey), *nageyari* (Japan), *skaen* (Ireland), and *uchi-ne* (Japan) – and the *plumbata* (Ancient Rome), which has a slender metal head made partly of lead (*plumbum,* whence the weapon's name).

Bows, Crossbows, and Rated ST

Every *bow* has a rated ST. The archer needs this much ST to draw back the bowstring fully by hand, which involves holding the bow out with one hand and pulling back the string with the other. It uses the strength of one arm.

A *crossbow* also has a rated ST. This assumes a weapon braced against the shoulder while drawing the string *two*-handed. This isn't optimal; crossbowmen usually exploit leg strength instead (see below). Using both arms achieves twice the pull (draw weight) of using one. However, a typical crossbow string is drawn back half as far before being cocked, so range and damage are comparable to those for a bow. A *steel crossbow* (above) has only 1/4 a bow's draw length, so performance is similar to that of a wooden crossbow with *half* the ST – but it can be built with much higher rated ST!

Typically, crossbows are lowered to the ground, braced with a foot in a stirrup or with one or both feet on the bow, and drawn by straightening up. This uses the strength of the entire body, which allows drawing a bow with 10-20% higher rated ST (+1 or +2 ST for a ST 10 crossbowman) with one leg, or 20-30% higher ST (+2 or +3 ST for a ST 10 warrior) with both legs. A *foot bow* (a bow built to be braced with both feet) likewise permits 20-30% higher ST.

Mechanical aids let warriors draw even stronger crossbows; see *Mechanical Artillery* (pp. 78-84). Conversely, the *repeating crossbow* (p. 72) is operated by alternately pushing and pulling on a lever one-handed. Thus, it has a wooden crossbow's draw length and a bow's draw weight. Maximum rated ST is 70% of the user's ST.

Bows and Crossbows in Combat

For a bow, readying an arrow takes a second. Drawing the bow by hand takes another second. Shooting takes a second.

Drawing a crossbow two-handed takes 2 seconds. Readying and placing a bolt takes 2 seconds. Shooting takes a second.

A repeating crossbow takes a second to cycle and a second to shoot. Bolt placement is automatic.

A leg-powered bow or crossbow takes 3 seconds to draw, plus 2 seconds to crouch and place a foot in the stirrup *or* 3 seconds to crouch or lie down and place one foot on the bow (4 seconds for both feet). If a footbowman stays on the ground, subsequent cycles need only 2 seconds to place the feet. Ammo-readying and shooting times don't change

Harsh Realism for Ranged Weapons

GURPS errs on the side of "heroic realism." For instance, it lets individual archers make shots typical of formations shooting at other formations – in part because it gives low-tech missiles Acc scores comparable to those of high-tech guns. These *optional* rules make life *much* tougher for low-tech missile users!

Malfunctions: Well-designed and properly maintained missile weapons don't suffer from malfunctions (p. B407). Cheaper weapons may, however. Any cheap mechanical missile weapon (e.g., crossbow) has Malf. 15; a cheap bow or sling has Malf. 16. On a malfunction, the weapon *jams* (if mechanical) or *breaks* (if a sling or bow). Thrown weapons are unaffected.

Poor Sling Penetration: Sling bullets have a relatively low velocity compared to firearms. To reflect this, change their damage type from *piercing* to *crushing*.

Reduced Acc: For really harsh realism, *halve* the Acc stats of all non-firearm missile weapons and round *down*. The GM may fine-tune the specific numbers, rounding *up* for weapons with a reputation for accuracy or a superior design.

Throwing Knife (p. 77) – *Universal.* True throwing knives rarely have a handguard, often lack a substantial handle, and are balanced for hurling, not fighting. This gives -2 to skill in melee combat. Like all knives, they come in many sizes; the Large Throwing Knife (p. 77) and Small Throwing Knife (p. 77) are typical.

Throwing Stick (p. 77) – *Universal.* Any heavy stick balanced enough to throw.

Tubular Bow (p. 76) – *India.* A Bow (pp. 72, B275) made of steel tubing, and usually recurved. It's heavier than a normal bow and has less draw length, but it's effectively *rugged* (p. 14): DR 7 and +2 HT. It can survive for many years without maintenance. Historically, tubular bows were Short Bows.

Woomera (p. 77) – *Australia.* A notched stick like the Atlatl (pp. 72, B276), but larger; its ammunition is a full-sized Spear (pp. 69, B276). The name comes from Australia, but similar weapons exist worldwide. Includes the *amirre* and *mirru* (both Australia).

He has prepared his deadly weapons; he makes ready his flaming arrows.

– Psalm 7:13

Muscle-Powered Ranged Weapon Table

This table includes *thrown weapons* (axes, spears, etc.) and *muscle-powered missile weapons* (e.g., bows and slings), from both pp. 72-75 and the ***Basic Set.*** Each weapon appears under the skill(s) used to attack with it. Some thrown weapons also appear on the *Melee Weapon Table* (pp. 64-71), but use the stats below when hurled. In all cases, "–" means the statistic doesn't apply, while "spec." indicates that special rules apply; see the footnotes. Terms and notation are defined on pp. B268-271, but in brief:

TL: The tech level at which the weapon became widespread in the real world.

Weapon: The name of the weapon or class of weapon; see the matching entry on pp. 72-75.

Damage: The ST-based damage that the weapon inflicts.

Acc: Accuracy, the skill bonus if you take an Aim maneuver before attacking.

Range: If there are two stats separated by a slash, the first is *Half-Damage Range;* at or beyond this distance, halve the weapon's damage roll. The second is *Maximum Range.* A lone statistic is always Maximum Range. Most ranges are expressed as multiples of the wielder's ST – or of the *weapon's* rated ST, for bows and crossbows.

Weight: The weapon's weight, in lbs. For weapons with Shots 1, this is *unloaded* weight, and the weight after the slash is that of one shot. For those with Shots 2+, this is *loaded* weight, and the weight after the slash is that of one full reload.

RoF: Rate of Fire. This is 1 for everything but the slurbow, which shoots multiple projectiles (see p. B409).

Shots: The number of shots the weapon can fire before you must reload. "T" indicates a thrown weapon. The parenthetical number is the number of Ready maneuvers required to reload the weapon or ready another thrown weapon. An "i" next to this means the time listed is *per shot.* See also *Bows and Crossbows in Combat* (p. 74).

Cost: The price of a new weapon, in $.

ST: The minimum ST needed to use the weapon properly; wielders with lower ST suffer -1 to skill per point of ST deficit. "†" means the weapon requires two hands. This *isn't* the ST used to find a bow or crossbow's damage and range. Every bow or crossbow also has a *rated ST,* the ST required to draw and use it at full efficacy, which determines damage and range; see *Bows, Crossbows, and Rated ST* (p. 74). Weaker users can shoot a stronger bow, but will suffer the standard skill penalty and FP loss for using an over-strength weapon. The ST score on the table for a given type of bow or crossbow is the *minimum* rated ST for that type. Rated ST doesn't affect weapon or ammunition weight.

Bulk: The penalty to skill when you take a Move and Attack maneuver (p. B365) or use Holdout to conceal the weapon.

Notes: Applicable footnotes at the end of the table.

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	Cost	ST	Bulk	Notes
BLOWPIPE (DX-6)											
0	Blowpipe	1d-3 pi-	1	×4	1/0.05	1	1(2)	$30	2	-6	[1, 2, 3]
BOLAS (No default)											
0	Bola Perdida	sw cr	0	×6/×10	1	1	T(1)	$10	6	-2	
0	Bolas	thr-1 cr	0	×3	2	1	T(1)	$20	7	-2	[4]
BOW (DX-5)											
0	Longbow	thr+2 imp	3	×15/×20	3/0.1	1	1(2)	$200	11†	-8	[3]
0	Regular Bow	thr+1 imp	2	×15/×20	2/0.1	1	1(2)	$100	10†	-7	[3]
0	Short Bow	thr imp	1	×15/×20	1.5/0.1	1	1(2)	$50	7†	-6	[3]
1	Reflex Bow	thr+3 imp	3	×20/×25	2.25/0.1	1	1(2)	$900	10†	-7	[3]
1	Straight Composite Bow	thr+2 imp	2	×15/×20	2.25/0.1	1	1(2)	$600	10†	-7	[3]
4	Tubular Bow	thr+2 imp	2	×20/×25	2/0.1	1	1(2)	$900	8†	-6	[3]

Europe's warrior-aristocrats differ greatly from their Turkish, Chinese, or Japanese counterparts, among whom the bow played a major role, both as weapon and as symbol.

– Bert S. Hall, ***Weapons and Warfare in Renaissance Europe***

CLOAK (DX-5, Net-4, or Shield-4)											
1	Heavy Cloak	spec.	1	2	5	1	T(1)	$50	8	-6	[4]
1	Light Cloak	spec.	1	2	2	1	T(1)	$20	5	-4	[4]
CROSSBOW (DX-4)											
2	Crossbow	thr+4 imp	4	×20/×25	6/0.06	1	1(4)	$150	7†	-6	[3]
2	Gastraphetes	thr+5 imp	4	×25/×30	9/0.15	1	1(8)	$3,400	10†	-7	[3]
2	Repeating Crossbow	thr+1 imp	1	×7/×15	10/0.6	1	10(3i)	$500	8†	-5	[3]
3	Composite Crossbow	thr+5 imp	4	×25/×30	7/0.06	1	1(4)	$950	8†	-6	[3]
3	Pistol Crossbow	thr+2 imp	1	×15/×20	4/0.06	1	1(4)	$150	7	-4	[2, 3]
3	Prodd	thr+4 pi	2	×20/×25	6/0.06	1	1(4)	$150	7†	-6	[3]
3	Slurbow	thr+3 imp	1	×25/×30	8/0.06	1×2	1(2i)	$1,000	9†	-6	[3, 5]
	or	thr+2 imp	1	×15/×20	8/0.1	1×5	1(2i)	–	9†	-6	[3, 5]
4	Fowling Crossbow	thr+5 imp	4	×25/×30	9/0.06	1	1(8)	$450	8†	-6	[3, 6]
4	Hunting Crossbow	thr+5 imp	4	×25/×30	12/0.06	1	1(13)	$600	10†	-7	[3, 6]
4	Military Crossbow	thr+5 imp	4	×25/×30	15/0.06	1	1(32)	$750	12†	-8	[3, 6]
4	Siege Crossbow	thr+5 imp	4	×25/×30	18/0.06	1	1(50)	$900	14M†	-10	[3, 6, 7]
LASSO (No default)											
1	Lariat	spec.	0	spec.	3	1	T(spec.)	$40	7†	-2	[4]
NET (Cloak-5)											
0	Large Net	spec.	1	spec.	20	1	T(1)	$40	11	-6	[4, 8]
2	Melee Net	spec.	1	spec.	5	1	T(1)	$20	8	-4	[4, 8]
SLING (DX-6)											
0	Bola Perdida	sw cr	0	×6/×10	1	1	T(1)	$10	6	-2	
0	Heavy Sling	sw+2 cr	1	×3/×6	1/1	1	1(2)	$20	8†	-5	[3]
0	Sling	sw pi	0	×6/×10	0.5/0.05	1	1(2)	$20	6	-4	[2, 3, 9]
1	Dart Sling	sw imp	1	×6/×10	0.5/0.25	1	1(2)	$20	6	-4	[2, 3]
1	Staff Sling	sw+1 pi	1	×10/×15	2/0.05	1	1(2)	$20	7†	-6	[3, 9]

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	Cost	ST	Bulk	Notes
SPEAR THROWER (DX-5 or Thrown Weapon (Spear)-4)											
0	Atlatl	–	–	–	1	1	1(1)	$20	–	–	[2]
	w. Dart	sw-1 imp	1	×3/×4	1	–	–	$20	5	-3	
	w. Javelin	sw+1 imp	3	×2/×3	2	–	–	$30	6	-4	
0	Stone-Launching Stick	sw-1 cr	0	×2/×3	1/0.25	1	1(1)	$20	5	-2	[2, 3]
0	Woomera	–	–	–	2	1	1(1)	$40	–	–	[2]
	w. Spear	sw+3 imp	2	×1.5/×2	4	–	–	$40	9	-6	
THROWN WEAPON (AXE/MACE) (DX-4)											
0	Hatchet	sw cut	1	×1.5/×2.5	2	1	T(1)	$40	8	-2	
0	Round Mace	sw+2 cr	1	×0.5/×1	5	1	T(1)	$35	12	-4	
0	Small Round Mace	sw+1 cr	1	×1/×1.5	3	1	T(1)	$25	10	-3	
0	Small Throwing Axe	sw+1 cut	1	×1/×1.5	3	1	T(1)	$50	10	-3	
0	Throwing Axe	sw+2 cut	2	×1/×1.5	4	1	T(1)	$60	11	-3	
2	Large Hungamunga	sw+2 cut	2	×1/×1.5	4	1	T(1)	$60	11	-3	[10]
2	Mace	sw+3 cr	1	×0.5/×1	5	1	T(1)	$50	12	-4	
2	Small Mace	sw+2 cr	1	×1/×1.5	3	1	T(1)	$35	10	-3	
THROWN WEAPON (DART) (DX-4 or Throwing-2)											
2	Throwing Dart	thr imp	1	×2.5/×3.5	1	1	T(1)	$20	6	-2	
THROWN WEAPON (DISC) (DX-4 or Throwing-2)											
1	Discus	thr+2 cr	2	×4/×6	2	1	T(1)	$40	6	-3	
2	Chakram	thr+1 cut	1	×4/×6	1.5	1	T(1)	$50	6	-2	
THROWN WEAPON (HARPOON) (DX-4 or Thrown Weapon (Spear)-2)											
2	Harpoon	thr+5 imp	2	×1/×1.5	6	1	T(1)	$60	11	-6	[11]
THROWN WEAPON (KNIFE) (DX-4)											
0	Large Knife	thr imp	0	×0.8/×1.5	1	1	T(1)	$40	6	-2	
0	Small Knife	thr-1 imp	0	×0.5/×1	0.5	1	T(1)	$30	5	-1	
0	Wooden Stake	thr(0.5) imp	0	×0.5/×1	0.5	1	T(1)	$4	5	-2	
1	Dagger	thr-1 imp	0	×0.5/×1	0.25	1	T(1)	$20	5	-1	
2	Hungamunga	sw-1 cut	1	×0.8/×1.5	1	1	T(1)	$40	6	-3	[10]
2	Large Throwing Knife	thr imp	1	×1/×2	1	1	T(1)	$40	6	-1	[10]
2	Small Throwing Knife	thr-1 imp	1	×0.8/×1.5	0.5	1	T(1)	$30	5	0	[10]
3	Sai	thr imp	0	×0.8/×1.5	1.5	1	T(1)	$60	7	-3	

Technical skill is more useful in battle than strength.

– Vegetius, ***Epitomia rei militaris***

THROWN WEAPON (SHURIKEN) (DX-4 or Throwing-2)											
3	Spike Shuriken	thr-2 imp	1	×0.5/×1	0.1	1	T(1)	$3	5	0	
3	Star Shuriken	thr-1 cut	1	×0.5/×1	0.1	1	T(1)	$3	5	0	
THROWN WEAPON (SPEAR) (DX-4, Spear Thrower-4, or Thrown Weapon (Harpoon)-2)											
0	Spear	thr+3 imp	2	×1/×1.5	4	1	T(1)	$40	9	-6	
0	Spear w. Thong	thr+3 imp	3	×1.25/×1.75	4	1	T(1)	$45	9	-6	
1	Javelin	thr+1 imp	3	×1.5/×2.5	2	1	T(1)	$30	6	-4	
1	Javelin w. Thong	thr+1 imp	4	×1.75/×2.75	2	1	T(1)	$35	6	-4	
THROWN WEAPON (STICK) (DX-4)											
0	Boomerang	sw cr	2	×6/×10	1	1	T(1)	$20	6	-2	
0	Throwing Stick	sw-1 cr	1	×4/×8	1	1	T(1)	$10	6	-2	

Notes

[1] Follow-up drug or poison attack if damage penetrates DR. Effects depend on the poison used; see *Poisons* (pp. 128-130).

[2] Requires *two* hands to ready, but only *one* hand to attack.

[3] An arrow or bolt for a bow or crossbow is $2. A dart for a pistol crossbow or sling is $1. A dart for a slurbow is $0.50. A dart for a blowpipe, a lead pellet for a prodd or sling, a shaped rock for a heavy sling, or a shaped stone for a stone-launching stick, is $0.10. A shaped sling stone is $0.06. Unshaped rocks and stones suitable for slings, heavy slings, and stone-launching sticks can be found for free, but they're less accurate: -1 to hit.

[4] May entangle or ensnare the target; see *Special Ranged Weapons* (pp. B410-411) and *Cloaks* (p. B404).

[5] Requires several Ready maneuvers to cock the bow before loading darts; use the standard cocking times for crossbows under *Bows, Crossbows, and Rated ST* (p. 74).

[6] Steel crossbows are normally cocked with a cranequin (p. 79), which multiplies the user's ST: ×1.5 for fowling crossbow, ×2 for hunting crossbow, and ×3 for military or siege crossbow. This allows use of a weapon with a very high rated ST. Typical values: ST 15 for fowling crossbow, ST 20 for hunting crossbow, ST 30 for military crossbow, and ST 36 for siege crossbow. Use *half* rated ST to determine range and damage.

[7] Tripod for siege crossbow: $360, 19 lbs.

[8] A net has no 1/2D range. Max range is (ST/2 + Skill/5) for a large net and (ST + Skill/5) for a melee net.

[9] Can fire stones (TL0) or lead bullets (TL2). Lead bullets give +1 damage and *double* range.

[10] Not balanced for melee combat! Treat small throwing knife as a small knife, hunga-munga or large throwing knife as a large knife, and large hungamunga as an axe, but with -2 to skill and therefore -1 to Parry (for knives, this adds to the usual -1 to Parry).

[11] Tethered. See pp. B276, B411.

Arrow Guide

Some Middle Eastern archers used a device called a *navak,* or *arrow guide,* to shoot lighter ammo that couldn't be reused against them by enemies who lacked similar equipment. The user fastened or held this gutter-like accessory in place and launched short, unfeathered darts down it. This gave the effect of a crossbow without the trigger, at the cost of some power.

Any type of bow may use an arrow guide. Its darts have a flatter trajectory than arrows, but are lighter: +1 to Acc, -1 to damage. Change Shots to 1(3); the dart must first be grasped and then placed in the groove before drawing the bow. Other stats are unchanged. Guide: $50, 0.5 lb. Dart: $0.50, 0.03 lb.

Panjagan

Persian archers sometimes fastened together five arrows, allowing them to be nocked and fired as one. Once launched, the arrows would separate. A fastener – called a *panjagan* – is $10, neg.

This reduces the bow's range and accuracy, as well as the arrows' hitting power. A group of five arrows gives -2 to hit, -2 to damage, half Range, and RoF 1×5. Reloading time is normal, but Fast-Draw (Arrow) attempts to draw clusters of arrows are at -3, in addition to any other penalties.

Trick shooters were known to fire as many as *10* arrows this way! There's no evidence that this was ever done in battle, but the GM may wish to let cinematic archers try. This gives -4 to hit, -4 to damage, half Range, and RoF 1×10.

Mechanical Artillery

Mechanical artillery was invented in Syracuse, the principal Greek colony in Sicily, between 399 and 397 B.C. (see *The Workshops of Dionysius* in ***GURPS Low-Tech Companion 1***). The first such device, the *gastraphetes* (p. 72), was a one-man weapon amounting to a crude, outsized crossbow. Larger weapons appeared not long after; they were standard military equipment by the time of the Roman Empire, and remained in use through most of the Middle Ages, until gunpowder replaced them. The Chinese Empire used similar engines, probably invented independently. A later Chinese development, the *beam sling,* traveled west and inspired counterweight artillery in medieval Europe.

Mechanical artillery comes in two basic types: *two-armed,* ultimately based on the bow, and *one-armed,* ultimately based on the staff sling. Either design requires a frame to support the working elements and prevent the weapon from discharging until released; this adds to the machine's weight. Two-armed engines launch either bolts or stones; one-armed devices almost always hurl stones.

Several power sources saw use in mechanical artillery. The earliest designs, known as *flexion artillery,* were large, heavy bows that stored elastic energy in wood. Later ancient engineers developed *torsion artillery,* the wooden arms of which were rigid levers moved by more efficient springs made from animal sinew – or, in emergencies, from hair (there are stories of women cutting off their long hair for catapult-makers). Torsion weapons stored more energy for the same weight. The beam sling dispensed with energy storage, getting power from soldiers pulling on ropes attached to a lever; this was *traction artillery.* Finally, the trebuchet (the large "catapult" of medieval Europe) used the same sort of lever powered by a raised *counterweight* many times as heavy as the missile it hurled.

Flexion, torsion, and counterweight engines – and many man-portable crossbows (see *Bows, Crossbows, and Rated ST,* p. 74) – require great strength to cock the bow or raise the weight. An exceptionally strong man, or a beast, may be able to substitute for a crew of ordinary men; e.g., an elephant might be harnessed to a beam sling (see *Combining Strength,* p. 9). Theoretically, a *superhumanly* strong man could use artillery without mechanical aid! In general, anyone with enough ST to carry a mounted weapon can also cock it unaided.

Several mechanical aids are available to help average men, or crews of men, exert the necessary force. Many can be used with crossbows with high rated ST.

Belly Brace (TL2)

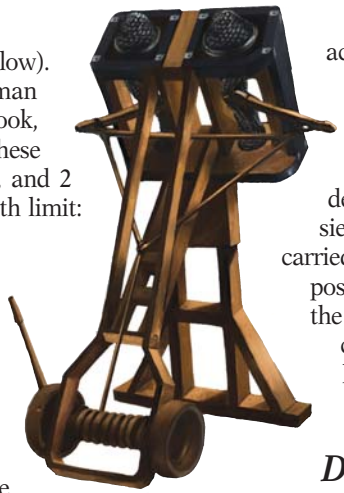
The device used to draw the bowstring on a gastraphetes (p. 72), giving the weapon its name, which means "belly bow." A long slider is pushed out the front of the weapon, a claw at the end engages the string, and then the user leans into a curved stock, forcing back the slider. Strength limit: user's ST +30%. Takes 2 seconds to prepare the slider, 2 seconds to lift, and 2 seconds to cock, plus 2 more seconds to draw and place the bolt. Built into the weapon, and included in its weight and cost.

Winch (TL2)

This machine is used with heavy flexion and torsion engines. A wheel at the side of the engine is turned, usually with the aid of projecting handles that offer a better grip. The wheel pulls a cord that draws the weapon. Takes 2 seconds to ready the weapon, plus a variable time to draw it (see *Windlass,* below). Built into the weapon, and included in its weight and cost.

Belt Hook (TL3)

An adjunct to the stirrup (see below). Instead of bending, the crossbowman kneels, catches the string on the belt hook, and stands up, drawing the string. These three steps take 1 second, 2 seconds, and 2 seconds – a total of 5 seconds. Strength limit: user's ST +10-20%. $25, neg.



Goat's Foot (TL3)

A standard device for cocking heavy crossbows, used by horsemen. A fork-like lever is braced against the crossbow stock. Two hooks extending out from the fork engage the string. Pulling back the fork's handle draws the string back. Using it takes 20 seconds. Strength limit: user's ST +30-40%. $50, 2 lbs.

Stirrup (TL3)

A single metal stirrup built into the front of a heavy crossbow. The user puts his foot through it, bends over to take the string in two hands, and uses his full body strength to draw the string. For effects, see *Bows, Crossbows, and Rated ST* (p. 74). Increases the crossbow's cost and weight: $50, 2 lbs.

Treadmill (TL3)

Trebuchets often use treadmills as power sources to raise their massive counterweights. A common design has a pair of treadmills at left and right. Weight and cost are included in the trebuchet's statistics.

Windlass (TL3)

A detachable equivalent of the winch, used with heavy crossbows and arbalests. It trades off speed for power, multiplying the operator's effective ST by a power ratio but multiplying the time required to draw the bow by a larger factor. It takes 5 seconds to attach the windlass to the weapon in the first place. Several models exist, each with its own specific ratios:

ST Multiplier	*Draw Time*	*Cost*	*Weight*
×1.5	9 seconds	$55	2.25 lbs.
×2	16 seconds	$100	4 lbs.
×2.5	25 seconds	$155	6.25 lbs.
×3	36 seconds	$225	9 lbs.

Cranequin (TL4)

A more sophisticated mechanical device for drawing a crossbow, made entirely of metal. A frame holds a toothed shaft that engages the string. Rotating a handle turns a gear whose teeth mesh with the shaft's, drawing it back. Like the windlass, available in variable power ratios. Costs the same as a windlass with the same ST multiplier, weighs half as much, and takes twice as long to use. Still requires 5 seconds to attach initially.

Heavy Weapons

Mechanical artillery made possible attacks much more powerful than unaided human strength could achieve, involving larger missiles and longer ranges. Such weapons had a variety of uses in war. The heaviest could defend a city or a military encampment against an assault or a siege – or, in a prolonged siege, be set up to overwhelm a city's defenses. Smaller engines were built into movable siege towers or placed on ships. Field artillery could be carried onto the battlefield and set up in an advantageous position; one man could carry the smaller pieces, while the larger ones could be broken down for several men to carry, or loaded onto carts. The *carroballista* of the later Roman Empire had its own wheeled carriage and harness for draft animals.

Direct-Fire Weapons

These weapons use the Gunner (Catapult) skill. They're mostly two-armed, with the ends of the arms pulling a cord that transmits force to a bolt or a stone. Most can be tilted backward on their base to allow indirect fire; such attacks require the Artillery (Catapult) skill.

Torsion-powered weapons typically have a narrow field of view between the springs. Seeing through this to aim is difficult! Before taking an Aim maneuver with the weapon, the operator must take a second and make a Vision roll to acquire the target.

Modifiers: A basic +10; target's SM; range penalties (p. B550), which can be offset by taking extra time (p. B346).

To achieve faster fire, operators often stand beside the weapon and look *around* rather than *through* it. This takes no extra time but doesn't allow Aim bonuses.

Ballista (TL2)

A torsion-powered stone-thrower with two horizontal arms that pull a cord – in effect, a gigantic prodd (p. 73). Large ballistae can hurl bundles of 1-lb. stones as well as single large stones.

Carroballista (TL2)

Used by the later Roman legions, the carroballista is the oldest known form of field artillery: a stone-thrower mounted on a wheeled carriage. Usually pulled by draft animals, but light enough for soldiers to pull if necessary.

Gastraphetes (TL2)

The original gastraphetes (p. 72) was a personal weapon comparable to a heavy crossbow. This was later scaled up to larger, heavier models that could only be drawn with mechanical devices. Two examples are described here: a large *double gastraphetes* that shoots two long bolts, and a lighter *mountain gastraphetes* that shoots one shorter bolt. The mountain gastraphetes has an unusual asymmetrical mount that lets it be set up on sloping ground.

Petrobolos (TL2)

Early flexion-powered stone-throwers were called *lithoboloi* or *petroboloi*. The table describes two models, one light and one heavy.

Polybolos (TL2)

The "automatic weapon" of the ancient world, designed for the highest possible rate of fire in order to intimidate enemy infantry. It's a torsion-powered bolt-thrower with a hopper filled with bolts mounted directly above it. Rotating a handle at the side draws back the bowstring, operates a cam that drops one bolt from the hopper, and then releases the string and launches the bolt. The mechanisms are coupled by a flat chain, like that of a bicycle. This is the oldest known example both of cams and of flat chains. Some ancient generals were reluctant to use the polybolos – they feared that its rapid firing rate would encourage soldiers to waste ammunition!

Scorpion (TL2)

Ancient ballistae that threw bolts rather than stones were nicknamed "scorpions" for both their sting and appearance. Like stone-throwing ballistae, these are torsion-powered, two-armed weapons with a low arc of fire. Scorpions are rated by the length of the shaft they propel.

Arbalest (TL3)

A medieval weapon resembling a large crossbow; in fact, crossbows are sometimes called "arbalests." Here the name is used for a larger weapon. A built-in winch supplies power.

Springald (TL3)

This is a bizarre hybrid design: a one-armed weapon, like a monankon (p. 81) or a trebuchet (p. 81), but hurling a bolt rather than a stone, and as direct rather than indirect fire. The power source is flexion; a thick wooden arm, like half of a bow, is winched back and released, letting it spring forward to strike the end of the bolt and drive it out a hole. Springalds were mainly used to defend fortifications against assaults by besiegers.

Indirect-Fire Weapons

These weapons use the Artillery (Catapult) skill. Their construction is one-armed, normally with a sling attached to the end of the arm to hold a stone. They lob projectiles in a high arc, giving them a *minimum* range; see the table notes. Such engines are almost always used from fixed emplacements, to defend or besiege a fortified site. Changing their line of fire is a slow, difficult process; see *Aiming Fixed-Mount Weapons* (below). The weapons on the table are just examples – larger models are recorded!

Aiming Fixed-Mount Weapons

Early artillery weapons were often too massive for their aim to be changed easily. They were built into large vehicles, placed on fixed mounts, or simply anchored to the ground.

In indirect fire, changing targets along the same line of fire can be managed by varying missile weight (for catapults) or powder charge (for bombards). This can be done with an Artillery (Catapult or Cannon) roll. A miss always lands along the line between weapon and target; use *Scatter* (p. B414), but any odd roll falls short along that line while any even roll overshoots. For bombards, a malfunction (p. B407) when the charge was reduced to shorten range means the shot doesn't even clear the barrel and must be removed (treat as a stoppage); a malfunction when the charge was increased to lengthen range means the bombard explodes!

Changing lines of fire – or setting up such a weapon in the first place – calls for an Engineer (Combat) roll or an Artillery (Catapult or Cannon) roll at -2. The task takes a base 5 hours, which can be reduced by accepting penalties for haste (p. B346); the maximum time reduction of 90% (-9 to skill) allows changing aim in 30 minutes. Huge weapons impose greater penalties: an extra -1 per full ton of weight. The work crew must be able to move the weapon; its weight can't exceed 15 × (total BL).

The line of fire of a vehicle-mounted weapon can be changed by turning the vehicle. See *Vehicle Weapon Mounts* (p. B467).

. . . such terror had seized upon the Romans, that, if they did but see a little rope or a piece of wood from the wall, instantly crying out, that there it was again, Archimedes was about to let fly some engine at them, they turned their backs and fled . . .

– Plutarch,
Parallel Lives

Monankon (TL2)

A simpler design than the ballista, the monankon has one arm, one torsion spring, and no string; the sling pouch is fastened directly to the end of the arm. The arm swings from horizontal to vertical, hits a cushion, and stops, releasing the missile. The later Roman version was nicknamed "onager" because of its recoil, which was compared to the kick of a wild ass.

Beam Sling (TL3)

The main heavy weapon of China and the Middle East, the beam sling – sometimes called a *mangonel, cheiromanganon,* or *traction trebuchet* – has at its heart a massive lever. The short arm is pulled by men hauling on ropes, while the long arm has a pouch or sack that holds the ammunition. The sizes of beam slings are denoted by the number of men needed to power them. Some Middle Eastern models improved performance by adding weights to the short arm, a step toward the counterweighted trebuchet (below).

Trebuchet (TL3)

The classic medieval "catapult," designed to smash castle walls with huge rocks. It's similar to the beam sling (above), but a massive counterweight replaces the men hauling on ropes. The basic trebuchet has the counterweight mounted directly on the short end of the beam. More advanced models attach it with hinges, letting it swing freely through different angles as it pulls down the beam, so that it descends in a path closer to vertical. Such a trebuchet wastes less energy in horizontal motion of the counterweight and consequently has much greater range.

Ammunition Costs

Engines that deal *impaling* damage shoot bolts. Those that do *crushing* damage hurl roughly spherical stones, with one flattened surface to keep from rolling. For *ballistae* only, an extravagant commander may substitute bundles of 1-lb. lead bullets (the largest known size) for bundles of 1-lb. stones; these give +1 to damage and make damage type *huge piercing* (pi++).

Cost depends on weight:

Bolts: $33/lb.
Lead Bullets: $1.60/lb.
Stones: $1/lb.

Crew Size Table

In addition to an artillerist or gunner, many weapons need a crew to load them, supply traction, etc. These people *don't* need Artillery or Gunner skill, and don't normally make skill rolls. If the GM requires a roll, use Soldier skill – although crewmen may substitute *ST*-based Artillery or Gunner, if better.

Weapon	*Crew Size*	*Weapon*	*Crew Size*
Ballista, 5-lb.	1	Carroballista	1
Ballista, 10-lb.	1	Monankon	2
Ballista, 15-lb.	1	Petrobolos, 40-lb.	2
Ballista, 20-lb.	1	Scorpion, 72"	1
Ballista, 30-lb.	2	Trebuchet, Large	30
Ballista, 60-lb.	3	Trebuchet, Small	25
Ballista, 180-lb.	6		

Mechanical Artillery Table

Terms and notation are as defined on pp. B268-271, with these additions:

Shots: Except for traction artillery, parenthetical loading times mostly cover drawing the bow or lowering the throwing arm. Loading ammunition is a comparatively minor task. For crewed engines (footnote [2]), multiply reload time by total crew size (add one for the gunner) to compare the amount of labor required.

ST: A giant who wishes to wield such an engine as a personal weapon must meet its ST requirement *and* have enough BL to lift it one- or two-handed, as follows. Weapons with footnote [4] are normally mounted on a fixed tripod; heroically strong users can lift them off this *two-handed* and shoot them from the shoulder. Engines with footnote [3] have a roughly rectangular base; a giant must wield such a weapon *one-handed,* like a clumsy pistol, subject to the rules for using two-handed weapons one-handed (p. B270).

Bulk: Where two scores appear, the worse is for giants using the thing pistol-style!

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	Notes
ARTILLERY (CATAPULT) (IQ-5)												
2	Monankon	12d-1 cr	1	440/550	3,800/15	1	1(60)	138M†	-15/-20	2	$95,000	[1, 2, 3]
3	Beam Sling, 15-Man	7d cr	2	50/60	240/2	1	1(15)	35M†	-12/-15	3	$2,400	[1, 2, 3]
3	Beam Sling, 30-Man	8d+2 cr	2	50/65	670/5	1	1(15)	58M†	-14/-18	3	$6,700	[1, 2, 3]
3	Beam Sling, 50-Man	10d+1 cr	2	50/65	1,400/10	1	1(15)	84M†	-16/-20	3	$14,000	[1, 2, 3]
3	Beam Sling, 100-Man	13d+1 cr	2	55/70	4,000/30	1	1(15)	140M†	-18/-22	3	$40,000	[1, 2, 3]
3	Beam Sling, Weighted, 30-Man	8d+2 cr	2	105/130	1,260/5	1	1(60)	80M†	-15/-19	3	$12,600	[1, 2, 3]
3	Beam Sling, Weighted, 50-Man	10d+1 cr	2	105/130	2,400/10	1	1(60)	110M†	-16/-21	3	$24,000	[1, 2, 3]
3	Trebuchet, Large	6d×3 cr	1	290/360	56,000/80	1	1(450)	530M†	-22/-27	4	$240,000	[1, 2, 3]
3	Trebuchet, Small	13d+2 cr	1	265/330	22,000/25	1	1(300)	330M†	-20/-25	3	$75,000	[1, 2, 3]
3	Trebuchet, Hinged, Large	17d cr	1	510/660	44,000/80	1	1(450)	470M†	-21/-26	3	$210,000	[1, 2, 3]
3	Trebuchet, Hinged, Small	12d+2 cr	1	480/600	17,500/25	1	1(300)	295M†	-19/-24	3	$70,000	[1, 2, 3]
GUNNER (CATAPULT) (DX-4 or other Gunner-4)												
2	Ballista, 1-lb.	4d+1 cr	4	245/305	140/1	1	1(15)	20M†	-10	1	$3,500	[4]
2	Ballista, 2-lb.	5d-1 cr	4	255/320	260/2	1	1(22)	36M†	-10	1	$6,500	[4]
2	Ballista, 5-lb.	6d cr	4	275/345	680/5	1	1(22)	58M†	-12	1	$17,000	[2, 4]
2	Ballista, 10-lb.	7d+1 cr	4	290/360	1,330/10	1	1(30)	82M†	-14	1	$33,000	[2, 4]
	or	4d cr	4	245/305	–	1×10	1(30)	–	–	1	–	
2	Ballista, 15-lb.	8d+1 cr	4	295/370	2,000/15	1	1(42)	100M†	-14	1	$50,000	[2, 4]
	or	4d cr	4	245/305	–	1×15	1(42)	–	–	1	–	
2	Ballista, 20-lb.	9d cr	4	300/375	2,700/20	1	1(55)	116M†	-15	1	$67,500	[2, 4]
	or	4d cr	4	245/305	–	1×20	1(55)	–	–	1	–	
2	Ballista, 30-lb.	10d+1 cr	4	310/385	4,100/30	1	1(45)	143M†	-15	1	$102,500	[2, 4]
	or	4d cr	4	245/305	–	1×30	1(45)	–	–	1	–	
2	Ballista, 60-lb.	12d+1 cr	4	315/390	8,000/60	1	1(55)	200M†	-17	1	$200,000	[2, 4]
	or	4d cr	4	245/305	–	1×60	1(55)	–	–	1	–	
2	Ballista, 180-lb.	16d cr	4	345/435	24,000/180	1	1(70)	350M†	-25	1	$600,000	[2, 4]
	or	4d cr	4	245/305	–	1×180	1(70)	–	–	1	–	
2	Carroballista	3d imp	4	220/275	160/0.5	1	1(10)	17M†	-10	1	$4,000	[2, 5]
2	Gastraphetes, Double	5d imp	4	300/375	715/4	1×2	1(40)	60M†	-12	1	$18,000	[4]
2	Gastraphetes, Mountain	3d imp	4	320/400	200/1	1	1(20)	22M†	-11	1	$5,000	[4]
2	Petrobolos, 5-lb.	5d+2 cr	4	250/315	715/5	1	1(40)	60M†	-12	1	$18,000	[4]
2	Petrobolos, 40-lb.	11d cr	4	330/415	6,600/40	1	1(60)	180M†	-16	1	$165,000	[2, 4]
2	Polybolos	3d imp	4	310/385	70/4	1	20(2i)	17M†	-9	1	$3,500	[4, 6]
2	Scorpion, 27"	3d imp	4	220/275	65/0.5	1	1(10)	17M†	-9	1	$1,600	[4]
2	Scorpion, 36"	4d imp	4	240/300	160/1.2	1	1(15)	21M†	-10	1	$4,000	[4]
2	Scorpion, 45"	5d imp	4	250/315	290/2.25	1	1(24)	38M†	-11	1	$7,200	[4]
2	Scorpion, 54"	6d-1 imp	4	250/315	515/4	1	1(35)	51M†	-12	1	$12,800	[4]
2	Scorpion, 72"	7d+1 imp	4	275/345	1,190/10	1	1(30)	77M†	-14	1	$30,000	[2, 4]
3	Arbalest	3d-1 imp	4	360/450	37/0.5	1	1(30)	15M†	-9	1	$15,000	[4]
3	Springald	5d+3 imp	1	90/110	216/2	1	1(20)	33M†	-11/-14	2	$5,400	[3]

Notes

[1] Minimum range is 25% of maximum range.

[2] Requires crew. Use the listed number of men for beam slings. See the *Crew Size Table* (p. 81) for other weapons.

[3] Rectangular-based weapon; see table introduction for effects.

[4] Detachable tripod required; see *Tripod Mount Table* (p. 83).

[5] Stats include built-in wheeled carriage, harness for two draft animals, and storage space for 100 bolts (weigh 50 lbs.). Total weight is low enough for the crew to move it if necessary, but the weapon is far too awkward for a giant to wield!

[6] Requires five Ready maneuvers between shots; emptying the 20-round magazine takes 2 minutes.

As soon as the great catapults were set, they began to throw missiles marvelously high . . .

– J.R.R. Tolkien,
The Return of the King

Alternate Catapult Ammunition

Ancient writers recorded several sorts of nonstandard artillery projectiles. One option – multiple smaller stones or bullets – is described for the ballista (p. 80). Incendiary attacks using pots of charcoal and pitch become possible at TL2, and vases filled with Greek fire at TL3; see *Incendiaries* (p. 84). At TL2, bolts can be used as large flaming arrows (see p. B410 and *Alternate Arrows,* p. 73) – but on a critical failure, apply the burning damage to the catapult itself! Ingenious artillerists can invent other missiles. For *one-armed* engines, these can be heavier than normal at the price of decreased range:

Weight Multiple	*Distance Multiple*	*Weight Multiple*	*Distance Multiple*
1	1	5	0.20
1.5	0.65	6	0.15
2	0.50	8	0.125
2.5	0.40	10	0.10
3	0.35	12	0.08
4	0.25		

Tripod Mount Table

Weapon	*Tripod Weight*	*Tripod Cost*
Arbalest	32	$800
Ballista, 1-lb.	60	$1,500
Ballista, 2-lb.	95	$2,300
Ballista, 5-lb.	165	$4,100
Ballista, 10-lb.	270	$6,800
Ballista, 15-lb.	340	$8,400
Ballista, 20-lb.	410	$10,000
Ballista, 30-lb.	570	$14,000
Ballista, 60-lb.	930	$23,000
Ballista, 180-lb.	2,000	$50,000
Gastraphetes, Double	270	$6,800
Gastraphetes, Mountain	75	$1,900
Petrobolos, 5-lb.	165	$4,100
Petrobolos, 40-lb.	800	$20,000
Polybolos	42	$1,000
Scorpion, 27"	42	$1,000
Scorpion, 36"	67	$1,700
Scorpion, 45"	93	$2,300
Scorpion, 54"	140	$3,500
Scorpion, 72"	250	$6,300

Personal Artillery

The Greeks and Romans also developed ballistae and scorpions light enough to use as personal weapons. Unlike the crossbows under *Bows, Slings, and Thrown Weapons* (pp. 72-78), which are custom-made (see *Bows, Crossbows, and Rated ST,* p. 74), these come in standard "calibers," based on the length of bolt or weight of stone hurled. The spring is a standard diameter suited to the ammunition, and every other part of the weapon is in proportion to the spring. Despite the differences, these weapons still use Crossbow skill. They have the narrow window of visibility of full-scale ballistae, though, and are subject to the limitations on Aim under *Direct-Fire Weapons* (pp. 79-80).

The later Roman Empire brought a more advanced design into use.

Cheiroballistra (TL2)

This two-armed, torsion-powered bolt-thrower – made from iron rather than wood – is small enough for one man to use. Roman cavalry were trained to cock, load, and fire it from horseback. Drawing the string doesn't pull the arms out to the side, but in toward the center, while the string takes a sharp "V" shape that aims most of its force forward. The torsion springs are placed out to the sides, and their wide spacing gives a better field of view, allowing an Aim maneuver *without* a previous Vision roll.

Personal Artillery Table

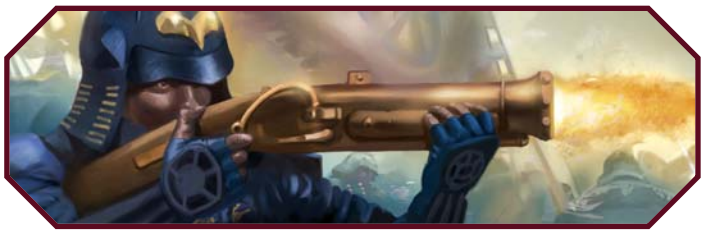
Terms and notation are as defined on pp. B268-271, with one addition:

ST: The first ST listed is that needed to aim and shoot the weapon effectively. The second, in brackets, is the mechanism's *rated ST.* If this exceeds 10, only use it when pulling back the string by hand; reduce it to 10 when cranking the weapon.

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*Cost*	*ST*	*Bulk*
CROSSBOW (DX-4)										
2	Ballista, 0.03-lb.	1d+2 cr	4	220/275	3/0.03	1	1(4)	$75	7†[8]	-2
2	Ballista, 0.06-lb.	1d+3 cr	4	225/280	6/0.06	1	1(4)	$150	7†[10]	-4
2	Ballista, 0.12-lb.	2d+1 cr	4	240/300	18/0.12	1	1(6)	$450	12†[13]	-6
2	Ballista, 0.18-lb.	2d+2 cr	4	255/320	27/0.18	1	1(7)	$675	13†[15]	-6
2	Cheiroballistra, 18"	2d+1 imp	4	215/270	7.5/0.12	1	1(6)	$375	9†[14]	-5
2	Scorpion, 9"	1d+2 imp	4	185/230	2/0.02	1	1(4)	$50	7†[7]	-2
2	Scorpion, 13.5"	1d+3 imp	4	200/250	6/0.06	1	1(4)	$150	7†[10]	-4
2	Scorpion, 18"	2d+1 imp	4	210/265	19/0.14	1	1(6)	$475	12†[13]	-6

Personal Artillery Ammunition

See *Ammunition Costs* (p. 81). Lead bullets for ballistae (only) give +1 to damage and make damage type *large piercing* (pi+) for 0.03-lb. and 0.06-lb. models, or *huge piercing* (pi++) for larger ones. Gadgeteers might lob other hard spheroids of suitable weight (e.g., chemical-filled glass balls) from ballistae.



Combustion-Based Weapons

All the weapons discussed so far use mechanical energy provided by human or animal muscles. Low-tech warriors also exploited thermal energy released by burning materials – both *incendiaries,* which use heat to set things on fire, and *explosives* and *propellants,* which convert it to mechanical energy. Indeed, the invention of gunpowder (TL3) started a revolution in warfare!

Incendiaries

Setting things aflame as a combat tactic may go back to prehistory; several recent-but-TL0 tribal societies used flaming arrows (p. B410). Experiments with incendiary weapons and combustible mixtures date to the start of the Iron Age. The Greek historian Thucydides described use of an improvised flamethrower to set fire to a defensive wall in 423 B.C.

Combustibles

Early Mixtures (TL2). Ancient Greek combustibles were predominantly based on pitch, which burned hot and stuck to what it hit. Common additives included sulfur, charcoal, and even incense. A small splash of such a mixture inflicts 1 point of burning damage per second; anything in an area doused with it takes 1d-1 burn per second. Such mixtures are *flammable* (see *Making Things Burn,* p. B433), and burn for 3d seconds once ignited unless smothered or submerged under water. Per pint: $1, 1 lb.

Black Powder (TL3). A powder train burns at 3" per second and requires 0.25 lb. of black powder (p. 85) per yard.

Greek Fire (TL3). This mixture of incendiary substances – likely including naphtha – was invented by a Syrian refugee, Kallinikos, in 673 A.D. Its exact composition was a secret of the Byzantine Empire and was lost, probably in the 1200s. Treat Greek fire as a Molotov cocktail (p. B411) for damage and other effects. It burns on top of water, making it a terror to enemy fleets, and can't be put out by pouring water over it; one of its Byzantine names was "marine fire." Often dispersed via fire-siphon (below). Per pint: $10, 1 lb.

Naphtha (TL3). Near Eastern alchemists developed methods for distilling petroleum, producing a substance called *naft*. Treat this as equivalent to oil (p. B288). It inflicts the same damage as early pitch mixtures, but is *highly flammable* (see *Making Things Burn,* p. B433) and continues to burn for 10d seconds. Per pint: $2, 1 lb.

Saltpeter (TL3). Potassium nitrate was first purified by Chinese alchemists around 492 A.D. They discovered its incendiary properties not long afterward. The raw material can be extracted from urine-soaked manure, or mined. It gives off oxygen when heated, accelerating the burning of other substances. Treating a material that's *highly flammable, flammable,* or *resistant* (see *Making Things Burn,* p. B433) with an alcohol/water solution of saltpeter makes it one flammability class easier to ignite. $5/lb.

Match (TL4). Used to set off matchlock guns (see *Locks,* p. 90) and charges of black powder (p. 85). Using match in a fuse requires an Explosives (Demolition or Fireworks) roll.

Slow match is saltpeter-impregnated flax or hemp cord. Once ignited, it burns at 1" per 15 minutes. Per yard: $2, 0.2 lb. (An improvised form, made by soaking cord in a wood ash solution, costs 1/10 as much, but gives -2 to firearms Malf. and Explosives rolls.)

Quick match is made by treatment with black powder and gum arabic. It burns at up to 4 yards per minute. Per yard: $2, 0.2 lb.

Delivery Systems

Fire-Cage Arrow (TL2). See *Alternate Arrows* (p. 730).

Flask (TL2). A light ceramic vessel (which shatters when it hits something hard) or a wooden one (which burns) can deliver incendiaries. Small containers (holding 1 pint) can be hurled by hand or by a light ballista (pp. 80, 82); assume that cost is that of 1 pint of incendiary and total weight is 1.5 lbs.

Fire-Siphon (TL3). A Byzantine device for spraying Greek fire at enemy ships, based on Roman pumping engines. It's built into a warship, its nozzle extending outside the hull. Greek princess Anna Comnena described its use in a sea battle in 1103 A.D. The handheld *cheirosiphon* appeared on battlefields by the early 10th century; the Arabs adopted it a few decades later as the *zarraq al-naft,* spraying naphtha rather than Greek fire. It remained in use in Egypt until at least the 1400s. A handheld siphon resembles a squirt gun with a large tank attached and a fuse of slow match (above) just outside the nozzle to ignite the fuel. These weapons appear on the *Flamethrowers Table* (p. 86).

Incendiary Blowpipe (TL3). Byzantine sources mention a blowpipe that was charged with pine resin. On being discharged, the fuel was set aflame by a wick at the end. This produced a small cloud of burning vapor, not as hot as Greek fire or naphtha. See the *Flamethrowers Table* (p. 86) for stats.

Incendiary Sphere (TL3). See *Bombs* (pp. 85-86).

Black Powder

Because saltpeter (pp. 26, 84) was expensive, Chinese alchemists tried mixing it with other substances. Sometime around 1100 A.D., they developed an explosive mixture: *black powder.* Saltpeter was exported to the Arabs by 1225; black powder, by 1250. Roger Bacon, in England, recorded black powder's formula in 1257. The ingredients are saltpeter, charcoal, and sulfur; typical proportions are 75%, 15%, and 10%, respectively. Charcoal is the main fuel, while saltpeter serves as the oxygen source; sulfur lowers the temperature at which the saltpeter releases oxygen. These components are ground fine with a mortar and pestle, and mixed together.

Early black powder was finely ground. This *serpentine powder* (TL3) burned rapidly but had limited explosive force. In the 15th century, *corned powder* (TL4) was invented, originally to make black powder easier to store and ship. It was made by moistening serpentine, pressing it into cakes, and grinding it into fine grains for priming powder, medium grains for small arms, or coarse grains for cannon and blasting explosives.

Black powder has many uses. It can serve as an incendiary, in a powder train (see *Incendiaries,* p. 84), or as an explosive (use the rules under *Explosions,* pp. B414-415). It can be made into fireworks (see *Fireworks,* p. 40). And of course it can be used in weapons.

Black powder is customarily sold in 100-lb. kegs. Corned powder is $20/lb.; treat serpentine as *cheap* (-0.5 CF). LC3.

Bombs (TL3)

These are containers of black powder, designed to be thrown by hand, hurled from a catapult, or placed and set off.

Incendiary Sphere (TL3). Available in China in the early 1100s, this contraption is meant to be hurled by a beam sling (p. 81). It's a perforated metal ball holding several pounds of low-grade black powder. The powder burns for 2 minutes, spraying flame out the holes to inflict 1d+1 burn over a one-yard radius. The sphere is studded with metal hooks that can catch on enemy fortifications or ladders. $200, 10 lbs.

Paper Bomb (TL3). Another Chinese development of the early 1100s, this is a huge firecracker: 3-4 lbs. of black powder enclosed in string-wrapped paper, or in bamboo. It inflicts 5d cr ex and fills a five-yard radius with smoke that lasts 1 minute, giving -10 to Vision and acting as a mild poison (p. B439). The burst is *loud;* anyone who takes crushing damage must make a HT-5 roll or suffer a Hearing penalty equal to his margin of failure for (20 - HT) minutes, minimum 1 minute. Failure by 10+, or critical failure, means deafness. Roll to recover from crippling injury, or suffer lasting or permanent Hard of Hearing or Deafness. Any failure on the initial HT roll also stuns the victim; roll vs. HT each turn to recover. Riding animals not specifically trained to tolerate explosions – and, at the GM's option, *people* encountering this weapon for the first time – must make a Fright Check (p. B360). $100, 5 lbs.

Iron Bomb (TL3). In the early 1200s, the Chinese developed higher-powered black powder that could burst an iron casing and produce shrapnel. A small iron bomb holds 14 lbs. of serpentine powder. Damage is 6d×4 [2d] cr ex. $600, 30 lbs.

"Can We Have Gunpowder?"

Players may want low-tech PCs to have black powder. This is up to the GM, but here are some important considerations.

Making Black Powder

Making black powder requires a Chemistry or Explosives (Fireworks) roll at +4, or an Explosives (Demolition) roll. Before gunpowder comes into common use, the Explosives skills are unavailable and have no default. Failure means the product is substandard: -2 to Malf. for bombs and firearms, and damage is at -1 per die. Critical failure means the mixture catches fire, destroying the maker's laboratory! A *Per*-based Chemistry roll, or a Danger Sense roll, gives the chemist enough warning to avoid injury; otherwise, he suffers 3d burning damage.

At the GM's option, early experimenters may be unable to obtain sufficiently pure ingredients, especially saltpeter. Impure ingredients give -5 (quality) to rolls to make black powder. Taking extra time (p. B346) for purification can partially or fully offset this penalty.

The Big "What If": Early Black Powder

Of all the "what ifs" in the history of technology, the most compelling may be the early invention of gunpowder. A Roman Empire with firearms might not have fallen; an Assyria with cannon might have destroyed Jerusalem's walls and prevented the birth of Christianity and Islam. But could they have come up with black powder in the first place?

Charcoal is no problem; it has been a portable fuel for millennia. Native sulfur was discovered in antiquity – the Bible calls it *brimstone.* Impure saltpeter can be found in stable manure piles. After the invention of the chariot (p. 137), ancient kings from Egypt to China had plenty of manure!

The problem is curiosity: an interest in picking up saltpeter crystals in the first place, purifying them, and mixing them with other substances. Chinese alchemists seeking an immortality drug tried this. Perhaps some physician or alchemist in the Roman Empire might have done the same experiment – or even an Egyptian priest or doctor seeking a medicine, an incense, or a preservative for mummies. Such a tradition of experimentation could kick off an alternate history with early gunpowder weapons.

Land Mine (TL4). A Chinese invention described in a 14th-century military text: a 9' length of bamboo buried upright in earth, the bottom 80% filled with black powder and the rest with lead balls. Stepping on it releases a weight whose fall powers a wheellock device, setting off sparks that ignite the powder. The soil channels the blast upward, inflicting 14d [4d] cr in a one-yard radius; the fragmentation damage is *crushing,* not cutting. $350, 10 lbs.

Petard (TL4). This is a Renaissance invention for forcing an entrance through a strong door or gate. Its name is a crude military joke, from the French *péter,* "to fart." It consists of an iron pot that holds 5 lbs. of black powder, mounted in a board that can be nailed to a door to hold the pot's mouth against the barrier. Roll 15d crushing damage for the blast and compare it to the target's DR and HP. $250, 15 lbs.

Some one intent on mischief, or inspir'd
With dev'lish machination might devise
Like instrument to plague the Sons of men
For sin, on warr and mutual slaughter bent.

– John Milton, ***Paradise Lost***

Fire Arrows (TL3)

A fire arrow is an arrow with an ounce of low-grade black powder fastened to the shaft in a paper globe or tube sealed with pine resin. See *Alternate Arrows* (p. 73).

Flamethrowers (TL3)

These weapons discharge continuing flame jets – like a rocket exhaust, but from a fixed or handheld base.

Fire-Lance (TL3). Developed in China in the early 1200s, the fire-lance was valued for defending city walls. It's a two-foot-long rocket fastened to the end of a pole. After lighting it, the soldier points it at the enemy, spraying out flame and sparks. The user needs a Ready maneuver to take hold of it, another to light it, and a third to shift grip to full length. Once used, it's discarded.

Iron Fire-Lance (TL3). Later fire-lances, developed in the late 1200s, used yard-long *iron* barrels on two-foot wooden poles. These could expel a fiercer flame than the earlier paper or bamboo models. Bits of metal or pottery were often mixed into the powder to inflict penetrating wounds on enemy soldiers. Readying works as for the regular fire-lance (above). The barrel can be recharged after use; this requires 10 minutes and an Explosives (Fireworks) roll.

Eruptor (TL3). A large-scale iron fire-lance, designed to be mounted on a city's walls or on a frame facing its gates. Lighting it takes a Ready maneuver. It's rechargeable in the same way as an iron fire-lance, but this takes 20 minutes.

Flamethrowers Table

Terms and notation are as defined on pp. B268-271.

TL	Weapon	Damage	Range	Weight	RoF	Shots	ST	Bulk	Cost	Notes
BLOWPIPE (DX-6)										
3	Incendiary Blowpipe	1d-1 burn	×0.2	1/0.05	1	1(20)	2	-6	$35	[1]
LIQUID PROJECTOR (FLAMETHROWER) (DX-4 or other Liquid Projector-4)										
3	Cheirosiphon	3d burn	×0.5/×1	20	Jet	12×1s	12†	-6	$1,000	[2, 3]
3	Eruptor	1d+1 burn	1-6	50	Jet	1×300s	16M†	-8	$500	[4]
	linked	1 pi-								
3	Fire-Lance	1d-1 burn	2-4	5	Jet	1×60s	9†	-6	$50	
3	Fire-Siphon	3d burn	15/25	550	Jet	60×1s	29M†	-14	$2,750	[2, 5]
3	Iron Fire-Lance	1d burn	2-4	10	Jet	1×120s	11†	-6	$150	
	linked	1 pi-								

Notes

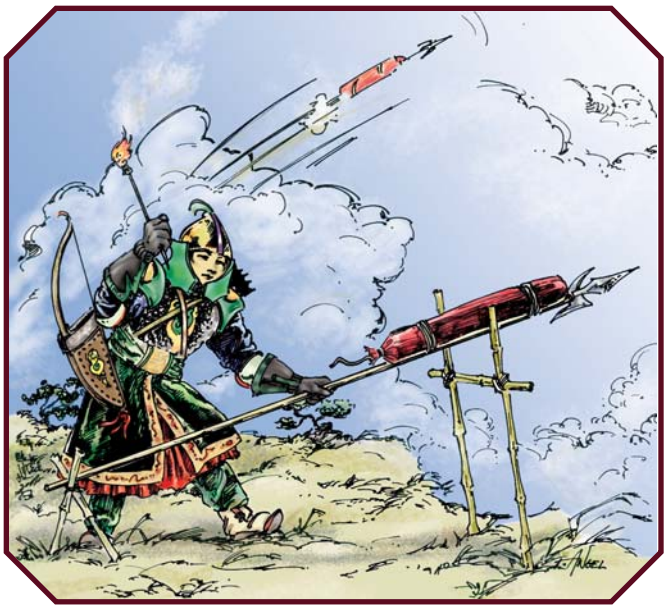
[1] Requires *two* hands to ready, but only *one* hand to attack. Range is ST-based. Produces a cone with terminal width equal to Range. Each charge costs $0.50.

[2] A shot may hit a single solid target or spread out over a two-yard radius on water. Listed damage is for initial hit; continuing damage is 1d burn per second for 10d seconds after initial impact (for fire-siphon) or 1d seconds (for cheirosiphon).

[3] Takes 10 seconds to prepare for firing. After first shot, further shots may be fired continuously. Range is ST-based.

[4] Placed on a static mount: $270, 13.5 lbs.

[5] Requires a two-man crew to operate the pump. Readying it takes a variable time; roll vs. crew's average ST every 10 seconds to see if the fuel has started to emerge. They may substitute *ST*-based Liquid Projector (Flamethrower) skill, if higher. After first shot, further shots may be fired continuously.



Rockets (TL3)

The Chinese developed rockets in the mid-1200s; the Koreans adopted them in the 1300s. Rockets seemingly evolved from fire arrows, when archers realized that the flaming exhaust could propel these arrows without a bow. The wooden shaft helped to stabilize the rocket's flight. Its explosion could set a distant target ablaze.

Rockets aren't fired blind (p. B389) but *are* unguided. Rocket attacks are the ranged equivalent of Wild Swings (p. B388); they have -5 to hit and maximum effective skill 9, and can't target specific hit locations.

Below are statistics for a *typical* rocket. It takes three seconds to reach full range and explode, traveling 90 yards in the first second, 270 in the next, and 450 in the third. As well as a crushing explosion, it does 1 point of burning damage over a two-yard radius *and* fills that radius with smoke. Further, anyone who takes crushing damage from the blast may suffer hearing loss and stun as for a paper bomb (p. 85); roll vs. HT-2 rather than HT-5 to resist.

TL	Weapon	Damage	Acc	Range	Wt.	RoF	Shots	ST	Bulk	Rcl	Cost
GUNNER (ROCKETS) (DX-4 or other Gunner-4)											
3	Rocket	2d+2 cr ex	0	810	1.15	1	1(15)	6M	-5	1	$23

Gunpowder Artillery

The fire-lance and eruptor gave rise to actual projectile weapons by the late 1200s. Armorers realized that projectiles that filled an eruptor's barrel, instead of being scattered through the propellant, flew farther and hit harder. They began making weapons specifically to hurl projectiles – the first guns. Early models tried many sorts of ammunition, including bundles of arrows, iron bolts like large crossbow quarrels, and bags of lead pellets, but in the 1300s, solid balls became standard. Wadding on top of the ball sealed the barrel so that nearly all of the explosion's force was used.

Bombards

Early gunpowder weapons – called *bombards* – were heavy and awkward to use. Gun carriages hadn't been invented; bombards were built into vehicles or buildings, or held in place by massive wooden frames. See *Aiming Fixed-Mount Weapons* (p. 80) for how this affects operation.

Bombards normally fire stone balls (see *The Cost of Ammunition,* below), which take a lighter powder charge and can safely be used in breechloading guns. Stone shot gets *half* the damage and range of metal shot. The weapon tables already account for this.

For examples of *really huge* guns, see ***GURPS Low-Tech Companion 2.***

European Guns (TL3)

European guns in the Middle Ages were made like actual wooden barrels, with long metal bars shaped into a cylinder and bound with metal hoops. To close off the end, a separate cup-shaped piece was joined to the barrel at the breech. Most such weapons were breechloaders. Guns of different sizes and proportions had different names:

Bombard: A big, short-barreled gun firing large or huge stones. The *Bombards Table* (p. 88) offers two examples.

Crapaudeau: A long-barreled, small-caliber breechloader firing small stones.

Veuglaire: A fairly small breechloader with a moderately long barrel, about 12 times its caliber, firing stones somewhat larger than the crapaudeau's.

Chinese Guns (TL4)

The first Chinese guns were small and low-powered. They were essentially personal firearms; see *Early Experiments* (p. 91). The use of metal made larger, heavier weapons possible. Cast-iron Chinese guns are classified as TL4.

The Cost of Ammunition

Ammunition for TL3-4 firearms consists of separate powder and balls. Balls must be cut or cast to fit individual weapons. Black powder and lead are bought in bulk, by weight, for soldiers to measure out for their guns. It's accurate enough to treat cost per shot as a simple multiple of weight per shot. Lead or iron shot is simply cast. Stone balls have to be cut, raising costs; on the other hand, stone is much lighter than metal for the same volume.

Metal ammunition: $20/lb.
Stone ammunition: $100/lb.

Bombards Table

Terms and notation are as defined on pp. B268-271.

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*Notes*
ARTILLERY (CANNON) (IQ-5)												
3	Bombard	13d+2 pi++	1	80/550	1,550/50	1	1(60)	55M†	-12	5	$21,000	
3	Bombard	6d×5 pi++	1	130/740	16,000/430	1	1(60)	92M†	-16	5	$220,000	
3	Crapaudeau	1d+2 pi++	1	20/170	32/0.12	1	1(60)	17M†	-8	2	$440	
3	Veuglaire	4d+2 pi++	1	40/340	700/2.5	1	1(60)	36M†	-12	2	$9,600	
4	Crouching Tiger Gun	6d+2 pi++	2	60/550	47/1.15	1	1(60)	16M†	-8	5	$650	Stone ball.
	or	1d-1 pi+	1	130/1,200	47/3.5	1×100	1(60)	19M†	–	1	–	Lead shot.
4	Long-Range Awe-Inspiring Gun	7d-1 pi++	1	130/1,200	160/3	1	1(60)	21M†	-10	4	$2,200	Lead ball.
	or	1d-1 pi+	1	130/1,200	160/3.5	1×100	1(60)	–	–	1	–	Lead shot.

Cannon

In the 1500s, big guns became more mobile. Ships' guns were mounted on carriages; thus, the barrel could be thrust out through a gun port to fire, and the weapon's recoil would carry it back into the ship for reloading. In the 1600s, Swedish king Gustavus Adolphus developed field artillery, designed to be towed on the battlefield by draft animals. These weapons were *cannon* in the modern sense, and predominantly TL4.

Most of the cannon described here are comparatively small; a squad of soldiers or a band of adventurers could haul one around. A few larger models are included to illustrate what big guns were like. *Huge* weapons were rare – TL4 warfare put a premium on mobility.

Swivel-Guns (TL3)

Swivel-guns are small cannon that can be mounted on a ship's gunwale or a city wall, and swung about to engage attackers. They entered use at TL3, in the form of relatively low-powered breechloaders that amounted to aimable bombards. Many TL4 models were also breechloaders. The *Cannon Table* (p. 89) includes an example for each TL: The TL3 *lantaka* (.69 caliber) is an Indonesian design using serpentine powder; similar weapons could be found on Chinese junks or Mediterranean galleys. The TL4 *swivel-gun* (2.25 caliber), using corned powder, is typical of small guns on European naval vessels and pirate ships.

Early European Cannon (TL4)

By the early 16th century, armorers had worked out the best way to make a big gun with the resources they commanded: a single piece cast from bronze, muzzle-loaded, firing an iron ball. These weapons still used serpentine powder; early corned powder was uneven in quality and burned too fast for safety. The name "cannon" actually referred to a specific size; other sizes had their own, often poetic names. Common sizes in England were the *rabinet, serpentine, falconet, falcon, minion, saker, culverin bastard, demiculverin, basilisk, culverin, pedrero, demicannon, bastard cannon, cannon serpentine, cannon,* and *cannon royal.* Other countries had their own names for different numbers of sizes spanning the same range.

Alternate Cannon Ammunition

Early gunners, especially ships' gunners, developed several forms of special-purpose ammunition:

Chain Shot (TL4). Designed to bring down an enemy ship's mast, rigging, or sails. Two sub-caliber balls are linked by a yard or two of metal chain. Damage amount is unchanged, but type becomes *cutting,* with armor divisor (0.5). Also halve Range, increase reload time by 20%, and double cost per shot. No other stats are affected.

Grapeshot (TL4). Primarily for antipersonnel use, this consists of half-inch-diameter iron balls sewn into a canvas bag. To determine the number of balls a given cannon fires, multiply the total weight of one round of ammunition by 40. Multiply RoF by the number of balls, but divide damage by the *square root* of this number. Damage becomes pi+, 1/2D becomes 60, Max becomes 600, and Rcl becomes 1. No other stats are affected.

Heated Shot (TL4). Cannonballs heated red-hot on a fire. They can only be used with powder in a cloth bag, which won't be touched off by the ball's heat; it's customary to add an empty bag and put a layer of clay between powder and ball. Even so, heated shot gives -1 to Malf., increases reload time by 50%, and adds the need for two extra crewmen. Other stats are unchanged, but in addition to its normal damage, the hot metal ball inflicts 3d burning damage per second for 30 seconds. If it sticks in a ship's outer hull, it may set the hull on fire – and if it penetrates the magazine, it may touch off the powder stored there!

These early cannon still weren't very mobile. Many were mounted on ships or on city walls. Others battered the defenses of besieged cities. Artillery forces hauled their guns about on large carts.

> *The engine's one shortcoming was that it was immobile. You had to wait for your target to cross your aim.*
>
> *– Glen Cook,* ***Shadow Games***

Field Cannon (TL4)

Cannon in the style developed by Gustavus Adolphus. The 3-lb. model is designed for regimental support; the 12-lb. gun supports larger forces in the field; the 24-lb. weapon is reserved for defending fortifications. Restriction to three standard sizes greatly simplifies problems of supply. These cannon have thinner walls and slightly shorter barrels than older models, making them lighter; in addition, they're designed to be placed on field carriages.

Ships' Guns (TL4)

Classic cannon as used by pirate ships on the Spanish Main. Table entries include a range of sizes: the 42-pounder *cannon of seven,* 18-pounder *culverin,* 9-pounder *demiculverin,* and 4-pounder *minion.* Barrel length is 9'-10' for the three larger sizes and 7' for the 4-pounder.

Cannon Table

Terms and notation are as defined on pp. B268-271.

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*
GUNNER (CANNON) (DX-4 or other Gunner-4)											
3	Lantaka	1d+1 pi++	1	40/400	30/0.08	1	1(20)	16M†	-6	2	$400
4	Rabinet	5d pi++	2	90/850	300/0.65	1	1(60)	29M†	-9	2	$4,000
4	Falconet	7d pi++	2	120/1,000	500/1.4	1	1(60)	33M†	-10	2	$6,700
4	Falcon	10d+1 pi++	2	140/1,300	680/3.2	1	1(60)	36M†	-12	2	$9,400
4	Saker	15d pi++	2	220/1,900	1,400/10	1	1(60)	43M†	-13	2	$19,000
4	Culverin	6d×4 pi++	2	300/2,200	4,800/30	1	1(70)	58M†	-15	2	$66,000
4	Cannon	6d×5 pi++	2	350/2,600	6,000/87	1	1(100)	68M†	-16	2	$80,000
4	Cannon, 3-lb.	14d+1 pi++	2	210/1,800	1,000/4.5	1	1(60)	39M†	-13	2	$14,000
4	Cannon, 12-lb.	6d×4 pi++	2	310/2,400	3,750/18	1	1(60)	55M†	-15	2	$50,000
4	Cannon, 24-lb.	6d×5 pi++	2	370/2,700	6,900/36	1	1(70)	64M†	-16	2	$95,000
4	Ship's Gun, 4-lb.	6d×3 pi++	2	270/2,300	1,000/7.5	1	1(60)	40M†	-12	2	$14,000
4	Ship's Gun, 9-lb.	6d×4 pi++	2	310/2,400	2,900/16.5	1	1(60)	50M†	-14	2	$39,000
4	Ship's Gun, 18-lb.	7d×4 pi++	2	340/2,600	5,000/28	1	1(70)	60M†	-15	2	$65,000
4	Ship's Gun, 42-lb.	6d×5 pi++	2	380/2,800	7,300/60	1	1(90)	75M†	-16	4	$100,000
4	Swivel-Gun	6d+1 pi++	1	90/900	140/2.5	1	1(20)	27M†	-8	3	$1,900

Notes

For the type of mount that each cannon requires, and its weight and cost, along with the number of loaders needed (if any), consult the following table:

Weapon	*Mount Type*	*Weight*	*Cost*	*Loaders*
Lantaka	Pintle	13.5	$270	–
Rabinet	Truck Carriage	375	$430	–
Falconet	Truck Carriage	625	$500	–
Falcon	Truck Carriage	850	$540	–
Saker	Truck Carriage	1,750	$650	3
Culverin	Truck Carriage	6,000	$870	6
Cannon	Truck Carriage	7,500	$1,000	12
Cannon, 3-lb.	Field Carriage	1,250	$590	1
Cannon, 12-lb.	Field Carriage	4,700	$825	5
Cannon, 24-lb.	Field Carriage	8,600	$960	7
Ship's Gun, 4-lb.	Truck Carriage	1,250	$590	2
Ship's Gun, 9-lb.	Truck Carriage	3,600	$770	4
Ship's Gun, 18-lb.	Truck Carriage	6,000	$890	6
Ship's Gun, 42-lb.	Truck Carriage	9,000	$1,200	11
Swivel-Gun	Pintle	65	$1,300	–

Personal Firearms

The first gunpowder weapons small enough for an individual soldier to carry date to the Middle Ages. Early designs didn't have a proper grip or stock, making them both awkward to use and inaccurate. The firing mechanism was equally clumsy. ***Low-Tech*** calls such weapons *gonnes,* and assigns them their own Guns specialty (see *Guns,* p. 10).

The standard "lock, stock, and barrel" design appeared early in TL4; Leonardo da Vinci sketched a musket in his notebooks in 1500. By the 16th century, standard designs had been worked out and named, and the best sizes for various purposes determined. Calibers *weren't* standardized, however; those given here are rough averages.

Musket-and-pike armies dominated TL4 battlefields. The complex sequence of actions needed to load and fire a musket, and the need to carry out these motions under fire, inspired the development of military drill. Late in TL4, the first bayonets appeared; soldiers armed with firearms no longer had to depend on pikemen for protection. For more on this, see *Pike and Shot and Bayonet* (p. 55).

Pistols were invented as weapons for cavalrymen, and soon adopted for self-defense. They were seldom dueling weapons, however. Gentlemen settled their differences with swords, reserving pistols for situations where honor wasn't involved.

Water and Firearms

Moisture can extinguish a match or get primer wet, preventing a *cannonlock* or *matchlock* from firing. Reduce Malf. by 4 in light rain; by 8 in heavy rain or blowing spray; or by 12 in a driving gale or heavy surf. If these penalties cause a malfunction when one wouldn't have occurred otherwise, it's a misfire, *not* a stoppage or an explosion (see p. B407). A match cover (p. 96) can partially protect against this.

A *wheellock* or *flintlock* has no match to go out; halve the above penalties (2, 4, or 6). Most flintlocks have a plate – the *frizzen* – that covers the primer when the gun isn't being fired, halving the penalties again (1, 2, or 3). The early *snaplock* variant lacks this feature, however.

Loading a gun with loose powder under wet conditions almost certainly gets the powder wet – the weapon will fire only on a critical success! Powder in paper cartridges or cloth bags isn't affected.

Firearms Design

The early modern era saw rapid innovations in gunsmithing, affecting all aspects of the gun.

Locks

The *lock* is the mechanism that ignites the powder and discharges the gun. Locks went through rapid technological progress involving several fundamentally different designs. Guns with older and newer styles often existed side by side.

Cannonlock: The oldest design, used throughout the Middle Ages. It had a simple touchhole, like a cannon's. Thrusting a handheld slow match (p. 84) or hot wire into the touchhole fired the gun.

Matchlock: Developed by 1411 and standard after 1500, this lock placed the burning match in a mechanical holder attached to the gun. Pulling a trigger moved the match into the touchhole. Matchlocks had limitations – they were vulnerable to rain (see *Water and Firearms,* below), the smoking match made them hard to conceal (-4 to Holdout), and the glow was visible at night – but they were sufficiently easy to use to become the standard infantry weapons of their era. At the GM's option, critical failure on Fast-Draw (Ammo) may either extinguish the match or set off the powder prematurely, causing 1 point of burn damage to the user.

Wheellock: This design came into use around 1500. Such locks were complicated and expensive. A clockwork spring in the lock turned a serrated steel wheel against a piece of iron pyrites, striking sparks that set off the powder. Pulling the trigger released the wheel. Then the gunner had to rewind the spring with a small lever, the *spanner;* reload the gun; and lower the *cock,* which held the pyrites, onto the firing pan. A gunman who loses his spanner can improvise one with a roll against Machinist-2, Armoury (Small Arms)-4, or *IQ*-based Guns-6.

Flintlock: Developed in the 1500s and perfected by 1620, a flintlock has a *cock* that holds a piece of flint, which is pulled back against spring tension. Pulling the trigger releases the spring, which drives the flint against a steel *frizzen,* discharging the gun. While found on the most advanced weapons of TL4, this design didn't become standard in military use until TL5. ***GURPS*** uses "flintlock" broadly to include variants such as the *snaphaunce, Miquelet lock,* and *doglock.* A shooter accustomed to one type of lock is at -2 to use another variety until he acquires familiarity with it (see *Familiarity,* p. B169).

Stocks and Grips

A TL3 cannonlock firearm was mounted at the end of a wooden pole, like a fire-lance (p. 56). Most illustrations show the pole tucked under the firer's arm. It's difficult to aim such a weapon – Acc is 1, at best!

By about 1450, gunsmiths adopted the curved stock to brace firearms against the shoulder. This gave rise to muskets, rifles, and other long arms.

Long arms were awkward on horseback; cavalrymen needed a hand free to hold the reins. The pistol grip – developed sometime before 1520 – made this possible, and cavalrymen took to carrying pairs of pistols. Pistol grips were often heavy, enabling pistols to function as improvised maces after firing.

The flintlock carbine under *Muskets* (pp. 92-93) has a peculiar *telescoping* stock. Folding this removes -1 from Bulk; gives -1 to Acc and +1 to Rcl (unless Rcl is 1); and multiplies ST by 1.2 (round *up*). Adapted to another gun, this feature would add $100, 0.5 lb.

Barrels

The barrels of gonnes were often made of bronze, but occasionally of wrought iron. The Chinese developed cast iron comparatively early and sometimes used it in gonnes.

When Europe developed more sophisticated personal weapons, some early models had wrought-iron barrels, as did Japanese firearms inspired by them. The later matchlock weapons, and wheellock and flintlock firearms, had cast-iron barrels, which gave better strength for the same weight.

Most barrels were *smoothbore*. These were favored for military use because they took less time to reload and could thus achieve a greater volume of fire. However, balls from smoothbores come out spinning on a random axis, which often deflects them from the target. *Rifled* barrels, which have spiral grooves that give the ball a controlled spin about an axis parallel to the barrel, date to the 1500s. Rifled guns were used in hunting, where accuracy was more important than reloading speed.

Hunting guns often had two or more barrels, to give the hunter a second shot if the first one missed. This was especially important when hunting dangerous game such as bear or boar.

Ammunition

Early firearms were loaded with powder, shot, and wadding – in that order. Each was put in separately. Swedish king Gustavus Adolphus, seeking more rapid fire from his troops, adopted paper cartridges with a premeasured amount of powder; the soldier could tear open the end, pour in the powder, and use the paper for wadding, saving time. See *Loading* (p. 94-95) for rules and additional information.

At TL3, powder is serpentine powder. At TL4, corned powder replaces this for small arms; only the arquebus and the Japanese firearms use serpentine. The standard material for shot is lead. Gun bores *aren't* standardized, although ***Low-Tech*** lists them as if they were; most gun owners carry equipment for casting their own bullets (see *Bullet-Molding Gear,* p. 96). Throughout this period, bullets are spherical and often called "balls." An exception was the Puckle gun (pp. 92-93).

Early Experiments

The first small arms were basically miniature cannon. Period illustrations depict something like vases with arrows or stones flying out of them. To facilitate shooting – and for safety if they exploded! – these gonnes were mounted on wooden poles; see *Stocks and Grips* (p. 90).

Firing such a cannonlock requires looking at the touchhole rather than the target. See *Locks* (p. 90). This means sacrificing any Acc bonus for aiming *and* incurring -2 to hit for divided attention.

Some gonnes had two-man crews: a man to fire the gonne and a man to hold and aim it, avoiding the -2 and retaining the Acc bonus. Only the man *aiming* the weapon needs Guns skill. The one touching it off rolls against DX (or Guns, if better); success sets it off instantly, failure means the shot is delayed by a second, and critical failure indicates a dropped match or wire.

All of these details make gonnes different enough from later firearms to require their own Guns specialty; see *Guns* (p. 10).

Gonne (.87 caliber). A miniature cannon, cast in bronze, mounted on the end of a wooden pole. The Arabian version is called a *midfa;* the Chinese one, a *pao* ("eruptor"). It usually fires lead balls, but some illustrations show gonnes shooting missiles resembling crossbow bolts. These firearms come in many sizes; the model on the table is comparable to the smallest surviving Chinese examples. Weapons of this type were commonly carried on Hussite war wagons (pp. 136, 137).

Mr. Facing-Both-Ways Gonne (.87 caliber). A Chinese gonne with a barrel at each end of a long pole, which can be flipped around (a Ready maneuver) for a second shot. The added weight and bulk make it awkward, but the greater weight also decreases felt recoil.

Ten-Eyed Gonne (.87 caliber). A Chinese gonne that goes about as far as possible toward repeated fire. Each half has touchholes for five charges, which are set off starting from the far end; when they're used up, the gun is flipped around (a Ready maneuver) for the other five shots. European firearms of similar design are often called "Roman candle guns."

Gonnes Table

Terms and notation are as defined on pp. B268-271.

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	Notes
GUNS (GONNE) (DX-4 or other Guns-4)												
3	Gonne	2d+1 pi++	1	55/550	6.9/0.17	1	1(30)	10†	-5	4	$240	Bullet.
	or	1d imp	1	75/1,200	6.9/0.13	1	1(30)	9†	–	3	–	Bolt.
3	Mr. Facing-Both-Ways Gonne	2d+1 pi++	1	55/550	10.8/0.26	1	2(30i)	9†	-6	2	$370	Bullet.
3	Ten-Eyed Gonne	2d pi++	1	50/510	27/1.7	1	10(30i)	11†	-7	2	$920	Bullet. [1]
	then	2d+1 pi++	1	60/590	–	1	–	–	–	2	–	
	then	2d+2 pi++	1	65/630	–	1	–	–	–	2	–	
	then	2d+2 pi++	1	65/650	–	1	–	–	–	2	–	
	then	2d+3 pi++	1	65/660	–	1	–	–	–	2	–	

Note

[1] Range and damage increase from the first to the fifth bullet on each end. The five lines show the increase. After one end is fully discharged, start over at the lowest values for the other end. Reloading the inner rounds takes *60* seconds per round rather than 30.

Blunderbusses and Shotguns

These weapons fire *multiple* balls with a diameter smaller than their caliber. They only become common in the flintlock era.

Blunderbuss (.62 caliber). A short-barreled shotgun with a muzzle that widens from back to front; the muzzle is 1.25 caliber. This doesn't much affect performance, but gives +1 to Intimidation against anyone it's pointed at! Thanks to the flared barrel, it's exempt from the usual Guns-2 roll to reload on a moving vehicle (see *Loading,* pp. 94-95). It fires the equivalent of buckshot. Fiction and cartoons sometimes depict blunderbusses being loaded with scrap metal and small stones, but this works poorly; see *Variant Ammunition* (p. 95) for effects.

Fowling Piece (12 gauge). A very long-barreled shotgun designed for hunting, customarily loaded with birdshot. It comes in single- and double-barreled versions.

Blunderbusses and Shotguns Table

Terms and notation are as defined on pp. B268-271.

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost
GUNS (SHOTGUN) (DX-4 or most other Guns-2)											
4	Blunderbuss	1d pi	2	45/810	11.2/0.06	1×7	1(40)	7†	-6	1	$165
4	Fowling Piece, Single	1d+1(0.5) pi-	2	15/330	9.5/0.1	1×175	1(40)	7†	-7	1	$135
4	Fowling Piece, Double	1d+1(0.5) pi-	2	15/330	17/0.2	1×175	2(40i)	8†	-8	1	$170

Muskets

Long arms of several sizes are the basis of "pike and shot" warfare at TL4. For most of the period, these are matchlocks; toward its end, the flintlock-based *fusil* enters use. Military weapons at TL4 are mostly smoothbores – both because they allow more rapid fire (see *Loading,* pp. 94-95) and because they cost much less than rifles. Military training emphasizes rapid reloading and standing one's ground under fire over marksmanship. Elite troops know Fast-Draw (Ammo).

Matchlocks

Arquebus (.60 caliber). The original long arm; the name derives from *hackbusch,* or "hook-barrel," and probably refers to the downward-curved stock. Guns of this type came into use in Europe shortly after 1500 and in China under the Ming Dynasty, which used them to complete the expulsion of the Mongols. Arquebuses use serpentine powder, not corned powder.

Caliver (.59 caliber). A lighter, handier musket, designed for use by ordinary soldiers without the strength to serve as musketeers.

Musket (.80 caliber). A larger smoothbore with a very long barrel, too heavy to hold level unaided. A musketeer requires a musket rest (p. 96) to use his weapon effectively; see *ST (Strength)* (p. B270). Musketeers need to be large, strong men to manage these high-powered weapons. The name "musket" came to be used for smoothbore long arms in general.

Teppo (.47 caliber). A Japanese arquebus first made in 1543 on the island of Taneshigama, in imitation of a Portuguese original. Sizes vary, but this is the standard model issued to the shogun's armies: 53.5" long, with a forged iron barrel. Matchlocks remained in use in Japan long after Europe moved on to flintlocks and caplocks (TL5). The teppo uses serpentine powder.

Winged Tiger Gun (.55 caliber). A short-barreled Chinese weapon, designed for use by cavalrymen. It's too awkward to reload on horseback. To allow multiple shots, it has three loaded barrels that can be fired separately.

Wheellocks

Carbine (.69 caliber). A musket-like weapon designed for cavalrymen who want more than a pistol. It has a short barrel and weighs much less than a musket or caliver.

Wall Gun (1.06 caliber). A smoothbore weapon even heavier than a musket, placed on a tripod mount atop a city wall for use in defensive fire. Some tripods have small wheels for improved mobility, but this isn't enough to make wall guns useful field weapons. The wall gun is normally fired with a wheellock – but for $25 more, it can also have a matchlock, for backup if the wheellock breaks down.

Flintlocks

Flintlock Carbine (.62 caliber). A carbine developed in England around 1690, with a telescoping stock. Collapsing this allows use as a handgun rather than as a shoulder arm. With stock collapsed: Acc 2, ST 10, Bulk -3, Rcl 5.

Fusil. The fusil is similar to a caliver, but with a flintlock rather than a matchlock. The *fusil de chasse* (.55 caliber) is widely used by hunters, avoiding the inconvenience of keeping a match lit in the wilderness; it becomes available around 1630. The *fusil fin* is similar, but custom-made for noblemen seeking a superior gun; treat it as fine (accurate), for +0.75CF. The heavier military model, or *fusil ordinaire* (.64 caliber), is initially used where a burning match would be inconvenient or dangerous; a French regiment sent to Canada in 1660 to fight the Iroquois was the first general military force to carry it. The *fusil grenadier* resembles this, but comes with a sling (p. 96). An even heavier variant, the *buccaneer fusil,* is favored for shipboard use: Dmg 3d+1 pi++, Wt. 7.5/0.065, ST 10†, Bulk -11.

Puckle Gun (1.25 caliber). One of the early 18th century's more eccentric weapons, the *Defence Gun* is commonly named for its inventor, James Puckle. It's a tripod-mounted weapon, like the wall gun, but with a flintlock. To boost its rate of fire, it has a cylinder that holds nine rounds of ammunition, turned with a hand crank between shots to line up unfired rounds with the firing mechanism. Normally, several cylinders are readied ahead of time.

Muskets Table

Terms and notation are as defined on pp. B268-271.

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*Notes*
GUNS (MUSKET) (DX-4 or most other Guns-2)												
4	Arquebus	2d+2 pi+	2	65/660	10/0.05	1	1(60)	9†	-6	2	$150	
4	Caliver	3d+1 pi+	2	85/870	6.6/0.07	1	1(60)	9†	-5	4	$135	
4	Carbine	3d pi++	2	80/800	6.5/0.08	1	1(40)	9†	-4	4	$290	
4	Flintlock Carbine	2d+2 pi++	3	65/670	3.9/0.06	1	1(40)	8†	-4	4	$245	
4	Fusil de Chasse	2d+2 pi+	2	75/750	6.5/0.04	1	1(40)	9†	-5	3	$145	
4	Fusil Ordinaire	3d pi++	1	75/750	6.5/0.065	1	1(40)	9†	-5	4	$150	
4	Musket	4d+2 pi++	2	120/1,200	21/0.15	1	1(60)	12R†	-7	4	$175	
4	Puckle Gun	2d+1 pi++	1	55/510	90/3.6	1	9(10i)	18M†	-8	1	$1,800	[1, 2]
4	Teppo	1d+2 pi+	2	45/500	8.6/0.025	1	1(60)	8†	-5	2	$170	
4	Wall Gun	5d+1 pi++	2	120/1,200	27.5/0.3	1	1(40)	13M†	-7	3	$425	[1]
4	Winged Tiger Gun	2d-1 pi+	2	45/470	6.5/0.135	1	3(60i)	8†	-5	2	$220	

Notes

[1] Normally used with a tripod mount. For Puckle gun: $380, 20 lbs. For wall gun: $260, 7.5 lbs.

[2] Spare cylinder (empty): $200, 10 lbs.

Swapping in a new, loaded cylinder for an old one takes 15 seconds. It came in two versions: one intended for use against Christians, which fired standard balls, and one intended for use against Turks, which fired *square* bullets!

Pistols

Pistols were developed as horsemen's weapons, designed to be aimed and fired one-handed while the other hand held the reins (they were no easier to *reload* on horseback; see *Loading,* pp. 94-95). They were initially carried with their butts hung from the pommel, and later in holsters (p. 96). Smaller models for other uses soon appeared – including belt pistols for self-defense, and concealable pocket pistols.

Designed for one-handed firing.

Matchlocks

Tantsutsu (.70 caliber). A Japanese firearm similar to the teppo (p. 92), designed for use by horsemen and reserved to nobles wealthy enough to afford a horse. Tantsutsu are made as presentation weapons; see *Styling* (p. 14). The example on the *Pistols Table* (p. 94) has +4 CF. The tantsutsu uses serpentine powder.

Wheellocks

Military Pistol (.55 caliber). A large, heavy pistol for cavalrymen. At least two are carried into battle, allowing more than one shot without struggling to reload on horseback.

Petronel (.60 caliber). A 16th-century cavalry weapon with a pistol-like grip, used with the grip resting against the breastplate of a cuirass, and often held two-handed. The barrel is 40" long, comparable to that of a carbine; reloading takes a correspondingly long time.

Pocket Pistol (.33 caliber). A small pistol with a very short barrel – just over 4" long – designed to be concealed under clothing. Fear of assassination attempts often leads to legal restrictions on such concealable weapons.

Puffer Pistol (.53 caliber). A lighter pistol than the military pistol, with a slightly smaller bore and a significantly shorter barrel, which can be thrust under a belt. The "puffer" design has a distinctive enlarged bulb at the end of the butt, giving +1 to Fast-Draw (Pistol). Also called a *dag* in the British Isles.

Flintlocks

Dragoon Pistols. Cavalrymen's weapons of the early 18th century. The light model is .56 caliber and has a 9" barrel. The heavy one is .65 caliber and has a 12" barrel.

Duck's Foot Pistol (.40 caliber). Developed in 1720 for crowd control, this bizarre handgun has four barrels spreading out from a single lock that fires them all at once. At up to 2 yards, it acts as a RoF 1×4 weapon that can engage *one* target. At 3+ yards, it works like four RoF 1 guns! Pick a 30° arc (as for *Spraying Fire,* p. B409) and attack one foe there with one shot; he need not be in the center. Then use *Hitting the Wrong Target* (p. B389) for everyone else in the arc. Roll in order from right to left or vice versa – your option. If you somehow manage to hit four targets total, immediately stop rolling.

Highland Pistol (.52 caliber). This weapon comes into use very late in TL4. Its 8" barrel makes it a convenient belt pistol. Unusually for the era, it's made entirely of steel.

Queen Anne Pistol (.50 caliber). A distinctive pistol design of the reign of England's Queen Anne (1702-1714), much favored by pirates. The 8" barrel is "brass" (meaning cast bronze), and screws into the combined lock and grip. To reload, the barrel must be unscrewed, but this allows use of bullets with minimal windage, improving accuracy.

Snaphaunce Pistol (.45 caliber). An early variant on the flintlock pistol, available from 1600, with a comparatively long 11" barrel.

Pistols Table

Terms and notation are as defined on pp. B268-271.

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost
GUNS (PISTOL) (DX-4 or most other Guns-2)											
4	Dragoon Pistol, Heavy	2d pi+	1	55/540	3.1/0.06	1	1(20)	10	-4	3	$145
4	Dragoon Pistol, Light	2d-1 pi+	1	45/490	3/0.04	1	1(20)	9	-4	2	$140
4	Duck's Foot Pistol	1d+1 pi	1	40/420	1.9/0.06	spec.	1(20i)	7	-3	1	$150
4	Highland Pistol	1d+2 pi+	1	45/500	2.75/0.03	1	1(20)	9	-3	2	$135
4	Military Pistol	2d-1 pi+	1	50/500	2.75/0.04	1	1(20)	10	-4	3	$250
4	Petronel	2d+2 pi+	2	60/630	7.75/0.04	1	1(40)	11	-7	3	$280
4	Pocket Pistol	1d pi	1	25/300	0.7/0.008	1	1(20)	6	-1	2	$190
4	Puffer Pistol	2d-1 pi+	1	50/550	2/0.035	1	1(20)	9	-3	3	$260
4	Queen Anne Pistol	1d+2 pi+	2	45/490	2.4/0.03	1	1(60)	9	-3	2	$135
4	Snaphaunce Pistol	1d+1 pi	1	40/420	1.3/0.01	1	1(20)	7	-2	2	$125
4	Tantsutsu	1d+2 pi++	1	40/400	4.5/0.06	1	1(45)	11	-5	3	$610

Rifles

The rifle was originally a hunter's weapon. Later, armies put rifles to use for hunting enemy soldiers. Ordinary troops, armed with muskets, often resented the sharpshooters who could pick them off from afar . . .

Wheellocks

Breechloading Carbine (.54 caliber). Based on an early carbine made for Henry VIII. The rifled barrel is short but the construction is substantial.

Jäger Rifle (.65 caliber). Used initially by German hunters and later adopted by the aristocrats they guided. Available in single- and double-barreled versions.

Rifles Table

Terms and notation are as defined on pp. B268-271.

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost
GUNS (RIFLE) (DX-4 or most other Guns-2)											
4	Breechloading Carbine	2d pi+	3	55/570	9.3/0.04	1	1(10)	9†	-5	2	$270
4	Jäger Rifle	3d+1 pi+	3	65/650	11/0.06	1	1(60)	10†	-6	3	$300
4	Jäger Rifle, Double-Barreled	3d+1 pi+	3	65/650	20/0.12	1	2(60i)	10†	-7	2	$500

Using Firearms

There's more to shooting than aiming and pulling the trigger! You have to load the gun beforehand – and you must clean it afterward, if you want to go on shooting with any accuracy. In between, you need to handle it with care.

Loading

At TL3-4, ammunition has three components: *powder, shot,* and *wadding.* Loading multi-part ammo is an involved process. The shooter must pour in the propellant, usually through the muzzle; insert and ram down the projectile, followed by the wadding; add powder to the priming pan; and then ready the action. The number of Ready maneuvers (seconds) required varies by weapon type, but some general rules apply:

- Using powder in small, pre-measured flasks subtracts 5 seconds from *final* loose-ammunition loading time.
- Paper cartridges *halve* the basic time required (round *up*), and supersede using pre-measured flasks.
- Loading a muzzleloading shoulder arm – *not* a pistol – in any posture other than standing multiplies the basic time required by 1.5 (round *up*). Loading *any* gun while mounted requires a roll against the lower of Guns-3 and Riding-3; see *Mounted Reload* (p. 12). Loading on a moving vehicle, or as a passenger in a howdah (p. 135), requires a Guns-2 roll.
- Loading a weapon with multiple barrels takes the indicated time for *each* barrel loaded.

Muzzleloading gonne with cannonlock action: 30 seconds. For "Roman candle"-style gonnes, double time for all shots but the outermost. Fast-Draw (Ammo) doesn't apply.

Muzzleloading musket or shotgun with matchlock action: 60 seconds. A successful Fast-Draw (Ammo) roll reduces this to 50.

Muzzleloading musket or shotgun with wheellock or flintlock action: 40 seconds. Fast-Draw (Ammo) reduces this to 30.

Muzzleloading pistol with matchlock action: 45 seconds. Fast-Draw (Ammo) reduces this to 36.

Muzzleloading pistol with wheellock or flintlock action: 20 seconds. Fast-Draw (Ammo) reduces this to 16.

Muzzleloading rifle with matchlock action: 90 seconds. Fast-Draw (Ammo) reduces this to 80.

Muzzleloading rifle with wheellock or flintlock action: 60 seconds. Fast-Draw (Ammo) reduces this to 50.

Breechloading musket, shotgun, or rifle with matchlock, wheellock, or flintlock action: 10 seconds, *regardless of position.* Fast-Draw (Ammo) reduces this to 8.

Variant Ammunition

Most multi-part ammunition can be given an extra-powerful propellant charge to eke out higher damage and better range. Make an Armoury (Small Arms) roll or an *IQ*-based Guns roll at -2 to stay within your weapon's safe limits. Multiply Dmg, Range, and ST by 1.1. Multiply cost per shot by 1.5. If you exceed safe limits – through failure or deliberately – the weapon has -2 to Malf. If this penalty cause a malfunction when one wouldn't have occurred otherwise, it's always an explosion (see p. B407).

If you resort to field-expedient projectiles such as stones or coins, apply -1 to Acc and *halve* Dmg and Range. Such ammo gives -2 to Malf., too – it's likely to damage the barrel!

Careful Loading

Taking time to load carefully has a marked effect on muzzleloader accuracy. Smoothbores in particular are more accurate when firing a well-fitted, tightly patched ball from a clean barrel. A perfectly smooth ram of the load and/or an exactly measured quantity of priming can affect the likelihood of the gun firing and scoring a hit. One reason that low-tech military commanders like to save the first volley for as long as possible is that it's the one that's most carefully loaded. *Doubling* loading time for a muzzleloading musket or rifle gives +1 to Acc.

Handling

In a realistic campaign, a firearm should always be considered loaded. Those who run around with a finger on the trigger, try to climb rigging with a pistol in hand, drop a loaded weapon as a "free action," and so on are *inviting* accidental discharge. If somebody with a gun in hand attempts to do anything but shoot – e.g., ride a horse or climb – the GM may rule that a failed DX or skill roll means an accidental discharge, a malfunction (p. B407), or even a broken firearm . . . especially if the gunman suffers from Unluckiness or Cursed! A weapon may also discharge accidentally if hastily shoved into a belt or pocket. An accidental discharge may hit the holder of the gun or somebody else (see *Hitting the Wrong Target,* p. B389), or at least draw attention at a possibly inconvenient time.

Special Shooting Situations

Certain environments pose special challenges to shooters.

Firing into Water

Shooting at an underwater target is difficult – as may be *seeing* the target in the first place. The projectile will be deflected considerably at some entry angles. All shots going *into* the water are at -4 to hit. As well, the water slows down the round; multiply the underwater distance to the target by 1,000 to check if it's in range.

Firing into the Air

Firing *any* firearm (from small arms to artillery) into the air at an elevation of 50°-90° reduces its range to 80% normal.

Cleaning and Maintenance

Black powder produces a solid residue. In a long fight, carbon and lead buildup can have adverse effects on accuracy, loading speed, and reliability. After every five shots, the firer must take a two-minute break to clean his gun *thoroughly.* Any kind of watery liquid, including urine, will do. Saliva works well – shooters commonly hold a patch in their mouth until it's saturated. For every five shots without cleaning, increase basic loading time by 10% (round *up*) and reduce Malf. by one step. For every 10 shots without cleaning, lower Acc by 1, too.

Battlefield swabbing can't remove all the fouling. Black powder is corrosive and attracts moisture. Cleaning and oiling the gun is a necessary after-battle chore. Disassembling the lock, cleaning it, reassembling it, and swabbing the barrel takes about an hour. Firearms that haven't been cleaned keep the accumulated penalties from previously fired shots. The GM may assess further penalties if an uncleaned or loaded weapon is kept in a damp environment.

A gun-cleaning kit (p. 96) is basic equipment for the above tasks.

Firearm Quality

Improvements to firearm quality typically affect either accuracy or reliability. These options *can* be combined. It's also possible to add *Styling* (p. 14) – alone or with other improvements – to create "presentation" weapons. These rules expand on the standard examples on p. B280 (which are both "accurate" *and* "reliable").

Fine (Accurate). The shooter's quest for accuracy commonly lands guns on the gunsmith's bench. By improving the fit of individual parts and installing custom-made triggers, grips, etc., a gunsmith can improve quality to fine (accurate).

This only benefits weapons with a base Acc of at least 2, and gives +1 Acc. The necessary modifications require an Armoury (Small Arms) roll and five hours' work. CF is +0.75.

Fine (Reliable). By installing better springs, custom-fitting all components, etc., a gunsmith can improve quality to fine (reliable). This increases Malf. (p. B407) by a step; e.g., from 14 to 15. The modifications require an Armoury (Small Arms) roll and two hours' work. CF is +0.25.

Very Fine (Reliable). Further work can improve Malf. by two steps. This is exceedingly rare except on the best target and sporting weapons available. The modifications require an Armoury (Small Arms) roll and 10 hours' work. CF is an additional +1 over that for fine (reliable) – that is, a total CF of +1.25.

Firearm Accessories

At TL4, ingenious armorers start to produce handy gadgets for users of small arms and artillery.

Bandolier (TL4)

A leather strap, worn over one shoulder and crossing to the opposite side of the torso, that holds the essential supplies for using a firearm: a dozen flasks for powder charges, a flask of priming powder, a small oilcan, a bullet pouch, a pouch of cleaning patches, and for matchlocks, a yard of slow match. Takes one second (a Ready maneuver) to don or remove. $50, 5 lbs.

Belt Hook (TL4)

Belt pistols, especially aboard ship, may have a metal hook attached to the side to prevent their slipping through a sash or belt. $10, 0.25 lb.

Bullet-Molding Gear (TL4)

Gun calibers *aren't* standardized, and balls can't be mass-produced. Gun owners need equipment for casting their own balls: an iron or bronze crucible for melting lead, tongs for handling it, and a set of bullet molds. The latter resemble a large pair of needle-nose pliers with several round hollows of the proper size; they can be closed, clamped shut, and then opened when the balls have cooled. A campfire produces enough heat to melt lead; casting half a dozen balls takes 4 minutes. Armies carry lead ingots with them; if this runs out, a Scrounging roll can locate lead in any TL2+ town. $50, 2 lbs.

Gun-Cleaning Kit (TL4)

Anyone who uses a firearm professionally needs equipment to clean it. This includes nipple key, vent pricker, oil bottle, screwdriver, double-pronged worm for cleaning, and tools for extracting jammed bullets. $20, 0.5 lb.

Holsters (TL4)

At TL4, holsters are horse furniture, designed to hang from a saddle. They're sold in pairs, one for each side of the horse, so that the rider can have two pistols available. Pair: $125, 5 lbs.

Match Cover (TL4)

This detachable cover fits over the lock of a matchlock gun, keeping the rain off. It was invented in Japan, which experienced frequent rainstorms. A secondary benefit is that it conceals the glowing match, keeping it from revealing the arquebusier's location at night. $10, 0.5 lb.

Musket Rest (TL4)

A pole with a forked upper end designed to be driven into the ground so that it can support the barrel; see *ST (Strength),* p. B270. $10, 2 lbs.

Shooting Stick (TL4)

A prop for a long arm, made from crossed sticks strapped together with cord or leather. A *sitting* marksman may treat a gun supported by shooting sticks as braced (see *Aim,* p. B364). $5, 1 lb.

Sling (TL4)

A sling is standard with the *fusil grenadier* (see *Muskets,* pp. 92-93), but other long arms can be adapted to use one. It allows the gunman to use two hands while keeping his shoulder arm close. Unslinging or slinging a long arm takes *two* Ready maneuvers – or three, if the slung position is across the back. For unslinging, a successful Fast-Draw (Long Arm) roll reduces these times by a second. A sling also lets a shooter brace even when he has nothing to prop his gun on, giving an extra +1 when aiming; see *Aim* (p. B364). Bracing with a sling is a two-handed task that takes one Ready maneuver per -1 Bulk; e.g., five seconds at Bulk -5. Leaving this position, thereby freeing the hands, requires a Ready maneuver. $10, 1 lb.

When Arkhidamos, the son of Agesilaos, beheld a dart to be shot from an engine newly brought out of Sicily, he cried out, O Herakles! the valor of man is at an end.

– Plutarch, ***Sayings of Kings and Commanders***

Chapter Six
Defenses

Martialis held up the tunic, admiring the way the fabric caught the light.

"Silk, isn't it?" he asked. "Attractive, and no doubt costly. But it looks too flimsy to be much good as armor."

"So it does," said Boaz. "But look here." He turned it inside out, and showed Martialis a bloodstain on the inner lining. "Here, my cousin Abram said, an arrow struck the man who wore this; and you can see that it wounded him. But the silk is not cut or torn. After the battle, his friends simply drew the silk out of the wound, and the arrowhead came out with it, barbs and all. No need for a spoon! And the silk does have some cushioning effect, as well."

"It must have been a spent arrow," Martialis said. "No mere piece of cloth this thin could resist the full impact of an arrow."

Boaz's eyes lit up. "That can be tested," he said. "If you care to fetch your sword, I'll set the cloth so that you can strike at it."

Half an hour later, Martialis thrust his sword at the silk garment as it hung suspended in a doorway, pinned shut at the bottom with a cushion held inside. He felt it give beneath his blade, and thought for an instant that he had torn through. But when he drew his arm back, he saw that the cloth had been carried before the sword, enclosing it like a sheath. Several more stabs confirmed this.

"Truly a marvel, O Boaz," he said. "Where does one buy this material, and at what cost?"

Clothing insulates the wearer from the elements; armor protects him from injury. Both suffer from the vagaries of fashion, and there are endless cultural variations. Adventurers *need* such protection, though – from tunic and cloak to the armor and shield of a Roman legionary or a medieval knight.

Clothing

Sun and cold can be as lethal as swords and arrows. Dressing like a member of a hated social group can likewise be fatal! Canny adventurers choose their wardrobe carefully.

Note that many costs here depend on knowing *Cost of Living* (pp. B265-266).

Everyday Clothing

Low-tech clothing falls into two classes: *wrapped* and *sewn*. Examples of wrapped garments are the loincloth, kilt, toga, and sarong. Sewn ones include tunics, doublets, and breeches. Many articles are fastened with pins and cords rather than buttons and buckled belts. Virtually every culture has its own version of the tunic, cloak, cape, and mantle. Dress outfits and noble attire are usually more elaborate versions of everyday clothes, with something extra to denote status (see *Clothing and Status,* p. 99).

Summer Clothing

This is lightweight clothing: the thin, white Arabian *thobe;* the pleated linen *kalasiris* of ancient Egypt; an Indian *sari* made from cotton; or perhaps a loincloth or a grass skirt. It's light, comfortable, and cool. In hot weather, loose clothes allow air to circulate and cool the body. Costs 10% of cost of living; weighs 1 lb.

Ordinary Clothing

Typical work wear or everyday dress for a temperate climate. It's usually made of heavier material than summer clothing; it may simply be an extra layer worn over the top. Even this much clothing may increase FP costs in hot climates, as described under *Fighting a Battle* (p. B426). Costs 20% of cost of living; weighs 2 lbs.

Winter Clothing

This is outdoor clothing for colder climates. In freezing temperatures, it allows a HT roll at no penalty to avoid FP loss (see p. B430). It may be as simple as adding an extra layer to ordinary clothing or it may consist of heavy textiles or furs, but it must protect the whole body against heat loss – particularly feet, hands, head, and neck. If there are missing items, the GM may penalize HT rolls with the -1 per item recommended on p. B345. Winter clothing is heavy enough to provide limited protection against weapons: DR 1 vs. *cutting.* Costs 30% of cost of living; weighs 5 lbs.

Hand and Footwear

Ordinary and winter clothing include basic footwear in their cost and weight. Winter clothing includes basic handwear, too. Such articles can be added to outfits that don't include them, or be bought in superior versions for those that do.

Custom-tailored shoes and boots can give skill bonuses. Articles made expressly for climbing give +1 to Climbing skill; similar bonuses are possible for skills like Hiking or Running. Buy such items as *good* quality: +4 CF; weight is unchanged.

Foot Wrappings (TL0)

The earliest foot protection was likely large, tough leaves or pieces of hide wrapped around the foot and bound with lacing. This would keep the feet warm while providing a little protection for the soles. Foot wrappings aren't very durable and need replacing every few miles. Minimal foot protection: $2, 0.5 lb. More complete wrappings that cover the lower leg as well: $10, 2 lbs.

Mittens (TL0)

The earliest mittens were simple bags covering the hands to keep them warm. They probably consisted of fur offcuts, bound at the wrist. The oldest iconographic evidence dates to the mid-second millennium B.C., and depicts two Minoan youths boxing with padded hand protection. It is unclear whether these mittens had separate thumbs, as is common with modern ones. Mittens are clumsy, giving the wearer Bad Grip 1 (p. B123) *and* Ham-Fisted 2 (p. B138). (*Armor* designed for the hands – gauntlets – gives Ham-Fisted but not Bad Grip.) Basic mittens afford DR 1 vs. *cutting:* $8, 0.5 lb. Lightly padded boxing mitts (such as the Minoan example) give DR 1 vs. *all* damage: $20, 1 lb.

Moccasins (TL0)

Light, thin leather footwear preferred by hunters and other people who must move quietly. Use the same statistics for any light, functional shoe; e.g., Japanese *tabi.* Like bare feet, they give +1 to Stealth. DR 1*. $40, 1 lb.

Mukluks (TL0)

Soft boots made of moose or caribou hide lined with moss. They protect the feet against frostbite and erase -2 in Stealth penalties for walking on snow. DR 1*. $50, 2 lbs.

Sandals (TL0)

These are the footwear of choice in warmer climates. Their open construction consists of a hard sole with straps to bind it to the foot. Sandals give the underside of the foot DR 1. $25, 0.5 lb.

Hobnails (TL2)

Roman military sandals (*caligae*) were hobnailed. Adding hobnails to footwear increases cost by $25, weight by 1 lb.; e.g., hobnailed sandals are $50, 1.5 lbs. This improves the wearer's footing, letting him ignore the -2 to attacks and -1 to defenses for bad terrain, but gives -1 to Stealth on tiled floors, cobblestones, bare rock, etc.

Gloves (TL1)

Gloves differ from mittens in having a separate sheath for each finger, allowing finer motor control. Early Greek and Roman texts record their use, but they were likely worn even earlier. Even fingered gloves hamper dexterity a little, giving the wearer Bad Grip 1 (p. B123) *and* Ham-Fisted 1 (p. B138). Gloves with open palms (same cost) negate Bad Grip but don't protect against cold. Good-quality gloves (+4 CF) specifically tailored to the wearer reduce the DX penalty to -1. DR 1* vs. *cutting.* $15, 0.5 lb.

Shoes (TL1)

Shoes are any light leather or textile footwear that covers the foot but doesn't protect the leg. Low-tech shoes aren't carefully tailored, and there's no such thing as a left/right pair. Shape depends on the fashion of the time; some are pointed while others are square-toed. They may simply slip onto the foot (slippers), or be fastened with lacing or buckles. DR 1. $40, 2 lbs.

Boots (TL2)

Boots are similar to shoes but made of thicker material, and longer, protecting part of the lower leg. With the advent of the stirrup (p. 134), the riding boot sometimes had a heel to prevent the foot slipping through. DR 2. $80, 3 lbs.

Headgear

Headgear is often included in a society's everyday clothing. Don't count its price and weight separately, except as specified below.

Hats (TL0)

Hats come in all shapes and forms. Invented to protect the wearer from the elements, they quickly became fashion symbols and often denoted status. In extreme weather, a hat is crucial to survival. A hat specifically designed to resist damage is called a *helmet* (see *Helmets,* pp. 111-113).

Hoods (TL0)

Some articles of clothing – e.g., cloaks and parkas – have an integrated hood that can be pulled up to cover the head as needed. Adding a hood where one isn't otherwise noted increases base clothing cost and weight by 10%.

Protective Clothing

These garments afford the wearer some sort of protection – perhaps from the weather or work-related injuries. They may have some value in battle, but that isn't their primary purpose.

Cloak (TL0)

Cloaks (p. B287) are usually fastened about the neck with a cord or a clasp. Some are split to assist riding; others have armholes or even sleeves, and resemble ponchos (below). A cloak is *versatile* – it provides protection from the elements, will suffice as a sleeping blanket, and can serve as a makeshift tent. It can help to conceal items (+4 to Holdout). It can even be used to defend actively against attack. The simplest method is to wrap it around one arm and use it to ward off blows (a Block with the Cloak skill; see p. B184). Held out in front like a curtain, a heavy cloak stands a good chance of absorbing a light ranged weapon's impact (see *Arrow Curtains,* p. 104).

A cloak costs 10% of cost of living and weighs 2 lbs. A heavy one made from wool or leather provides DR 1 vs. *cutting,* costs 15% of cost of living, and weighs 3 lbs.

Parka (TL0)

A parka is a hooded, long-sleeved coat made from two layers of hide. The inner layer has inward-facing fur to trap heat. The outer layer can be waterproofed; see *Wet-Weather Gear* (below). Worn over winter clothing (p. 98) to protect against arctic conditions, it gives +5 to HT rolls to avoid FP or HP loss due to freezing temperatures (see p. B430). This combination is also thick enough to provide +1 DR vs. *all* attacks, but the layering results in the -1 DX penalty explained under *Layered Armor* (p. 103). $100, 10 lbs.

Poncho (TL0)

This is simply a blanket with a hole in it for the head. It can act as regular clothing or be worn as an extra layer to resist cold, but it hampers the arms somewhat (-1 DX when using the arms). Because of their bulk, ponchos – like cloaks – grant +4 to Holdout to conceal gear on the body. Cost and weight are as for ordinary clothing (p. 98).

Clothing and Status

In most cultures, attire broadcasts social status. The quality of the fabric and the cut of the tailoring are often good indicators. Then there are specific badges, such as the purple toga-stripe of the Roman senator, or the ermine worn by European royalty. In some circumstances, a person couldn't hold a particular position *without* wearing suitable finery, and sumptuary laws (see *Luxuries,* p. 36) were rigorously enforced to prevent lower classes from dressing above their station.

GURPS links clothing with Status – a person's cost of living (pp. B265-266) determines the price of his clothes. The ***Basic Set*** doesn't increase the tailor's bill after Status 3, but this isn't appropriate in low-tech societies. A Status 7 ruler dresses far more richly than any Status 3 lord! Use cost of living to determine clothing costs for *any* Status.

Example: King Olaf (Status 7) has a $60,000,000 cost of living. A suitable set of summer attire costs 10% of this amount, or $6,000,000. It might incorporate the finest gem-studded cloth, the most expensive embroidery and threads, and appropriate jewelry and regalia.

Snow Goggles (TL0)

Made of wood with narrow eye-slits, these protect against snow-blindness. Vision is at -3. DR 1. $15, 1 lb.

Wet-Weather Gear (TL0)

Rain and spray can reduce clothing's effectiveness in cold weather (see *Cold,* p. B430). A waterproofed cloak, parka, or poncho can be worn over clothing to keep the wearer dry. Waterproofing agents include beeswax, vegetable oil, animal fat, tree pitch, and lacquer. Waterproofing increases the basic garment's cost by $50, weight by 1 lb.

Leather Apron (TL1)

Craftsmen such as blacksmiths and stonemasons often wear leather aprons to protect themselves and their clothes. These are flexible, but thick enough to resist light damage. A leather apron covers the front, protecting the torso except for the very top (protects on 1-5 on 1d), and the upper legs (protects on 4-6); see the *Armor Locations Table* (p. 100). DR 1. $60, 3 lbs.

Long Coat (TL1)

This is a trench coat, duster, overcoat, *kaftan,* or similar item that covers the torso and extends to the knees or below. It can conceal bulky items (+4 to Holdout), but may look out of place in some situations. $50, 5 lbs. A leather or heavy felt version provides DR 1: +4 CF, double weight. Even heavier leather variants were worn as armor and called "buff coats" during the English Civil War; treat these as armor (see *Hide,* p. 104).

Undercover Clothing (TL2)

Clothing designed to hide things gives a Holdout bonus. This may be accomplished through a special cut, hidden pockets, loops, reinforcements, panels, etc. An outfit that gives +1 (quality) to Holdout adds +4 CF; one that gives +2 (quality) adds +19 CF.

Beekeeper's Outfit (TL3)

Medieval illustrations depict an ankle-length garment (probably linen or hemp canvas) with long sleeves and bloused gloves. A hood covers the head and shoulders, and a circular mesh protects the face for complete body coverage. This outfit isn't heavy enough to turn blows (DR 0), but it *will* resist insect swarms (p. B461). $80, 5 lbs.

Fireproof Clothing (TL3)

Moslem sources record the use of fireproofing by soldiers who employed incendiaries on the battlefield. Exposed skin was protected by a paste of vinegar, red clay, dissolved talc, fish glue, and sandarac. Clothing was sometimes coated in this concoction, too – and brave warriors would occasionally don such garb, set themselves ablaze, and ride into the enemy to cause havoc! This long-sleeved and hooded garment of treated heavy wool, similar to the woolen garment used by firefighters until the 20th century, gives DR 4 vs. *burning*. $150, 6 lbs.

Armor

Armor doesn't seem to have been used until the beginning of the Bronze Age, when warfare became organized (see ***GURPS Low-Tech Companion 2***). Helmets and shields appeared first, followed by body armor. Armor design has always been a tradeoff between protection and ease of movement. Through most of history, the military elite equipped themselves with heavy armor. The rest of the army sometimes wore lighter armor and occasionally had nothing but a shield.

Even very light armor can help to protect a warrior from many attacks and incidental injuries. Heavy armor can render him nearly immune to battlefield threats, although it's fatiguing to wear (see *Armor Fatigue,* p. 101).

Armor Legality

Like weapons, armor has variable Legality Class (pp. B267, B507). If it could be categorized as "clothing," but has some protective benefit, it's LC4 – or maybe LC3. If it would *only* be worn for combat, it's LC2 or even LC1. Shields are usually LC3: they are intended for combat, but cheap enough that a militia might be expected to own them.

Armor Locations Table

The *Armor Table* (pp. 110-111) gives costs and weights for armor for the *entire torso.* Use the table below to find cost and weight for armor for other hit locations. For armor that covers only *half* of a location – e.g., "front only," like a breastplate – *halve* the cost and weight of armor for that area. Do the same for just *one* arm, leg, hand, foot, etc.

Example: The *Armor Table* lists a light mail vest as $500, 12 lbs. Long sleeves for all of both arms (50%) are $250, 6 lbs.; leggings for both legs (100%) are $500, 12 lbs. Mail for both hands (10%) is $50, 1.2 lbs.; ditto for both feet (10%). Total: $1,350, 32.4 lbs.

The same percentages can be used to calculate other figures; e.g., manufacture time (see ***GURPS Low-Tech Companion 3***) and donning time (see *Donning Armor,* p. 102).

All pieces can be worn separately – groin (*codpiece*), shoulder (*pauldron*), elbow (*couter*), forearm (*bracer*), knee (*poleyn*), shin (*greave*), etc.

Location	*Cost and Weight*	*Hit Location*	*Notes*
Head	30%	3-5	[1]
Skull	20%	3-4	
Face	10%	5	
Neck	5%	17-18	
Torso	100%	9-11	[2, 3]
Chest	75%	9-10	[2]
Abdomen	25%	11	[2, 4]
Groin	5%	–	
Arms	50%	8, 12	[5]
Shoulders	10%	–	[6]
Upper Arms	10%	–	[7]
Elbows	5%	–	[8]
Forearms	25%	–	[9]
Hands	10%	15	
Legs	100%	6-7, 13-14	[10]
Thighs	45%	–	[11]
Knees	5%	–	[8]
Shins	50%	–	[9]
Feet	10%	16	

Notes

[1] Includes *skull* and *face.*
[2] Roll 1d; on 1, the vitals are hit.
[3] Includes *chest* and *abdomen;* see pp. 102-103.
[4] Includes *groin.*
[5] Include *shoulders, upper arms, elbows,* and *forearms,* but not hands.
[6] Roll 1d; on 6, the armor is hit.*
[7] Roll 1d; on 5, the armor is hit.*
[8] Roll 1d; on 4, the armor is hit.*
[9] Roll 1d; on 1-3, the armor is hit.*
[10] Include *thighs, knees,* and *shins,* but not feet.
[11] Roll 1d; on 5-6, the armor is hit.*

* Partial limb armor provides only partial protection! Roll 1d *once* to see whether an attack hits armor. For an *arm:* (1-3) forearm; (4) elbow; (5) upper arm; (6) shoulder. For a *leg:* (1-3) shin; (4) knee; (5-6) thigh.

Optional Rules for Armor

Here are many *optional* rules that allow a more realistic treatment of armor.

Armor Fatigue

Heavy body armor is cumbersome, but not as much as one would imagine. Unless it's *cheap* (see *Armor of Quality,* p. 109), it will be carefully tailored, with its weight evenly distributed over the whole body. A trained warrior can conduct most activities – running, jumping, mounting a horse, etc. – without undue strain or penalty.

Body armor is hot and stuffy, however – especially if a helmet is worn. And leg armor *is* cumbersome, and can restrict movement. A full set of armor (helmet, chest, and legs) is heavy, and stifling even in temperate conditions. In hot weather, it increases FP costs (see *Fighting a Battle,* p. B426) and can contribute to heatstroke (see *Heat,* p. B434).

Long battles, even with extended breaks between actual combat, can quickly fatigue a warrior. During the Battle of Towton in 1461, when knights fought each other on foot, the prolonged melee caused some to collapse from heat exhaustion despite the fact that heavy snow was falling! If using ***GURPS Mass Combat,*** the GM may wish to consider the length of the battle rounds when assessing FP loss.

Chinks in Armor

Even a full suit of armor has small gaps where the plates overlap. A precisely placed weapon point can exploit this; see *Targeting Chinks in Armor* (p. B400). The penalty to hit chinks in armor is -8 on the torso, -10 everywhere else. Remove -2 from the penalty for plate armor that doesn't use *sliding rivets* (p. 109). Armor damage can further mitigate the penalty; see ***GURPS Low-Tech Companion 2.*** On a successful hit, *halve* armor DR.

Only *rigid* armor has exploitable chinks. Flexible armor lacks chinks (but has other weaknesses). Flexible DR is marked with a "*" on the *Armor Table* (pp. 110-111).

Harsh Realism – Armor Gaps

In addition to chinks, there are places that rigid armor cannot cover *at all* – usually at the joints. For harsh realism, some of the more vulnerable locations are described below. These get *no* DR, not half DR, and may be easier to hit! Flexible armor was often worn underneath to help protect these vulnerabilities (see *Arming Garments,* below).

Armpit: The armpit is vulnerable because it's often exposed when the warrior lifts his arm to swing a weapon. An impaling wound there can sever the brachial or subclavian artery and the nerves controlling the arm before puncturing the lungs and heart. Treat an impaling attack to the armpit as an attack to the vitals at -8 to hit. On a critical hit, don't roll on the *Critical Hit Table;* instead, the arm is automatically *crippled* (pp. B420-423). This is in addition to impaling damage to the vitals!

Back of Knee: Rigid knee protection cannot wrap around to protect the back of the joint without preventing the leg from bending. The back of the knee may be targeted at -8. Treat a successful hit as if the joint itself was targeted (see ***GURPS Martial Arts,*** p. 137).

Eyes: Any armor that fully covers the face also covers the eyes. Anyone wishing to target the eyes can do so through the eye-slits at -10. If successful, there's *no* DR and the eyes suffer full damage! See *Face Protection* (p. 112) for more on armoring the face.

Groin: The groin is especially difficult to armor and particularly vulnerable to attack. The rigid *codpiece* was an attempt to provide additional protection, but had to be removed before mounting a horse. The codpiece gives full DR to the groin but leaves gaps that can be targeted at -8. It also grants +2 to knockdown rolls for groin hits. Flexible armor, such as mail, gives more freedom of movement, but since the groin is susceptible to crushing damage (p. B399), it's of only limited use.

Inside Elbow: As with the knee, rigid armor can cover the elbow, but only on the outside. If it protected the entire joint, the warrior could not bend his arm. Because of this, the inside elbow is another gap that can be targeted at -8. Treat a successful hit as if the joint itself was targeted (see ***GURPS Martial Arts,*** p. 137).

Neck: The neck is another location that's tricky to armor. A rigid collar limits head movement, while a flexible one leaves the throat susceptible to crushing attacks. Neck armor gaps are at -8 to hit. For extra detail, see the *Neck Wounds Table* on p. 138 of ***GURPS Martial Arts.*** See *Neck Protection* (pp. 112-113) for more on armoring the neck.

Open Palm: Most gauntlets have a soft leather (or completely open) palm to make it easier to grip a weapon. This may be targeted at -8 to hit – or just -6, if the wearer is unarmed. If successful, there's *no* DR and the hand suffers full damage! Master Fiore taught a dagger parry that involved intercepting the opponent's descending weapon hand with a dagger, and noted that it was especially effective against gauntlets.

Arming Garments

Historically, flexible armor was frequently worn under rigid armor to protect gaps. As well, padding was sometimes layered beneath mail to bolster it against crushing attacks. In Europe such garments were called *pourpoints, haketons,* or *gambesons.* Handle this using *Layered Armor* (p. 103). When chinks are targeted, though, the attacker need only overcome the flexible layer's DR; e.g., if DR 1 padded cloth is worn beneath DR 6 plate, successfully targeting a gap in the plate means that the attacker must defeat only DR 1.

At TL3, plate was strapped over a mail shirt called a *haubergeon* ("little hauberk"). This provided excellent protection but was very cumbersome. Any attack that struck the wearer had to contend with both layers (see *Layered Armor,* p. 103); gaps were protected only by the mail.

At TL4, plate armor made use of a specialized garment called an *arming doublet,* which incorporated cords called *arming points* (twine or leather lacing) to attach small bits of plate and mail. This long-sleeved garment is very lightly padded and provides no additional DR. However, the patches of armor – called *voiders* or *gussets* – *do* give DR, and are specifically located at armor gaps; e.g., they're sewn over the armpit and inside elbows. An arming doublet should be worn with any TL4 plate armor that includes arms and/or legs. It costs $160 and weighs 3 lbs.

It's possible to wear a suit of plate without an arming doublet, but this results in -1 to DX and DR, since it no longer fits correctly (see *My Armor Doesn't Fit,* p. 103), and the gaps are now unprotected!

Concealing Armor

To conceal armor from somebody who's looking for it, you must win a Quick Contest of Holdout (p. B200) vs. his Search skill (p. B219). Holdout suffers a penalty equal to DR for rigid armor, DR/3 (round *up*) for flexible armor. Also add any bonus for clothes worn over the armor; e.g., *Long Coat* (p. 99) and *Undercover Clothing* (p. 100). Range penalties apply to Search.

Armor can be made more concealable to mitigate the Holdout penalty; flexible armor is most suitable, but rigid panels can also be concealed. The craftsman needs Armoury (Body Armor) *and* Sewing at skill 12+. He chooses a type of clothing and the armor he wishes to conceal within it, and then rolls against the *lower* of the two skills. Remove -1 from the Holdout penalty per two *full* points of success; e.g., success by 5 erases -2 in Holdout penalties. Critical success means the armor can only be detected with a tactile search. Critical failure indicates that the armor will fail completely at some dramatically appropriate time during combat (GM's decision).

Total weight and base cost follow the rules for combination devices that can be used simultaneously; see *Combination Gadgets* (p. 14). Multiply this base cost by the amount of Holdout penalty removed, +1.

Example: Ordinary clothing for Status 2 costs $600 (20% of $3,000 cost of living). Fine mail armor is $900. A combination gadget has base cost $900 + (0.8 × $600) = $1,380. If it removes -3 in Holdout penalties, final cost is (3 + 1) × $1,380 = $5,520.

Donning Armor

Historically, most warriors who could afford a suit of armor also had at least one servant to carry it when it wasn't needed, and to help put it on when it was. Many pieces of armor have laces and straps that are difficult for the *wearer* to fasten. Each piece (cuirass, helmet, gauntlet, greave, etc.) requires a certain amount of time to don. Some items, such as a mail shirt, can simply be slipped over the head in a few seconds; others, such as a scale corselet, are fastened with buckles or lacing, requiring much more time.

The time to don each type of armor appears in the *Armor Table* (pp. 110-111), which covers only *torso* armor. Calculate times to armor other body parts using the percentages on the *Armor Locations Table* (p. 100). If the wearer has assistance putting on his armor, divide donning time by 4 (minimum 3 seconds). Time to *remove* the armor is halved.

Hit Locations

Obviously, different body parts require different pieces of armor! It's rare for armor to provide the same protection over the entire body. A suit of plate, for example, uses heavier plates for the head and chest; much lighter plates protect the arms and legs. Most hit locations are described on pp. B398-399, but some others are outlined below. See the *Armor Locations Table* (p. 100) for weight and cost.

Chest

The *Armor Table* (pp. 110-111) lists armor that covers the entire torso. In reality, many types of armor are too rigid for this. They would prevent the warrior from bending at the waist, making many maneuvers impossible – sitting down, mounting a horse, and even running. Most armor stops at the midriff, leaving stomach and groin exposed. Gamers who wish to simulate this can separate the *torso* location into two sections: the *chest,* which includes breast and upper back (areas 9-10), and the *abdomen* (below). The chest is targeted at no special penalty. If a *crushing, piercing,* or *impaling* attack strikes the chest, roll 1d; on a 1, the *vitals* are hit.

Abdomen

As noted above, many types of armor can cover the upper torso but aren't flexible enough to cover the lower torso.

Blunt Trauma and Edged Weapons

Realistically, it's extremely difficult for a blade edge to cut through any sort of armor. Most damage to armored opponents is in the form of blunt trauma. Here's an optional rule to reflect this:

Roll damage and determine whether the blow can put at least 1 point of penetrating damage past *twice* the armor's DR. If it can't, then treat the cutting attack as merely crushing – that is, simply subtract the armor's usual DR from damage to get injury. Such injury doesn't actually slice through the armor, and is equivalent to blunt trauma. If the blow can penetrate twice the armor's DR, then use the rules for cutting attacks as written – subtract the armor's usual DR from damage and then multiply by 1.5 to find injury – and assume that the armor (and flesh!) is cut.

Example: Sir Gnaff is wearing DR 7 plate. He's hit by Conan the Bar's sword for 14 points of cutting damage. Twice DR 7 is 14, so the blow fails to penetrate and is considered crushing. Thus, it inflicts 14 - 7 = 7 HP of injury. If Conan were using poison, it would be useless; the blow merely dented the armor. If Conan had rolled 15, this would have been enough to penetrate twice DR 7. Penetrating damage would have been 15 - 7 = 8 points, and cutting injury would have been 8 × 1.5 = 12 HP. . . and if Conan's sword were poisoned, the venom would have a chance to work.

For more on wounding and blunt trauma, see p. B379. This rule applies only to *armor,* not to other forms of DR (e.g., Tough Skin).

An additional, more-flexible piece of armor (called a *fauld*) is required to protect the abdomen. This hit location includes the stomach and groin (area 11). A fighter may wish to target the abdomen deliberately because it's less well protected; if so, roll at -1 to hit. If a *crushing, piercing,* or *impaling* attack strikes the abdomen, roll 1d; on a 1, the *vitals* are hit.

Improvised Armor

An adventurer might wish protection in battle but lack access to professionally made armor. Many types of armor can be improvised. It doesn't take a professional to make a straw-mat breastplate (see *Straw,* p. 106); a leather jacket or a craftsman's apron requires no modification at all to act as armor; and a large animal skull can be stuck on the head as an improvised pot helm (see *Bone,* p. 106).

Other types of improvised armor require basic knowledge of Armoury (Body Armor), so a skill roll is required – but at +4. Basic smithing tools can work a suitable metal pot into a helmet. With wire and simple tools, you can make unriveted mail armor (see *Butted Mail,* p. 107). Cheap-quality (-1 DR) splint bracers and greaves (see *Splinted Armor,* p. 105) can be made with a length of cord and some metal or wooden strips. A tailor's kit (p. 30) and a Sewing skill roll, still at +4, can quilt a pile of tunics into cheap-quality (-1 DR) layered cloth armor (below).

Layered Armor

The rules in *Combining and Layering Armor* (p. B286) require armor to be flexible and concealable if it's to be worn as an underlayer. ***Low-Tech*** offers advanced rules for concealing armor; see *Concealing Armor* (p. 102). When using these, warriors wishing to combine layers and their respective DRs may simply omit the need for inner layers to be concealable. Such armor must still be flexible, though.

Apply -1 to DX for one additional layer, or -2 to DX for two. More than three layers total is rare. This penalty only affects deeds performed with the affected hit location. For example, if only the legs have layered armor, the penalty only affects actions involving the legs – including combat (but not *mounted* combat), running, and climbing. If armor is layered on the torso, the penalty applies to *all* actions. However, DX penalties don't apply if the total odds of partial armor protecting a hit location are 3 in 6 or less (see the *Armor Locations Table,* p. 100), or for armor that covers only the head.

Items that don't provide DR don't cause DX penalties. Notably, many types of armor are worn with padding to improve fit and comfort, but that isn't thick enough to provide DR. There's no DX penalty for this. Armor in the *Armor Table* (pp. 110-111) includes suitable padding, which neither provides additional DR nor affects DX. If a warrior wore armor over thick padded cloth (DR 1), though, DX penalties *would* apply.

My Armor Doesn't Fit!

Low-Tech assumes that most armor is custom-tailored for the owner. If an adventurer acquires a piece of armor that wasn't designed for him, he'll suffer -1 to DX *and* -1 to DR while wearing it, because it doesn't fit correctly. This can be fixed by a craftsman with Armoury (Body Armor) and suitable tools. It takes an hour and a successful Armoury roll at +2 to alter the armor for its new owner. Failure simply means that the DR and DX penalties remain, but critical failure destroys the armor.

The GM may make exceptions for extremely flexible armor, remarkably similar wearers (twins, clones, etc.), and other special cases. He may also exempt cheap *munitions armor,* which is specifically designed to fit a range of body sizes; see *Armor of Quality* (p. 109).

Removing the integrated padding from armor might save a little weight (GM's option), but will result in the above DX and DR penalties.

Sneaking in Armor

Armor is noisy and easily noticed: halve DR, round *up,* and assess a Stealth penalty of that size. If armor DR varies by hit location, use the piece with the *highest* penalty. If the overall encumbrance penalty (p. B17) would be worse, use that *instead* of the DR-based one.

Special preparation can reduce the chances of being detected. Spending 10 minutes to pad or tie down rattling buckles and rubbing segments decreases noise. Another method is to wrap each individual segment in soft cloth or fine leather. Lacquering also reduces the amount of noise armor makes; handle this using *Styling* (p. 14), treating it as +4 CF. Each of these methods removes -1 from the Stealth penalty.

If appropriate camouflage colors are used (see *Camouflage,* p. 126), then a bonus to Camouflage also applies.

Textiles

If clothing can be made from fabric, then so can armor. To provide protection, it must be much thicker than regular clothing. This is accomplished either by stuffing two textile layers with padding or by quilting together multiple layers.

Layered Cloth (TL0)

Multiple layers of quilted cloth can form a semi-rigid defense. Examples include the Greek *linothorax,* European *padded jack,* Indian *peti,* and hair and fiber armor of South America and the Pacific Islands. Layered cloth armor provides better protection than a similar weight of leather armor. The degree of protection is a function of the number of layers and the weight of the fabric: *light, medium,* or *heavy* (see the *Armor Table,* pp. 110-111). Armor quality depends on the grade of fabric and the spacing between rows of quilting.

Padded Cloth (TL0)

Usually either a heavy layer of felt (about 1/4" thick) or a stuffed quilt (two layers of cloth between which rags, tow, horsehair, rock salt, dried grass, or straw is sandwiched).

Other materials can be substituted for similar protection; e.g., sheepskin with the wool on the inside. This is the standard cloth armor on p. B283.

Silk (TL2)

Byzantine medical manuals – and monks such as Carpini, who traveled far into the East – mention the usefulness of silk undershirts. Most suitable is raw silk, which is tougher than refined threads. Mongolian silk *dels* consisted of several layers of tightly woven raw silk, worn under armor to help resist arrows.

Such a garment doesn't prevent a weapon from penetrating the body, but engulfs the tip and is pulled into the wound. This reduces the depth of penetration and makes the weapon easier to extract. It also decreases the likelihood of dirt and fragments of fabric entering the wound. Silk gives an extra +1 DR vs. *cutting* and *impaling* attacks, and negates the effects of barbed weapons. Against such attacks, it grants +1 to First Aid rolls to treat injuries and eliminates -2 in penalties to HT rolls for infection due to dirt in the wound (p. B444). Finally, silk prevents skin contact, negating any blood agent or contact poison. Any cloth armor can be made of silk instead of more common textiles. +19 CF; weight is unchanged.

Some campaigns may allow more exotic threads, such as *spider silk.* This produces a superior fabric when woven into cloth. Treat as regular silk, but with +*2* DR vs. cutting and impaling. +99 CF; weight is unchanged.

Feathers (TL1)

Aztec nobles wore feathered armor. For this to work, the feathers' quills must be incorporated into the initial weaving process. Overlapping rows of feathers are assembled in a manner similar to the plates in scale armor (pp. 106-107). A feathered surcoat is both water-resistant and effective at deflecting arrows and darts. Adding feathers to any cloth garment adds +1 DR vs. light missiles (see *Arrow Curtains,* above). Melee attacks aren't affected. Firearms are also unaffected, due to the higher velocities. Adds $2,000 to the base price of cloth armor; weight is unchanged.

Hide

"Hide" refers to *any* kind of animal skin – processed or not. Some hides are more suitable than others for making armor.

Furs (TL0)

There's no evidence that Stone Age warriors wore garments specifically designed to resist weapons, but a few layers of animal skins *are* heavy enough to provide DR 1 vs. *cutting* (only). For stats, see *Winter Clothing* (p. 98).

Arrow Curtains

A loosely hung cloth or light leather curtain is useful against ranged attacks, as light projectiles that encounter such a barrier are less likely to pass through. Some Greek hoplite shields employed a curtain hung from the bottom of the rim to stop arrows and sling shot (protects the legs). Aztec shields sometimes used a curtain made of feathers. The Japanese *horo* worked on a similar principle – attached to the wearer's neck and waist, it billowed out behind like a sail when he rode his horse (protects the back, but only when moving faster than Move 2).

An arrow curtain gives +1 DR vs. any light ranged weapon (arrows, sling shot, thrown knives, etc.). *Firearms* are exempt because bullets' higher velocity lets them pass through with minimal interference. A curtain attached to the bottom of a shield makes the shield less maneuverable: -1 to Shield skill. $80, 2 lbs.

Leather (TL0)

Leather has been used extensively to make armor. The size of the animal generally determines its thickness and hence its DR.

Light Leather: Soft, flexible leather, from animals such as cattle, sheep, pigs, deer, reptiles, and even fish. Not often worn as standalone armor; it's usually the backing for something more substantial, such as scale armor (pp. 106-107). Worn on its own, it works like furs (above), providing DR 1 vs. *cutting* attacks.

Medium Leather: From animals such as bear, aurochs, buffalo, and large crocodiles. Medium leather armor was used from Europe to Indonesia. It's still flexible, but offers reasonable protection. Medium leather gives DR 2 vs. all attacks *except* impaling, against which it has DR 1.

Heavy Leather: From large animals, such as elephant, hippopotamus, and rhinoceros. Heavy leather was once widely used throughout Asia; the Asian rhinoceros was hunted to extinction during the Bronze Age as a result. Coastal Chinese clans sometimes used whaleskin once the rhinoceros became scarce. Heavy leather affords DR 3 vs. all attacks *except* impaling, against which it has DR 2.

Rawhide (TL0)

Rawhide is basically untanned leather. It's vulnerable to moisture, and deteriorates quickly. Treat it as hardened leather armor (p. 105), with two exceptions. First, it gives the DR of hardened leather only while dry; if it gets wet, it loses all protective capability until thoroughly dried and reshaped. Second, it has half the HP of hardened leather (see *Armor Damage* in ***GURPS Low-Tech Companion 2***). Coating it with oil, wax, lacquer, or resin can avoid the first problem (see *Wet-Weather Gear,* p. 99), but only tanning (see *Leathers,* p. 22) or a very dry environment can mitigate the second.

Layered Leather (TL1)

In Bronze Age China, warriors wore armor made of several layers of leather. Asian nomads and Eastern Europeans adopted similar armor during the Middle Ages. South American examples have also been recovered. The multiple layers enable it to absorb impact and resist impaling attacks more effectively than a single thick layer. All but the lightest of layered leather cuirasses are rigid. The number of layers and the thickness of each layer determine the degree of protection: *light, medium,* or *heavy* (see the *Armor Table,* pp. 110-111). Leather scale armor may also be treated as layered leather (for *metal* scale armor, see pp. 106-107).

Leather of Quality

Kangaroo leather has a very high tensile strength, three times that of cowhide. Sharkskin is extremely tough, and more resistant to abrasion than any other leather. Giraffe hide is sought after in Africa because it's both lightweight and extremely tough. Certain sections of horse hide also provide excellent leather. In addition, some advanced tanning methods may improve leather's quality. Treat superior hides as fine leather armor with +1 DR. +4 CF; weight is unchanged.

Hardened Leather (TL2)

Known as *cuir-bouilli,* hardened leather was first documented in Western Europe near the end of the 12th century. It was used centuries earlier in Asia. Soaking leather in hot water softens it, enabling it to be molded into a desired shape. Then it's either left to dry naturally or slowly baked in an oven at medium temperatures. Finally, it's waterproofed with a wax, resin, or lacquer coating. The end product is a very hard, water- and shatter-resistant material, perfect for resisting weapons.

Hardening adds +1 to leather's DR against impaling damage. It also causes the leather to shrink; more material is required to cover the same area (+25% weight). *Light* leather cannot be strengthened this way; it would warp and crack. Hardened *medium* leather is the leather armor on p. B283, with DR 2 vs. all attacks. Hardened *heavy* leather provides DR 3. Use these stats for both a solid leather cuirass and one assembled from narrower segmented panels.

Reinforced

Textile or leather armor may be reinforced with metal, horn, wood, or shell pieces for additional protection. This option isn't available for metallic armor. Reinforcing grants +1 DR vs. *cutting* (only), but adds +0.25 CF and 25% to weight. Recalculate armor HP based on the new weight. Below are some common types of reinforcing.

Bezainting (TL0)

Bezainted garments have small pieces of horn or bark – or fish scales, coins, or metal discs – attached with rivets or lacing. A surviving Alaskan example consists of a hardened leather cuirass covered with Japanese and Chinese coins. In medieval Europe, this was sometimes called a "pennyplate coat." If the discs overlap, treat this defense as scale armor (pp. 106-107) instead. Metallic bezainting is TL1.

Armored Surcoat (TL2)

A sturdy surcoat reinforced with rows of fairly long, rectangular, overlapping plates, set vertically and riveted to the inside of the fabric. It first appeared in Europe in the second half of the 12th century, and was layered over mail (p. 107) for extra protection. By the 13th century, it had evolved into the coat of plates (see *Segmented Plate,* pp. 107-108).

Example: Treat an armored surcoat as reinforced textile armor. Light layered cloth has DR 2*, and is $150, 12 lbs. Reinforcing increases DR vs. cutting to 3, but adds 25% to both cost and weight. Final cost is $187.50; final weight is 15 lbs.

Ring Armor (TL2)

Often incorrectly called "ring mail," this armor was used on rare occasions in Asia, and consisted of a cloth or leather garment upon which metal rings were sewn. There's little proof that ring armor ever existed in medieval Europe. During the Renaissance, a type of ring armor called an "eyelet doublet" was developed; this consisted of a quilted garment onto which hundreds of small rings or eyelets were sewn.

Splinted Armor (TL2)

Splinted arm and leg guards were common in many cultures. Construction consists of a cloth or leather item with vertical strips of metal, horn, or wood riveted to either the inside or outside (sometimes alternating). Metallic splints may be concealed by riveting them underneath the foundation and then covering the rivet heads with another layer of cloth (see *Concealing Armor,* p. 102).

Example: We want splint reinforcing on hardened leather shin greaves. Hard medium leather torso armor has DR 2, and is $125, 15 lbs. Greaves cover only the shins; from the *Armor Locations Table* (p. 100), we find that shins have 50% the cost and weight of torso armor, so they're $62.50, 7.5 lbs. Reinforcing raises DR vs. cutting to 3, but adds 25% to both cost and weight. Final cost is $78.13; final weight is 9.38 lbs.

Jack Chains (TL3)

Narrow metal bars or splints are aligned along a limb (arm or leg) to offer additional protection. A small length of chain – maybe three or four links – joins the bars together while allowing the limb to articulate. Sometimes a small metal cup covers the knee or elbow.

Other Nonmetallic Armor

Nonmetallic armor can be made from materials other than cloth and hide. A region's raw materials determine what kinds of armor are prevalent among the locals.

Bone (TL0)

Dead bone is too brittle to make decent armor, but it was used on occasion. Examples include the bone-splint breastplates of the American Plains Indians, and the animal-skull helmets of some South American and African tribes. Treat as horn armor (p. 110), but semi-ablative (see p. B47).

Jade

The Chinese believed that jade could preserve the physical body after death. Ceremonial suits of jade armor were crafted as funerary goods for powerful individuals. Jade is extremely tough, however, and could be used for actual combat! Treat as stone armor (above), but it gives +2 to reaction rolls and has +4 CF. Gem-quality jade armor would give +3 to reaction rolls and have +9 CF.

Cane (TL0)

Common among the Inca of Peru and on many Pacific Islands, cane was sometimes used in Europe. One method of construction is to lace rattan to a tree-bark lining. Another is to weave flexible cane rods into the desired shape, such as a helmet, breastplate, or greave. Cane is *combustible* – it can catch fire if burning damage penetrates DR! See *Making Things Burn* (p. B433); treat the armor material as *resistant*.

Horn (TL0)

This includes antler, ivory, hoof, turtle shell, and baleen. Such materials are light and tough, and can be molded when heated in water, making them good for fashioning armor – most commonly a kind of scale armor (below). Horn armor was popular in regions with few resources, such as the Asian steppes and the Arctic Circle. An early example is the boar's tusk helms worn in Greece by the ancient Mycenaeans. Another is the scale armor worn by the Neolithic Sarmatians, made by slicing horses' hooves into scales and sewing them onto a garment with sinew.

Straw (TL0)

Although heavy and uncomfortable, straw-mat armor offers decent protection at a bargain price. During his final expedition, the English explorer Captain James Cook tried to subdue a Hawaiian native with musket small shot. His opponent fell to the ground, but the man's straw-mat breastplate prevented serious injury. Straw is as combustible as cane (above).

Wood (TL0)

Solid chunks of wood can be carved into shapes that are fitted to the body. Armor may also be assembled from wooden slats or rods tied together with cord or rawhide and suspended from the shoulders, hanging loosely against the body. Wooden armor is semi-ablative (see p. B47).

Stone (TL1)

In 1999, archaeologists in China discovered a huge tomb southeast of the Qingshihuang Mausoleum containing several types of stone armor. Every piece was chipped and polished from stone into different shapes, which were then connected with wire to create a type of lamellar armor. It is unlikely that this armor was ever meant for fighting, however; it was probably created purely for funerary purposes. Treat as heavy scale armor (p. 110), but semi-ablative (see p. B47), and with -0.5 CF and *double* weight.

Paper (TL2)

In Japan, the peasant hat called a *jingasa* was sometimes made of several layers of rice paper (p. 24), coated with lacquer. This keeps the rain off, and offers a little head protection (DR 1).

In most cases, however, what's really meant by "paper armor" is *barkcloth* (see *Paper and Its Cousins,* p. 24). Laminated barkcloth was issued to common soldiers as cheap, disposable armor. In Korea, it was called *jigap*. This material is remarkably efficient at distributing impact, and its multiple layers can trap weapon points. Treat as layered cloth (p. 110), except that it can catch fire if burning damage penetrates DR. See *Making Things Burn* (p. B433); the armor material counts as *resistant*. -0.25 CF; weight is unchanged.

Barkcloth can be *proofed* against light firearms by combining it with a few layers of silk. This version is TL4. Like other paper armor, it's combustible.

Metallic Armor

Metal has been preferred for armor since the dawn of the Bronze Age. The earliest examples were Sumerian copper helmets – but soon, elite troops were wearing bronze scale armor. Pound for pound, work-hardened metals such as bronze and iron afford better protection than any other material available to a low-tech society.

Scale and Lamellar (TL1)

These are the oldest known types of metallic body armor. Both consist of small plates laced to each other in overlapping rows. If the plates are fastened to a cloth or leather backing, then the armor is *scale*. If they're assembled so that no backing is required, then the armor is *lamellar* – an example of which is the *o-yoroi* worn by Japan's samurai.

Chinese Mountain Scale

Armor made from scales shaped like the Chinese character for "mountain." When assembled, the surface of each scale resembles a star; thus, this armor is also known as "star scale." This construction is flexible like scale armor, but the scales lock together on impact, creating a rigid surface that's less susceptible to blunt trauma – a behavior called "shock hardening." Treat this as light or medium scale *without* the -1 DR vs. crushing. +1 CF; weight is unchanged.

The plates' thickness and degree of overlap determine the level of protection. Three grades of scale armor approximate this on the *Armor Table* (p. 110): *light, medium* (most common), and *heavy.* Heavy scale is usually only worn on the chest, although panels can be made into guards for shoulders, abdomen, and thighs.

Mail (TL2)

Probably the most successful type of body armor ever devised, mail seems to have been invented in Central Europe in the fourth century B.C., and was soon adopted by the Celts and then the Romans (who called it *lorica hamata*). It saw continuous use for the better part of 2,000 years in most metal-using cultures, with the exception of China. In essence, it's a fabric of interlocking metal rings, each linked through four others – two in the row above it and two below – and riveted closed. There are variations, but this "four-in-one" pattern is by far the most prevalent. The diameter of each link and the thickness of the wire determine mail's effectiveness.

Fine Mail (TL2). Made from small links of light wire, this material flows through the fingers like metallic cloth, yet can resist all but the heaviest sword cuts and spear thrusts. The earliest finds date to the Roman period.

Light Mail (TL2). Consisting of fairly *large* links of light wire, this mail was more often layered with other armor than worn by itself.

Heavy Mail (TL2). Has large links of *heavy* wire. Historically, mail worn as primary armor (Roman, Viking, Norman, etc.) tended to be heavier than that meant to be layered under other armor.

Jousting Mail (TL3). Mentioned in some medieval accounts, this seems to have been specifically designed for tournaments at a time when jousts involved fully sharpened war lances! It isn't entirely clear how it differed from field mail, but it was likely more rigid and heavier. As with *jousting plate* (p. 109), the armor's construction hampers movement: -1 to all DX-based skills except Lance.

Mail and Plates (TL3). Sometimes called *combined mail,* this consists of mail armor with vertical rows of overlapping plates incorporated into it. It appeared in India, Russia, and the Middle East around the 14th century. It has better resistance to crushing damage than heavy mail.

Mail and Padding

Mail – like many types of armor – is usually worn over light padding. This might be a separate layer (an *aketon* or *pourpoint;* see *Arming Garments,* p. 101) or sewn to the back of the mail. Such padding is rarely thick enough to add DR. Mail's main disadvantage, however, is that it's flexible, and susceptible to blunt trauma (p. B379). To mitigate this, it's sometimes layered with padded cloth (DR 1) or more-rigid armor. This gives a DX penalty; see *Layered Armor* (p. 103).

Jack of Plates (TL2)

European jacks usually consist of overlapping plates – similar to scale armor – sandwiched between two layers of lightly padded fabric and held in place with cord. Oriental jacks have individual pockets into which the plates are sewn. Either type of armor resembles quilted cloth, making it fairly easy to conceal (+1 to Holdout).

Segmented Plate (TL2)

Segmented plate is made from large horizontal bands, curved around the body and overlapped to allow some articulation. The best-known variety is the *lorica segmentata* of the Roman legions, but such armor also saw use in the Middle East and Asia. The earliest known example is the bronze Dendra panoply (Greece, dating to around 1400 B.C.), which consists of a solid cuirass protecting the chest, with hide-laced segmented plates hanging below to protect the abdomen and thighs.

Mail Variants

Mail is a flexible design – in every sense. Wire gauge and link size aren't the only variations possible.

Butted Mail (TL2)

Heavy wire links bent into rings that aren't riveted closed. While cheaper, it provides less protection against impaling attacks – weapon points can easily open the rings! Historically, butted mail is rare except as ceremonial armor, but modern recreationists prize its ease of manufacture. Treat butted mail as heavy mail, but with only DR 2 vs. impaling and 40% manufacture time. -0.6 CF; weight is unchanged.

Banded Mail (TL3)

Light mail with horizontal strips of leather woven through every other row to stiffen the weave and increase resistance to blunt trauma. This rare construction is unsuitable for hit locations that require flexibility – arms, legs, abdomen, etc. – and is normally only used on collars to protect the neck (see *Mail Collar,* p. 113). Negates the -2 DR vs. crushing. +0.5 CF; +50% weight.

Jazerant (TL3)

A mail shirt sandwiched between two layers of light padding and/or fine leather. The word is derived from the Arabic *kazaghand;* its earliest recorded use is in the 12th century, in the Middle East. With this construction, the mail is sewn *inside* the padding rather than worn over it. The most common form of concealed armor, jazerant can be based on any regular mail, typically fine mail. It has the underlying armor's weight and DR; modify cost to reflect the Holdout modifier, as explained in *Concealing Armor* (p. 102).

A more advanced version is the *coat of plates* (TL3), which probably evolved from the armored surcoat (p. 105). This segmented variant differs in that the horizontal plates are riveted to the *inside* of a foundation garment so that only the rivet heads are visible on the surface. It's often layered over a light mail shirt for additional protection. Most of the evidence for this armor was excavated from Scandinavian graves at the site of the Battle of Wisby (1361), although it was also worn in Russia and Asia.

Segmented armor is much easier to fashion than solid plate because the metal sections required are smaller, and the armor requires less tailoring to a given wearer. Once the segments have been forged, assembly is quick and simple. Lace, wire, or rivets connect adjacent bands, or the plates can be riveted to canvas or leather. The rules for increasing DR under *Heavy Plate* (p. 109) *are* applicable to segmented plate.

Brigandine (TL4)

Well-tailored, close-fitting armor consisting of small, overlapping metal plates riveted to the inside of a cloth or leather garment. The name has nothing to do with thieves or bandits! The term "brigand" originally denoted a foot soldier; thus, "brigandine" simply describes a type of armor for infantry.

Brigandine first appeared in Europe in the middle of the 14th century, evolving from the coat of plates (see *Segmented Plate,* above). Similar armor was developed in Asia, and became fashionable as courtly wear. Within a generation, brigandines grew very popular, remaining in fashion until the end of the 16th century. Many commentators regard it as a civilian armor worn by Renaissance gentlemen, but it made frequent appearances on the battlefield, where it provided excellent protection; some examples were proofed against firearms (see *Heavy Plate,* p. 109), and had lance-rests (see *Jousting Plate,* p. 109).

Brigandine *can* be concealed by hiding the rivets under a textile or fine leather cover (see *Concealing Armor,* p. 102); however, while it might seem ideal for this treatment, it was rarely concealed historically. Brigandines were the height of fashion – flamboyantly displayed, with expensive textiles and gilded rivets arrayed in attractive patterns. They were even emulated in civilian dress both in Europe and in Asian courts. Cloth garments known as *faux brigandine* were cut and tailored like brigandines, with rivets attached in similar patterns, but without metal plates behind them. Such clothing is sometimes erroneously called "studded armor," but provides no DR.

Plate (TL4)

The ***Basic Set*** lists plate armor as TL3 (see p. B283). Historically, solid plate torso protection made from iron was exceedingly rare before TL4. Earlier attempts (e.g., Japanese *tanko*) relied on smaller plates that were riveted or welded together, and made of poorer-quality iron. These were heavy and required an exceptional craftsman to fashion. Solid plate armor began to advance only after the development of blast furnaces (see *Iron and Steel,* p. 20) that could smelt iron blooms large enough to create a single-piece breastplate, and of water-powered trip-hammer mills that reduced the labor and manufacturing costs.

Treat the TL3 plate in the ***Basic Set*** as an early attempt to create such armor – or to fit anachronistic armor into TL3 fantasy. Its weight *is* higher than many real TL4 examples. This applies only to torso armor and complete suits, though. Smaller pieces of iron plate, such as helmets and greaves, are available starting at TL2. Full suits of *bronze* plate are available from TL1, with the usual +3 CF.

Copper and Bronze

The stats for metallic armor assume worked iron. However, metal armor can be and often was made from *bronze* – and sometimes *copper.*

Copper Armor (TL1)

Very early TL1 societies sometimes used unalloyed copper for armor; e.g., in helmets. Copper's metallurgical qualities make it poorly suited to this application. Copper armor is of *cheap* quality, yet has *full* cost; see *Armor of Quality* (p. 109).

Bronze Armor (TL1)

Bronze is an alloy of copper and tin (see *Copper, Bronze, and Brass,* p. 20); the higher the tin content, the harder the metal. Approximately 10-12% tin was common for weapons, while 8-10% was usual for armor. Properly cast and work-hardened, bronze is as effective as iron for armor.

Even during the Iron Age (TL2), bronze was the most common metal for plate armor. This was because iron had to be forged from relatively small billets, which made it extremely difficult to fashion larger plates, and the laborious hand-forging and careful tempering required relied on techniques not widely known before late TL2. The Roman desire for mass-produced armor led to solid bronze plate armor being abandoned in favor of segmented iron protection (see *Segmented Plate,* pp. 107-108). Iron's key advantage was *availability* – it enabled a far higher proportion of an army to be equipped with metal arms and armor, while bronze was reserved for the elite. Not until quench-hardened steel was fully understood at TL4 (see *Hardened Steel,* p. 110) did iron articles begin to surpass bronze ones in actual effectiveness.

All types of iron armor can be made of bronze. Bronze armor is as good as iron armor, but adds +3 CF. Weight is unchanged.

Full suits of iron plate first appeared in Western Europe in the late 1300s. Over the next century, they evolved into fully articulated protection far surpassing anything previously developed. Plate armor could be surprisingly light and, if custom fitted to an individual and articulated properly, quite comfortable. It allowed a full range of movement, and weighed less than any other low-tech armor offering similar protection. A plate suit (called a "harness") used pieces of varying thickness, with the lightest on the least-susceptible areas (ribs, forearms, shins) and the heaviest on the most-vulnerable ones (head and chest). See *Heavy Plate* (above) for additional details.

Jousting Plate

By the 15th century, jousting plate was well-developed. This cumbersome and highly specialized form of protection is the source of many misconceptions about plate armor. Its awkwardness gives -1 to all DX-based skills except Lance. A knight who's knocked over or unseated needs *two* Change Posture maneuvers for each posture change (treat him as being in the original posture until the end of the second maneuver). Additionally, Move is reduced due to encumbrance – jousting plate isn't light.

Such armor's specialized protection is concentrated at the *front torso, left arm, neck,* and *head.* Other locations are more lightly protected, as they're less likely to be hit while jousting. The cuirass is fitted with a lance-rest: +1 to Lance skill, $50, 0.5 lb.

There are three ways to arrive at this kind of armor:

- *Use purpose-built jousting plate.* That is, a heavy harness designed exclusively for jousting, unsuitable for the battlefield or adventuring. Build such armor by using *Heavy Plate* (above) to add extra DR in strategic locations. A knight who owns a suit like this will also want a separate harness (called "field armor") for fighting in battle.
- *Add a grand-guard.* A *grand-guard* is a piece of armor specially designed to bolt on top of another plate harness. Purchase it as a separate suit of armor, with an extra $100 to cover the connectors. This arrangement allows two layers of *rigid* armor that otherwise follow the rules under *Layered Armor* (p. 103).
- *Buy a garniture.* A *garniture* consists of modular heavy pieces – built using *Heavy Plate* (above) – that can replace individual articles of field armor, converting it into jousting armor. One piece is worn on any given location at a time, but only the heaviest arrangement of the garniture suffers the problems of jousting plate listed above. Because the heavy pieces are made to match another harness, they cost extra; each piece that can be swapped out has +0.2 CF. Still, money is saved by not having to purchase separate harnesses for jousting and battle!

Heavy Plate

Plate can be very thick, but high DR is costly and massive. For every +1 DR, add 50% to *base* cost and weight. All armor made with large plates – including segmented plate (p. 107) and brigandine (p. 108) – can use these rules.

Example: A DR 3 iron cuirass is $1000, 8 lbs. For every +1 DR, add $500, 4 lbs. Thus, a DR 6 cuirass is $2,500, 20 lbs.

See the *Armor Table* (pp. 110-111) for other examples. The thickest plate that can be manufactured before TL5 has DR 14. This is at the upper range of historical examples – specialized jousting plate (above) or the heaviest proofed armor (p. 110). Anything above DR 10 is usually only worn on the head or chest; a complete suit would be too cumbersome and difficult to articulate.

Sliding Rivets (TL4)

Developed in the 15th century and perfected during the 16th, the *sliding rivet* is integral to the production of well-articulated plate armor. The rivet's head is burred over and fixed in the upper plate, while the lower plate is slotted for about 3/4", so that it can slide up and down on the rivet's shank, allowing more mobility than the previously used "arming nail" (fixed rivet). This helps to produce an evenly distributed system of interlocking plates, permitting excellent freedom of movement. Primitive TL3 plate *doesn't* use sliding rivets; this weakness reduces the penalty for targeting chinks in armor (pp. 101-102) by -2, to -6 or -8.

Armor of Quality

Skillfully crafted armor that's custom-fitted to a particular wearer affords improved protection. Metal armor made from better grades of steel – or with added ribs and fluting – is likewise superior. Conversely, poorly made armor has reduced effectiveness. Thus, armor has quality grades besides the *good* quality assumed by the *Armor Table* (pp. 110-111).

Cheap Quality

This might be mass-produced *munitions armor,* issued to an army's rank and file; an early example is the *lorica segmentata* (*Segmented Plate,* pp. 107-108) of the Roman legions. Alternatively, the armor could be the work of an inexperienced armorer, or incorporate low-grade materials. Cheap armor has -1 DR. -0.6 CF; weight is unchanged.

Fine Quality

Fine-quality armor has increased DR and/or reduced weight. Such weight reductions *don't* lower HP. Calculate HP from weight *before* quality adjustments.

Below are some common examples. These can be combined unless noted otherwise; DR modifiers, CF, and weight reductions are additive. For instance, masterfully tailored, fluted armor has +33 CF, -40% weight.

Many other types of fine-quality armor are possible. Two examples are *Silk* (p. 104) and *Leather of Quality* (p. 105). Exotic materials – dragon hide, spider silk (p. 104), and so on – may provide additional benefits, increasing DR or reducing weight even further.

Expert Tailoring (TL1)

Low-Tech assumes that all but cheap-quality armor is custom-fitted to the owner. An experienced armorer can improve the fit even further. This adds -1 to penalties to target chinks in armor (pp. 101-102). +5 CF; reduce weight by 15%.

Masterful Tailoring (TL1). This is *very fine* armor, made by one of the world's best armorers. As above, but +29 CF and reduce weight by 30%.

Armor of Proof (TL4)

There are several ways to improve armor's resistance to powerful bows and firearms. One is to bolt an additional plate called a *plastron* over the breastplate; handle this with *Layered Armor* (p. 103), as explained in *Jousting Plate* (p. 109). Another is use thicker plate; see *Heavy Plate* (p. 109). However, these methods proved impractical as firearms improved – they made armor unbearably heavy. A more advanced technique involved trying to determine the ideal heat treatment for shot-proof plate, but the process was too complex to yield reliable results with medieval technology. The most elegant solution was to rivet or weld together two plates of different hardness; this *duplex plate* provided both the hardness and toughness to resist firearms without complicated heat treatments; see *Hardened Steel* (p. 110).

Fluting (TL1)

All plate armor (pp. 108-109) is specifically shaped to cause blows to glance off harmlessly, but adding flutes, ribs, and bosses in key areas allows a weight reduction with no loss of strength. Scale and lamellar armor (pp. 106-107) can likewise be strengthened with a boss or vertical medial rib raised on each scale. Not available for other armor. +4 CF; reduce weight by 10%.

Hardened Steel (TL4)

Typical metal armor is made from good-quality bloomery iron, which is reasonably tough and ductile – but heavy weapons can cause dents and tears in light plate. Armorers worked out fairly early how to add carbon and heat-treat the result to get hardened steel, but this isn't a mature technology until the late Middle Ages. All *metal* armor, including mail and scale, may be made from hardened steel. It provides +1 DR. +4 CF; weight is unchanged.

Duplex Plate (TL4).This is an advanced form of hardened steel; see *Armor of Proof* (above). It's only an option for plate armor. As above, but +8 CF and reduce weight by 10%.

Armor Table

See *Armor Tables* (p. B282) for an explanation of the notation and abbreviations used here. In brief:

TL: The tech level at which this armor is available.

Torso Armor: The armor's name. All armor here protects the *torso* (areas 9-11, plus *vitals*). Use the *Armor Locations Table* (p. 100) to determine the weight and cost of armor covering other hit locations.

DR: The amount of Damage Resistance the item gives. The DR of some armor, such as mail, varies depending on damage type (see the notes after the table). "*" means that the armor is flexible and susceptible to blunt trauma (p. B379).

Cost: The item's price, in $.

Weight: The item's weight, in pounds.

Don: The time required, in seconds, to put on this armor; see *Donning Armor* (p. 102).

Notes: Many items have special features or restrictions; see the notes after the table.

TL	*Torso Armor*	*DR*	*Cost*	*Weight*	*Don*	*Notes*
0	Cane	1	$35	12	28	[1]
0	Cloth, Padded	1*	$50	6	15	
0	Horn	3	$250	25	30	
0	Layered Cloth, Light	2*	$150	12	20	
0	Layered Cloth, Medium	3	$350	20	30	
0	Layered Cloth, Heavy	4	$600	28	30	
0	Leather, Medium	2*	$100	12	30	[2]
0	Leather, Heavy	3	$200	20	30	[2]
0	Straw	2	$50	20	30	[1]
0	Wood	3	$100	30	30	[3]
1	Layered Leather, Light	2*	$120	15	20	
1	Layered Leather, Medium	3	$220	26	30	
1	Layered Leather, Heavy	4	$525	35	30	
1	Scale, Light	3	$320	16	30	[4]
1	Scale, Medium	4	$550	28	30	[4]
1	Scale, Heavy	5	$1,100	40	30	
2	Hardened Leather, Medium	2	$125	15	30	
2	Hardened Leather, Heavy	3	$250	25	30	
2	Jack of Plates	3	$300	18	30	[4]
2	Mail, Light	3*	$500	12	15	[5]

TL	Torso Armor	DR	Cost	Weight	Don	Notes
2	Mail, Fine	4*	$900	15	15	[5]
2	Mail, Heavy	5*	$1,200	18	15	[5]
2	Segmented Plate, Light	3	$600	16	45	
2	Segmented Plate, Medium	4	$900	24	45	
2	Segmented Plate, Heavy	5	$1,200	32	45	
3	Mail and Plates	5	$1,000	20	20	[4]
3	Mail, Jousting	6	$1,500	30	30	[6]
4	Brigandine, Light	3	$900	10	30	
4	Brigandine, Medium	5	$1,800	20	30	
4	Paper, Proofed	6	$2,000	45	20	[1]
4	Plate, Light	3	$1,000	8	45	
4	Plate, Medium	6	$2,500	20	45	
4	Plate, Heavy	9	$4,000	32	45	

Notes

[1] Combustible. If DR is penetrated by *burning* damage, it can catch fire. See *Making Things Burn* (p. B433); treat the armor material as *resistant*.

[2] -1 DR vs. *impaling*.

[3] Semi-ablative. Loses 1 DR per 10 points of basic damage it resists (see p. B47)

[4] -1 DR vs. *crushing*.

[5] -2 DR vs. *crushing*.

[6] -1 DX, except for Lance skill.

Helmets

The first weapon specifically designed for use on humans was probably the club or mace. Since this was most often swung for the head, the helmet was likely the earliest form of armor. The oldest iconographic evidence of helmets depicts their use in Sumer at the beginning of the second millennium B.C. Early helmets were made from organic materials or copper, but bronze soon became the material of choice. Many TL1 examples consisted of small plates laced to a flexible foundation; treat these as scale armor (pp. 106-107).

Types of Helmets

The degree of protection that a helmet offers is a function of the material from which it's made. For example, a Mycenaean boar's tusk helm would be horn armor (p. 106): DR 3. Cost and weight depend on how much of the head is protected; see the descriptions below.

Pot Helm (TL1)

Sometimes called a *skullcap* or *cervelliere,* this is the simplest of helmets. It protects only the skull (areas 3-4), leaving face and neck completely exposed (areas 5, 17-18 get *no* protection – front or rear). Cost and weight are 20% of equivalent torso armor. Cloth padding gives +1 DR and adds $10, 1.2 lbs.

Example: A DR 3 iron cuirass is $1,000, 8 lbs. A pot helm of DR 3 iron is thus $200, 1.6 lbs. With padding: DR 4, $210, 2.8 lbs.

Bascinet (TL1)

Norman cavalry are commonly depicted wearing this helm. It's more comprehensive than the pot helm, extending down to protect the entire head except for some of the face (all of areas 3-4, plus area 5 from the back but *not* the front). It covers the ears – giving the wearer the Hard of Hearing disadvantage (p. B138) – but not the cheeks. Thus, it has a small chance of protecting the face: a roll of 1 on 1d. Cost and weight are 25% of torso armor. Padding (+1 DR) adds $12.50, 1.5 lbs.

Full Helm (TL1)

This helmet covers the skull and face, like the Greek "Corinthian" helm. Only the eyes are exposed; targeting them through the eye-slits is at -10 (see *Chinks in Armor,* p. 101). The wearer suffers from Hard of Hearing (p. B138) *and* No Peripheral Vision (p. B151). Cost and weight are 30% of torso armor. Padding (+1 DR) adds $15, 1.8 lbs.

> *The God of War will see fair play – he's often slain that wants to slay!*
>
> *– Homer,* ***The Iliad***

Coif (TL2)

Head protection made of mail (p. 107), sometimes attached to a mail shirt like a hood. It covers the same locations as the bascinet (above), plus the neck (areas 17-18). It gives the wearer Hard of Hearing (p. B138) only if layered with padding. Cost and weight are 30% of torso armor. It's often worn over padding (+1 DR, $15, 1.8 lbs.) and under a rigid helmet (see *Layered Armor,* p. 103). A coif may extend down to protect the upper chest and shoulders; add 50% of its DR to area 9, and increase cost and weight to 45% of torso armor.

Greathelm (TL3)

This helm is worn over another, smaller helmet, and is more common in tournaments than on the battlefield. Some versions (e.g., the *great bascinet*) are bolted to torso armor, and are spacious enough to allow the head to move inside. A greathelm offers excellent protection – including neck coverage – but limits head movement and perception. The wearer suffers from Hard of Hearing (p. B138) *and* Tunnel Vision (p. B151). Targeting eyes through the eye-slits is at -10 (see *Chinks in Armor,* p. 101). A greathelm is layered over another helm – an exception to *Layered Armor* (p. 103), which usually requires the inner layer to be flexible. Cost and weight are 35% of torso armor. Only the inner helmet requires padding.

Helmet Options

There's more than one way to make a helmet.

Spangenhelms vs. Single-Piece Helmets

It takes great skill to fashion a helmet from a single piece of material. It's far simpler to attach small bits of horn, leather, or metal to a framework, yielding what's termed a *spangenhelm.* Spangenhelms are heavier than single-piece helmets, but easier and cheaper to make. Most historical helmets were of this type. A single-piece helmet has +9 CF and reduces weight by 25%.

Flat-Topped Helmets

Most helmets were fashioned with a domed or conical top that caused blows glance off. Some had a flat top, however. Flat helmets are easier and quicker to make, but because they're less deflective, they require more material to provide comparable protection. -0.2 CF; increase weight by 20%.

Face Protection

Helmets that don't cover the face – that is, everything but the full helm or greathelm – can be modified to add face protection. Each addition provides the helmet's DR over a certain hit location and has a chance of protecting against an attack to the front of area 5. Add up the listed odds and roll 1d. If the result is equal to or less than the total, then the helmet's DR protects the face.

Example: A helm with a nasal (1/6) and full cheek guards (3/6) has a 4/6 chance of protecting the face. On a roll of 1-4, the helmet's DR protects the face.

Nasal

The most common helmet addition, this consists of a vertical strip covering the nose. Some are hinged or detachable. Has a 1/6 chance of protecting the face; cost and weight are 5% of the base helmet.

Example: A DR 3 iron cuirass is $1,000, 8 lbs., so a DR 4 one is $1,500, 12 lbs., and thus a DR 4 bascinet (25%) is $375, 3 lbs. A nasal for it would be 5% of *that,* or $18.75, 0.15 lb. Padding (+1 DR) adds $12.50, 1.5 lbs. All together, this comes to $406.25, 4.65 lbs.; has DR 5; and with the basic 1/6 odds for a bascinet, has a 2/6 chance of protecting the face.

Brim

This addition goes around a helmet to ward off rain and sun, but also affords limited protection against attacks. Examples include the European *kettlehat* and Japanese *jingasa.* A brim has a 1/6 chance of protecting the face, rising to 5/6 when the threat originates from above (e.g., a volley of arrows or an attack faced when assaulting a fortification from below). Cost and weight are 15% of the base helmet.

Cheek Guards

These pieces protect the cheeks and jaw. They're often hinged at the top and laced together under the chin, giving a 2/6 chance of protecting the face. Cost and weight are 10% of the base helmet.

Some cheek guards cover the ears, giving a 3/6 chance of protection and the Hard of Hearing disadvantage (p. B138). (The bascinet *already* offers ear protection.) Cost and weight are 15% of the base helmet. Adding perforations reduces the Hearing penalty to -2, but removes -2 from the penalty under *Chinks in Armor* (p. 101) and adds +0.2 CF.

Roman legionary helmets (called *galea* or *cassis*) had cheek guards.

Spectacles

Metal rims that shield the eyes and have a 1/6 chance of protecting the face. They give the wearer No Peripheral Vision (p. B151), and the eyes may still be targeted at -10 (see *Chinks in Armor,* p. 101). Cost and weight are 5% of the base helmet. Viking helmets are commonly depicted with spectacles.

Visor

This represents any full-face plate or mask (like the Japanese *mempo*) with eye-slits and breathing perforations. It's often hinged and/or detachable. It *replaces* nasal, cheek guards, and spectacles, providing a 5/6 chance of protecting the face. The eyes may be targeted at -10 (see *Chinks in Armor,* p. 101), and the neck is still vulnerable. The wearer has Hard of Hearing (p. B138) *and* No Peripheral Vision (p. B151). Adding perforations reduces the Hearing penalty to -2, but removes -2 from the penalty to target chinks in head armor. Cost and weight are 25% of the base helmet.

Neck Protection

The neck (areas 17-18) – especially the throat – is one of the most difficult body parts to armor. It's often one of the few places where a heavily armored man is vulnerable! For more on this hit location, see p. B399.

Turret (TL1)

The earliest neck protection was a large, turret-like tube that sat on the shoulders. It covered the neck and lower face (2/6 chance of protecting the face), but severely limited vision (the wearer couldn't look down!). The only practical use seems to have been to protect chariot drivers from arrows; other soldiers, such as archers and spearmen, didn't wear it. One was found with the Mycenaean Dendra panoply. Middle Eastern charioteers were also depicted wearing them. Cost and weight are 10% of torso armor.

Plumes and Crests (TL1)

Helmets often sport plumes or crests made of feathers, bristles, or horsehair. These serve as quick identification on the battlefield (indicating Status or Military Rank) and increase the wearer's apparent height. Horns are another form of helmet ornamentation, surprisingly common during the Bronze Age. In some cultures, these additions give +1 SM for the purpose of Intimidation (p. B202) only. They also remove -1 from penalties to grapple the head, and give +1 to Vision rolls made to spot the wearer in the midst of a group of people (such as in a battle). $20, 1 lb.

Aventail (TL2)

This curtain of mail or light scale hangs from the bottom of a helmet, covering the neck (front *and* back). Cost and weight are 5% of torso armor.

A *lobsterback* (TL2) is an aventail made from segmented plate that only protects the *back* of the neck. Cost and weight are 3% of torso armor.

Mail Collar (TL2)

A collar made from a dense weave of mail that sits rigid around the neck. Some versions use a *lighter* weave, stiffened with leather thongs (see *Banded Mail,* p. 107). Either may stand alone or be integrated into a mail shirt. Saladin is said to have worn such a collar to protect against assassination. Because it's rigid, it isn't susceptible to blunt trauma and doesn't suffer reduced DR vs. crushing damage. Cost and weight are 5% of torso armor.

A *standard* (TL3) is a mail collar extended to protect the upper chest and shoulders; add 50% of its DR to area 9. The neck guard is rigid but the drape is flexible. Cost and weight increase to 20% of torso armor.

Ventail (TL2)

This flap of mail is attached to a mail shirt. It's unfolded up over the face and tied in place behind the head. The Norman "bibs" depicted on the Bayeux Tapestry are mail ventails edged with leather. The ventail protects the neck from the *front* only, as well as the chin (2/6 chance of protecting the face). Cost and weight are 3% of torso armor.

Bevor (TL3)

A rigid plate collar that extends up to protect the chin and mouth. Some chin guards were hinged or detachable. The collar shields the entire neck, while the chin guard has a 1/6 chance of protecting the face. Cost and weight are 7% of torso armor.

Gorget (TL3)

Worn under the cuirass, this rigid collar protects the neck and throat. At TL4, gorgets are segmented and articulated to allow better movement. Cost and weight are 5% of torso armor.

SHIELDS

The shield was the most common piece of defensive equipment from the beginning of organized warfare until the widespread use of firearms. ***GURPS*** categorizes shields by Defense Bonus (DB). This depends on their size: *small* (DB 1), *medium* (DB 2), or *large* (DB 3). Only exotic abilities allow DB 4+. For more on shield DB, see pp. B287, B374.

SHIELD GRIPS

Shields are also organized according to how they're wielded. Each grip has its own Shield skill specialty; see *Shield* (p. B220). These specialties default to each other at -2:

Buckler: Any shield wielded with a central handgrip. You can ready it in one second and drop it as a free action. The ***Basic Set*** states that a buckler can't be used for a shield rush (p. B406). This isn't quite true; the Roman *scutum* was specifically designed for this tactic. However, it *is* difficult to put your full weight behind a buckler – damage is at -1, relative to a shield, in a rush.

Guige: Any shield controlled by a neck strap and not the hands – it's wielded hands-free. You can ready the shield in a number of seconds equal to its DB, and drop it in one second. You may not use it for a shield bash or a shield rush.

Shield Bosses

Many shields with central handgrips (*bucklers*) need hollows in them to make room for the wielder's fist. This hollow is protected by a metallic dome or "boss" that's fixed to the outside of the shield. The boss provides an additional weapon with which to strike the enemy (p. B406). Some bosses are conical, coming to a point in order to deal more damage; rules for these appear in ***GURPS Low-Tech Companion 2.*** All shields in ***Low-Tech*** are assumed to have bosses, regardless of whether they're bucklers.

Blocks using just the neck strap for control are at -3. See ***GURPS Low-Tech Companion 2*** for advanced rules.

Shield: Any shield held in place with arm straps. You can ready or drop it in a number of seconds equal to its DB. It can be used for a shield bash or a shield rush (p. B406). It's less maneuverable than a buckler, and so has -1 in a Feint.

Types of Shields

Shields come in a great variety of sizes, shapes, and materials, but can be generalized into a few groups based on size and weight. A larger shield covers more of the wielder's body, providing a higher DB. A heavier one can take more damage; rules for this appear in ***GURPS Low-Tech Companion 2.***

The shields described below are examples of specific designs, drawn from a range of cultures and locations. Historically, most societies used shields of *many* shapes and sizes. In principle, then, any of these types could be produced anywhere – at TL1 if it has metal components, at TL0 otherwise. In practice, while simple round and oval shields should be available in most settings, other shapes and features might only appear in particular times and places.

Unless specifically noted otherwise, all of these shields are assumed to be heavier models – composites of wood, hide, and metal, with DR 4 – which are strapped to the arm.

Improvised Shields

Some items, such as large turtle shells, are ideal ready-made shields – just attach a handle and you're done. This takes 20 minutes and an Armoury (Melee Weapons) roll at +5. Any large, flat object can be converted into an improvised shield by adding a handgrip this way.

If there's no time to affix a handle, then the item must be grasped by the rim. This requires *two* hands – so one would need at least three hands to wield a weapon simultaneously – and leaves the fingers exposed. Whenever its DB is used as part of a successful defense roll, roll 1d; on a 1, a hand is hit instead of the shield. Still, this might keep the user alive for long enough to be rescued!

Examples: A frying pan, heavy book, or metal ale mug gives DB 1; a cauldron lid or chair, DB 2; and a table, DB 3.

Comanche Shield (TL0)

DB 2

A medium shield constructed of two layers of hide laced around a wooden hoop and stuffed with feathers, hair, or grass – or paper from the books of pioneers! Treat as Fragile (Combustible) (p. B136). It's carried over the shoulder on a neck strap (*guige*) when riding.

Large Shield (TL0)

DB 3

Lighter models (TL0) are made of a single layer of hide stretched over a frame of light wood or wicker, or of several layers of hide stitched together. Heavier wooden versions (TL1) covered with leather and/or metal are common in formation fighting. Such shields were first employed by the Sumerians, but saw widespread use by many cultures. They cover the warrior from chin to shins, and can be of any shape – including oval, rectangular, scalloped, hexagonal, and figure-eight. They're curved so that they wrap a little around the body, and usually incorporate a guige to take some of the weight off the arm.

Medium Shield (TL0)

DB 2

Both light (TL0) and heavy (TL1) variants are constructed in a manner similar to the large shield (above), but are smaller, covering from chin to thighs. Such shields were used in some form or other by most cultures until the end of the Middle Ages. Medium shields could be many different shapes, but circular ones were by far the most common. A distinctive crescent-shaped shield (the *pelta*) was carried by Greek peltasts, Scythians, and other cultures in eastern Central Europe.

Mycenaean Shield (TL0)

DB 3

A light large shield made of wicker and faced with hide. It comes in two main types: one is rectangular, with a rounded top edge, while the other is figure-eight shaped. Both are carried and wielded solely by means of a guige around the neck, enabling a long spear to be used two-handed. They're large enough to stop most attacks, but difficult to control.

Parrying Buckler (TL0)

DB 1

A long, very narrow buckler used in East Africa, India, and Australia. In India, it was sometimes made by joining two antelope horns. The central grip is its widest part; the shield tapers to rounded points at either end. These do crushing damage for the basic model, but metal points (TL1) can be added to permit an *impaling* shield bash: +1 CF. The parrying buckler provides only DB 1, but adds another +1 to Block rolls (only).

Small Shield (TL0)

DB 1

Both light (TL0) and heavy (TL1) variants are constructed like the large and medium shields, but are even smaller – rarely longer than the forearm. They give only DB 1, but are highly maneuverable; the wielder has only -1 DX in close combat (p. B392). Middle Eastern archers sometimes carried such a shield and practiced firing "under" it by holding the shield and bow in a more horizontal position, while other fighters wielded a knife in the same hand as their shield; either gives -2 to weapon and Shield skills, and one-handed weapons suffer off-hand penalties.

For more on this trick, and for rules tying DB to weapon skill penalties when using a shield, see ***GURPS Low-Tech Companion 2.***

Homeric Buckler (TL1)

DB 2 or 3

Homer describes these shields in some detail in the *Iliad.* They're circular in shape and made of several layers of ox hide, with a bronze facing and a boss that's sometimes fashioned into the head of a fantastic creature. Often, the bronze is elaborately decorated with embossing and enamel (styling, +4 CF). The rim is reinforced with either bronze or hide, and fastened with rivets. It has a central grip (requiring the Buckler specialty), but a guige takes some of the weight off the arm. Size ranges from medium (DB 2) to large (DB 3). Large ones are broad enough to provide shelter to a companion – usually an archer.

Argive Shield (TL2)

DB 2

Also called the *aspis* (Greek for "shield"), this is a specific pattern of medium shield optimized for hoplite phalanx warfare. It's circular in shape and deeply dished so that the rim can rest on the shoulder, eliminating the need for a guige. It's made of wood, lined with leather, and sometimes faced with bronze. It lacks a boss; the hand slips through the central arm band and holds a grip near the rim. Only two-thirds of the shield protects the bearer. The other third projects out past his elbow, partially covering the man standing on his left. While only medium-sized, overlapping Argive shields are ideal for tight formations, and provide DB 3 when used in a shield wall. In one-on-one combat, though, they offer the medium shield's usual DB 2.

Roman Scutum (TL2)

DB 2 or 3

This buckler variant of the heavy large shield is made of laminated birch wood, faced with felt and edged in metal. The hand holds a horizontal handgrip in an overhand position, and is protected by a domed boss. The Republican scutum is oval in shape; at approximately 22 lbs., it's one of the heaviest shields ever actively wielded in combat. It is ideal for shield charges and can withstand a great deal of abuse. Laminated construction adds 20% to HP, but makes cost about *twice* that of other large shields (as a general option, this adds +1 CF).

The scutum of the Imperial period is shorter (DB 2) and has squared-off edges. It, too, is made from laminated birch – but now it's covered in leather and faced with linen. The edge is reinforced with rawhide rather than metal. These changes make it lighter (about 16 lbs) and more maneuverable. The medium scutum is laminated, as above, doubling its price and giving 20% more HP.

Sample Armor Loadout: Roman Imperial Legionary

Near the end of the first century B.C., the Roman army introduced a new type of armor: a cuirass of segmented iron plates, known today as *lorica segmentata.* This was an early example of munitions armor, issued to men who couldn't afford mail or a bronze cuirass (legionaries' equipment costs were deducted from their pay!). It consisted of cheap-quality segmented plate covering the chest (areas 9-10) and shoulders.

Under this went a lightly padded *subarmalis,* with heavily padded shoulders and a kilt of overlapping quilted linen strips (*pteryges*) covering the abdomen (area 11). Under *this* was a regular linen tunic. On the legionary's head was an iron helmet (*galea* or *cassis*) with cheek guards and a crest. On his legs and feet, he wore shin guards (*ocreae*) and hobnailed sandals (*caligae*). He carried a rectangular medium shield (*scutum*).

From the *Armor Table* (p. 111), medium segmented plate is DR 4, $900, 24 lbs. Segmentata only covers the chest, so cost and weight are 75%: $675, 18 lbs. Cheap quality is -1 DR, -0.6 CF, for DR 3, $270, 18 lbs.

Shoulder protection is 10% of torso armor: $90, 2.4 lbs. Cheap quality yields DR 3, $36, 2.4 lbs.

Cost and weight of armor padding are included in the *Armor Table* (see *Layered Armor,* p. 103), but the kilt isn't. Treat it as light layered cloth: DR 2*, $150, 12 lbs. The kilt only covers the abdomen, for 25% of cost and weight: $37.50, 3 lbs.

A tunic is ordinary clothing: 20% of cost of living ($300 for a poor citizen), or $60, and 2 lbs.

Treat the Roman helmet as a pot helm with cheek guards. As explained in *Heavy Plate* (p. 109), a DR 4 plate cuirass is $1,500, 12 lbs. A pot helm is 20% of that: $300, 2.4 lbs. Cheek guards (sans ear protection) are 10% of *that* – or $30, 0.24 lb. – for a total $330, 2.64 lbs. Cheap quality gives DR 3, $132, 2.64 lbs. We also need helmet padding (+1 DR, $10, 1.2 lbs.) and a crest ($20, 1 lb.). This headgear comes to DR 4, $162, 4.84 lbs.

Legs are protected by greaves. Starting with the DR 4 plate armor above, we note that shin armor has 50% of cost and weight, or $750, 6 lbs. As greaves cover only the front, we halve again: $375, 3 lbs. Cheap quality gives a final DR 3, $150, 3 lbs.

Feet are protected by hobnailed sandals (p. 98): DR 1 (bottom only), $50, 1.5 lbs.

Finally, a medium scutum (see *Shield Table,* p. 116) is DB 2, $140, 16 lbs.

The total cost deducted from our legionary's pay is $905.50 (although this may have been subsidized). He'll be carrying a load of 50.74 lbs. On top of this, he must carry his weapons and marching equipment.

Dueling Buckler (TL3)

DB 0

The smallest of bucklers, this shield consist of little more than a boss with a handgrip. German duelists specifically trained with it, calling it a *hut* ("hat"). It gives *no* DB, but gives +1 to Block rolls (only), and provides DR 4 to the shield hand. Any buckler that's destroyed in combat may still be wielded as a dueling buckler.

Heater Shield (TL3)

DB 2

By the end of the 13th century, the European kite shield (below) was replaced by its smaller cousin, the heater. This still tapers to a point at the bottom, but doesn't provide any benefit that other shapes wouldn't – although it might be a little more manageable on horseback. Treat as a medium shield.

Kite Shield (TL3)

DB 3

During the 11th century, this long, teardrop-shaped shield took over from the round shield as Europe's most popular shield. It remained dominant well into the 13th century, used by both cavalry and infantry. The kite shield reaches down to protect the leading leg while in formation, and can cover the left leg when on horseback. It is constructed like a heavy large shield, but weighs less owing to its taper.

Dueling Long Shield (TL4)

DB 3

Depicted in Renaissance fencing manuals such as Talhoffer's *Fechtbuch* and the *Codex Wallerstein,* dueling long shields are designed for trial by combat. They're weapons in themselves: long, narrow shields mounted on vertical poles with spikes at either end, sometimes with special cutouts that enable the attacks described under *Hook* (p. 54). The relevant skill is Shield at -2 or Staff at -4. Readers with ***GURPS Martial Arts*** should note that an Exotic Weapon Training perk *can* negate this skill penalty.

Moveable Cover (TL1)

Some defenses are classed as *cover* (pp. B407-408) rather than as shields, and provide no DB. Examples are the *pavise* and *mantlet*. These barriers were most often deployed when besieging fortifications. They were handy shelters against missiles, but of little use in melee.

Shield Table

See *Shield Statistics* (p. B287) for an explanation of the notation and abbreviations used.

TL	*Shield*	*DB*	*Cost*	*Weight*	*DR/HP*	*Cover DR*	*Notes*
0	Parrying Buckler	1	$50	8	4/16	8	[1]
0	Small Shield, Light	1	$30	3	2/12	5	
0	Comanche Shield	2	$100	16	4/21	9	[2]
0	Medium Shield, Light	2	$45	7	2/16	6	
0	Large Shield, Light	3	$68	10	2/18	6	
0	Mycenaean Shield	3	$58	9	2/17	6	[3]
1	Small Shield, Heavy	1	$40	6	4/15	7	
1	Homeric Buckler, Medium	2	$100	16	4/21	9	
1	Medium Shield, Heavy	2	$60	14	4/20	9	
1	Homeric Buckler, Large	3	$150	20	4/22	9	
1	Large Shield, Heavy	3	$90	20	4/22	9	
2	Argive Shield	2	$120	15	4/20	9	[4]
2	Roman Scutum, Medium	2	$140	16	4/25	10	[5]
2	Roman Scutum, Large	3	$200	22	4/27	10	[5]
3	Dueling Buckler	0	$25	2	4/11	6	[1]
3	Heater Shield	2	$75	13	4/19	8	
3	Kite Shield	3	$120	18	4/21	9	
4	Dueling Long Shield	3	$200	16	4/21	9	[6]

Notes

[1] +1 to Block.

[2] Fragile (Combustible); see p. B136.

[3] Controlled solely by neck strap; see *Shield Grips* (p. 113-114).

[4] +1 DB when used in shield wall.

[5] Laminated wood (+20% HP).

Pavises could be carried by one man, and were designed to protect one or two people; e.g., an archer or a crossbowman, plus the pavise's bearer (the *paviser*). A pavise has DR 4, HP 24, and provides cover DR 10. $120, 27 lbs.

Some pavises had folding legs so that they could stand up unassisted (add $40, 1 lb.). Others had rows of large nails projecting from the face (add $50, 2 lb.). When troops had to flee, they would abandon their pavises face-up on the ground. Enough spiked pavises in the way were a handy means of deterring pursuit; treat as caltrops (p. 123). In winter campaigns, Russian troops mounted pavises on skids to make them easier to move (add $30, 2 lbs.).

Mantlets were larger and could protect more men – or even provide cover to artillery – but needed several soldiers to carry and deploy. Weight scales with the number of men protected, raising HP (see p. B558); cost is proportional to weight.

But when a stronger than he shall come upon him, and overcome him, he taketh from him all his armour wherein he trusted, and divideth his spoils.

– ***Luke*** *11:22*

Animal Armor

Animals involved in combat or hunting can be armored, too – although they must be specially trained to tolerate the armor! Protection for beasts is sometimes called *barding*. Below are four common types. All weights and costs are given as percentages of the base figures listed for equivalent human torso armor on the *Armor Table* (pp. 110-111).

Example: A light mail shirt is $500, 12 lbs. Light mail elephant armor (below) would cost and weigh 200% as much for the chanfron ($1,000, 24 lbs.), and 1,200% as much for the caparison ($6,000, 144 lbs.).

Horse Armor

Men have armored horses since the Bronze Age, when all the great civilizations from the Aegean to China fought with chariots and archers. The earliest armor was made from cloth, leather, or metal scale. Mail appeared during the Iron Age; solid plates, toward the end of the Middle Ages.

Horse protection consists of one or more of the following (for important details, see the hit location table for quadrupeds on p. B553):

Caparison: A flexible armored blanket (cloth, scale, or mail) covering neck, torso, groin, and legs, and reaching down to the knees or even lower (protects the legs on 1-4 on 1d). Also called a *trapper,* it sometimes has a hole for the saddle. Cost and weight are 500% of human torso armor.

Chanfron: Head armor, protecting the skull and face. It can be made of flexible or rigid armor. Cost and weight are 50%.

Crinet: Protects the neck. It can be made of flexible or rigid armor. Cost and weight are 50%.

Crupper: Plate armor protecting the hindquarters and upper legs. It protects the torso on 4-6 on 1d, and the hind legs on 1-3 on 1d. Cost and weight are 150%.

Flanchards: Plate armor attached to the saddle, covering the flanks. It closes the gap between crupper and peytral. Flanchards protect the torso on 1-3 on 1d. Cost and weight are 50%.

Peytral: A rigid plate that protects the torso from the front only (sides and back are unprotected). Cost and weight are 100%.

Armorers experimented with leg armor, but it proved impractical on the battlefield.

Camel Armor

Camels were sometimes armored and ridden into battle. They were covered with a chanfron (25% cost and weight) and a peytral or caparison (as *Horse Armor,* above).

Elephant Armor

Elephants were considered the ultimate shock unit. Their main role was to charge the enemy ranks, striking fear and causing men to rout, or to crash through lines of spearmen. They were also effective at countering enemy cavalry charges. India was the main region in which they were deployed, but they saw battle throughout Asia, in Africa, and even in Europe. Elephant armor consists of a chanfron on the head (200% cost and weight), and a caparison covering the body and reaching to the knees (1,200% cost and weight). These can be made of cloth, leather, scale, mail, or mail and plates.

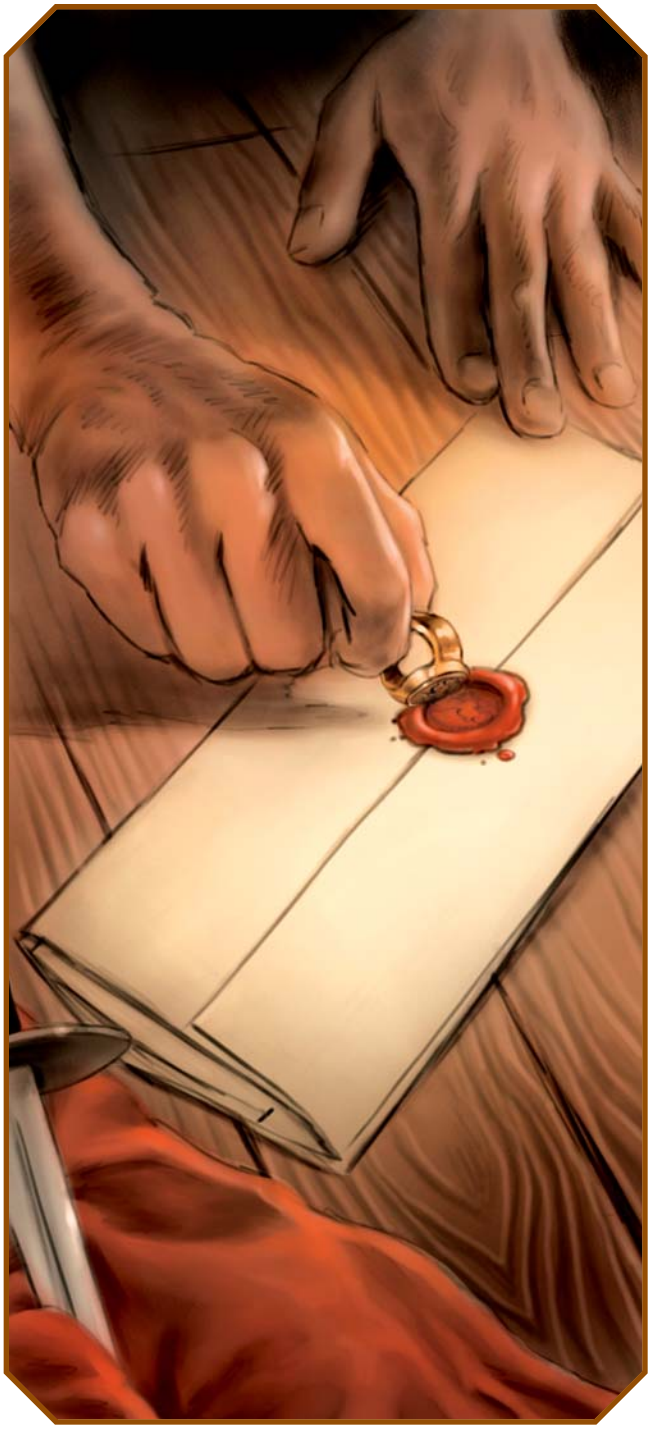
Dog Armor

Dogs were used more often for hunting than for warfare, so their armor was designed to protect them from other animals – e.g., boars – rather than from humans. The most common dog armor was a heavy collar protecting the neck (5% cost and weight). Other parts of the body were covered with armor very similar to the components of horse armor (above). Find the cost and weight of equivalent horse armor, and then divide by 10 for a large dog; reduce cost and weight further for smaller breeds.

Chapter Seven
Security and Covert Ops

The secretary showed Publicius Pertinax the fair copy of his report to Caesar, and he scanned it. The account of that young sea captain, Sergius Martialis, commending his sense of duty, made a good cover story; Pertinax seriously considered the captain a likely choice for promotion. But the real content was hidden in the epithets and literary allusions, a code that he and Caesar's secretary had worked out for sensitive information – and the evidence that Flaminius Felix was in league with the pirates was certainly sensitive. He had to assume that Flaminius would learn the contents of the letter, whether by having it opened and resealed, or by suborning Pertinax's secretary. There were advantages to cultivating a reputation for literary and scholarly interests; they neatly explained the use of ornate rhetoric.

Pertinax folded the letter over and got out his personal seal. "For the next ship for Ostia," he said.



If one side of the coin called "warfare" is *open battle,* then the other is *covert operations.* The two go hand in hand. Unlike battle, where one attempts to use force to harm an opponent, covert ops seek to do harm through stealth. Many of history's best generals, including Sun Tzu, believed that covert ops and intelligence-gathering were more important than military equipment and troop strength. Extensive resources have been devoted to intelligence and counterintelligence since the dawn of organized warfare.

Security and Surveillance

Many technologies exist to prevent unauthorized access to property or information. *Security* usually involves passive measures, while *surveillance* is more active. Devices for either are LC4 except as indicated. Notably, those that inflict harm on an intruder – like many traps – are LC2.

Barriers

A barrier is a natural or manmade obstruction that denies access. People who wish to pass must climb over, tunnel under, or break through it. Alternatively, one can construct some sort of permanent opening to assist passage, which might have a cover to prevent unauthorized use.

Chest/Strongbox (TL0)

A wooden, metal, or stone container used to secure treasure, protect weapons and armor, or store clothing or linens – or sometimes for burial of important people. Consult *Containers and Storage* (p. 34) for the box. To control access, use any of the locks under *Bars, Bolts, Latches, and Locks* (pp. 120-121).

Door (TL0)

A door is a moveable barrier that covers an opening. The earliest evidence for manmade doors appears in paintings in Egyptian tombs. Doors are used to restrict access to certain areas and/or to control temperature by keeping the *weather* from intruding. They can be secured with bars, bolts, or latches (p. 120). See p. B558 for the DR and HP of various materials from which door scan be made.

Some general examples:

Construction	*Wood*		*Ironbound Wood*		*Iron*	
	DR	*HP*	*DR*	*HP*	*DR*	*HP*
Light	1*	23	5	27	12	36
Average	2*	29	10	34	25	46
Heavy	3*	33	15	39	50	58
Extra-Heavy	6*	42	30	49	75	66
Vault	12*	54	60	62	150	84

* Wood has *ablative* DR (see p. B47); ironbound wood and iron do not.

Concealed Doors

Concealed doors and secret passages date to the early Bronze Age (TL1). Most are part of a building, constructed when the structure is erected. However, a secret passage may be a later alteration, like the classic prison escape tunnel.

A craftsman must roll against the *lower* of Architecture or Smuggling to design a concealed door. He needs either Carpentry (for wooden doors) or Masonry (for stone ones) at 12+ to build it. To hide a regular door – by moving a bookcase in front, placing a rug over a trap door, etc. – requires the Camouflage skill.

Finding concealed doors takes an active search. The GM rolls a secret Quick Contest for each searcher: the *highest* of Vision, Observation, or *Per*-based Traps vs. the Architecture, Camouflage, or Smuggling skill used to hide the door. Victory reveals the door (if there is one!). *Opening* it may require Search rolls for hidden latches and/or IQ-based Traps rolls for mechanisms.

Spikes/Thorns (TL0)

An early defense involved planting thorny shrubs around a secure area. Like modern barbed wire, such plants are a physical deterrent; they look menacing and slow would-be intruders. Anybody passing through the obstructed area must make a DX-5 roll once per yard. Failure means the barbs tear the victim's skin; he must make a Will roll (at +3 for High Pain Threshold or -4 for Low Pain Threshold) to avoid crying out. (It would take *monstrous* thorns to inflict even 1d-5 cutting damage!) The thorns also snag clothing and equipment; treat this as a Binding (p. B40) with ST 7. Clothing or armor with DR 1+ will prevent tearing but not entangling. The easiest way to cross thorns is to lay something over them – a log, a thick cloak, a body, etc. – and climb across.

Window (TL0)

A window is a hole in a wall to admit light and air. To prevent unauthorized access, it might be covered by a grate (below) or a windowpane – or simply made too small to climb through! Prior to the invention of transparent glass, translucent materials such as horn and paper were used for windowpanes; see *Materials* (pp. 19, 22, 24-25) for the TL and properties of such layers. Wooden or metal shutters could provide additional protection, keeping intruders and the elements out, and warmth in; see p. B558 for typical DR and HP.

Grate (TL1)

A grate is a metal grille that covers an opening. It lets in light and air, but prevents access. It counts as half cover (p. B407): Attacks through the grate in either direction are at -2 to hit specific locations – or strike it *instead* of the target on a roll of 4-6 on 1d, if attacking a random location.

A grate may be fixed in place, hinged like a door, or raised and lowered from above as a portcullis. The following table lists DR for some typical grates, along with HP and weight *for a 10-square-foot section.* Destroying a section allows normal humans to squeeze through one at a time; see *Breaking and Entering* (p. 122) for other important details.

Construction	*DR*	*HP*	*Weight*
Light	6	15	7
Average	9	19	15
Heavy	12	23	25
Extra-Heavy	18	31	60
Vault	24	37	100

The typical castle portcullis is about 15'×20'; that's 300 square feet, or 30 sections. An average example would thus weigh 30 × 15 = 450 lbs. A representative mechanism for such a portcullis can raise it a foot every three seconds or drop it one foot per second, and requires eight men to operate. Cutting the portcullis' rope or chain would let it fall completely closed in a second. Heroically lifting it would use the standard lifting rules (p. B353), in the unlikely event that the barrier lacks a latch or a bar to prevent this.

A *cross-hatched* grate – with additional horizontal bars – has double weight and 25% more HP.

Placing a grate horizontally over a depression in the ground hampers some creatures (notably hoofed animals) from walking over it. Crossing requires a DX roll at the speed penalty for current Move (p. B550); e.g., Move 5 gives -2. Failure means 1d-4 HP of injury to the limb that falls through the grate, doubled if the victim is carrying more than Light encumbrance. Most hoofed beasts will simply refuse to cross such a barrier, but an appropriate skill roll at -4 will overcome this reluctance.

Razor Surfaces (TL1)

Sharp fragments of stone, glass, pottery, or metal can be affixed atop a wall or to a windowsill to deter intruders. This takes 10 minutes per 10 square feet covered, and requires an adhesive such as glue, bitumen, or mortar, which needs at least 24 hours to harden fully. Treat the results exactly like spikes/thorns (p. 119), except that failing the DX-5 roll also inflicts 1d-3 cutting damage, and the ensuing Will roll suffers a penalty equal to the injury.

Bars, Bolts, Latches, and Locks

A *bar* (TL0) is a wooden beam dropped into sockets on the inside of a door. The only way to gain entry from outside is to break through the door or sever the beam. A *wedge* jammed between door and floor can also secure the door (or keep it open) – at least temporarily.

A *bolt* (TL1) is similar to a bar, but smaller and made of metal. Instead of dropping into sockets, it slides sideways into metal staples. It is "unlocked" from the inside by lifting it or drawing it back.

A *latch* (TL2) is a more advanced mechanism that performs the same operation as a bolt. Often, it pivots up at one end and drops into its receptacle to secure the door.

Any such device has DR and HP that must be overcome to open the door (see *Breaking and Entering,* p. 122), as given by the following table:

Construction	*Bolt/Latch*		*Bar/Wedge*	
	DR	*HP*	*DR*	*HP*
Light	3	6	1	14
Average	6	12	2	18
Heavy	9	18	4	23
Extra-Heavy	12	23	8	30
Vault	24	46	16	37

He stood without and would not knock,
Because he meant to pick the lock.
– William Camden, 1605

Knots (TL0)

One of the earliest security measures for doors and containers involved lashing the thing shut with rope and then tying a complicated knot known only to the owner. An example is the famous "Gordian knot" faced by Alexander the Great. The only real advantage of this system is that the owner will know if his property has been tampered with. Someone truly intent on entering will simply cut the rope (as Alexander did).

To enter without using a blade requires the Knot-Tying skill, not Lockpicking. Roll a Quick Contest between the tier and the challenger. Victory means the knot is untied and the door opened. To retie the rope using exactly the same knot requires a skill roll, at -5 if one isn't familiar with the knot; apply +2 for Eidetic Memory or +5 for Photographic Memory (see p. B51). Time to tie is 20 seconds, less 2 seconds per point of success.

For added security, a clay seal can be used. This is a lump of clay wrapped around the knot, with a seal pressed into it to prevent tampering. See *Seals* (p. 124).

Locks (TL1)

The measures discussed so far are only secure when they're on the *inside* of the door. If they're inside, though, there's no way to secure the door from *outside.* Accomplishing that calls for some means of fastening and unfastening a bar, bolt, or latch from without – a *lock.*

Locks don't just make a door or a container harder to open – they alert the owner that someone has tampered with it. Two main technologies have been used to obtain security from mechanical locks and keys. One involves fixed obstructions, called *wards,* which prevent the wrong key from entering or turning in the lock. The other employs moveable pins, known as *tumblers,* which the key must move to a prearranged position before it can be turned. The best locks use a combination of wards and tumblers.

Most low-tech locks are fairly easy to pick, giving a bonus to Lockpicking (p. B206) when that skill is needed at all. Anachronistic settings can have more complex locks. Realistically, though, a door or a chest is more likely to sport multiple locks – requiring different keys to open – than a single, highly complex one.

Locks aren't just about security; they also signify wealth. Some are elaborately decorated. Keys, too, are sometimes cut with intricate designs. Such embellishments are usually decorative, but may serve to deceive buyers into thinking that the lock is more complex than it actually is! Locks are frequently custom-made and priced so that only the wealthy can afford them. Cheap quality can make a lock easier to pick, while good or fine locks are more challenging.

Cord and Bolt (TL1)

This is a bar or a bolt with attached cords. To open the door from outside, two cords are tied to the bolt and passed through holes in the door. Pulling one cord locks the door; pulling the other unlocks it. Someone inside who wants to prevent the door from being unlocked can simply draw in the cords! An intruder needs some sort of tool that he can poke through the hole to hook the cord and tug the end out.

An improvement on this design adds a key to the second cord. The door has a hole, level with the bolt, through which a cord is threaded. Pulling this cord locks the door from the outside. To unlock the door, the bolt-cord is threaded through the key and the key is pushed through the hole. Then both cords are used together to unlock the door and the key is retrieved from the inside.

To pick this type of lock, the burglar needs an object that can fit through the hole. If a suitable piece of wood is available, roll vs. Carpentry to fashion a duplicate key. Success means the wood has been whittled to the right shape. Even a poor woodcarver should be able to make a serviceable key in 10-15 minutes, if he has access to the lock.

Adding a false cord or two is a good means of trapping such a lock. Tugging the wrong cord activates the trap (see *Traps,* pp. 122-123).

Bolt and Tumbler (TL1)

This lock originated in the Middle East but quickly spread. It's similar to a cord and bolt (above), except that it has a hole through the bolt and a vertical pin – the tumbler. When the bolt is drawn into the locked position, the tumbler drops down into the hole, securing the lock. The bolt cannot be moved again until the tumbler is released.

Simply poking the tumbler with a finger – pushing it up out of the hole – releases the bolt, which can then be slid open with the finger still in the hole. This doesn't require the Lockpicking skill. If the bolt is on the outside of the door, then, the tumbler should be concealed; the main challenge to opening the lock is finding the concealed tumbler (a Quick Contest of Vision or Search vs. Camouflage). If the bolt is on the inside, then the door needs a hole or a slot to admit a hand so that users can find the hole in the bolt. A simple trap for such a lock is a false tumbler; pressing the wrong tumbler activates the trap (see *Traps,* pp. 122-123).

A more advanced version of this lock makes the hole and tumbler too small to be released with a finger. Such a lock requires a piece of metal to slip through the door and up into the bolt. If the hole is irregularly shaped, then this "key" requires the same cross section. This is the simplest type of lock that requires the Lockpicking skill; all rolls are at +6 to +8.

Multiple Tumblers (TL2)

An advanced version of the bolt and tumbler (above), this lock consists of a bolt with *several* tumblers that drop down through holes in it. To open it, a key resembling a metal toothbrush is pushed through a slot in the door and lifted up into the holes. Each prong on the key raises a different tumbler, freeing the bolt, which is unlocked by using the key to slide it sideways along the slot in the door. The door is locked in the same fashion, sliding the key in the other direction. To pick such a lock, *all* of the tumblers must be lifted simultaneously. Lockpicking rolls are at +3 to +5, depending on the number of tumblers.

Bolt and Barb-Spring (TL2)

This type of lock has one or more V-shaped springs that spread out against the staples, preventing the bolt from moving, thereby securing it. The key is relatively flat, with prongs or hooks on its end. It's inserted through a horizontal slit (the keyhole), turned in a quarter-circle, and then pulled back. Pulling brings the prongs to bear on the springs, making them lie flat. With the springs clear of the staples, the key can now be used to slide the bolt, unlocking the door. Such locks seem to have been common in Rome and China, and were used until fairly recently in Scandinavia. Lockpicking modifiers range between +1 and +4.

Barb-Spring Padlock (TL2)

This device operates similarly to the bolt and barb-spring lock (above). Unlike today's padlocks, the shackle is separate from the body. On the shackle's lower side is a pair of spreading springs. These enter the lock's body through a hole. When the shackle is pressed in fully, the springs – which were gradually closed during insertion – spread out inside the body, holding the shackle in place. To remove the shackle, the springs must be compressed again. This is done with an L-shaped key, which is pushed into a keyhole in the body. Both the Romans and Chinese used this type of padlock. Modifiers to Lockpicking range from +1 to +4.

Rotary Lock (TL2)

First developed by the Greeks, these locks had keys that rotated instead of being pressed against the tumblers. Early keys were sickle-shaped; a key would work on most locks of a similar size. Turning the key in one direction caused the bolt to slide into the strike plate, locking it. Turning the key in the opposite direction slid the bold out again, unlocking it. Lockpicking rolls are at +1 to +4.

Warded Rotary Lock (TL3)

The perfection of the rotary lock rendered locks that relied on sliding or pushing the key largely obsolete, and tumblers were soon abandoned in favor of wards. The shapes of keys came to resemble those of today, though larger. More advanced rotary locks had hollow lock pins with rotating bearings on both ends, and keys were fluted to fit. This was the most common type of lock in medieval Europe. Lockpicking modifiers vary between -2 and +4.

Combination Lock (TL4)

The earliest known combination lock was described by the Arab inventor Al-Jazari in the 13th century, but didn't see common use for several more centuries. There are two main types:

Disc Combination: Used on padlocks, chains, etc., this lock consists of a number of thick discs that are numbered on their outside edges. Behind one of the numbers on the inside of each disc is a notch. When all the notches are aligned, the bolt slides freely, locking or unlocking the mechanism. These are fairly easy to crack, with a Lockpicking modifier between +2 and +4.

Dial Combination: These were initially placed on "puzzle padlocks" in China. They had three to seven discs of characters or letters which released the hasp when properly aligned. Later developments place the discs *inside* the lock, with only a single dial on the outside. The dial needs to be spun multiple times in both directions, aligning the marker with a different number each time until the lock opens. Lockpicking modifiers range from -2 to +2.

Portable Padlocks (TL2)

A padlock can be a barb-spring padlock (TL2), rotary lock (TL2), warded rotary lock (TL3), or either variety of combination lock (TL4). Weight varies from 0.1 lb. to 2 lbs. It has DR 2. Find HP from the "Machine" column of the *Object Hit Points Table* (p. B558). Cost depends on the Lockpicking modifier:

Lockpicking Modifier	*Cost*
+6	$5
+5	$10
+4	$20
+3	$40
+2	$80
+1	$160
0	$320
-1	$640
-2	$1,280

Breaking and Entering

Doors, grates, strongboxes, etc. can be destroyed using *crushing* or *cutting* weapons. Don't bother with attack rolls! Roll damage at +2, or +1 per die, for All-Out Attack (Strong) – plus *another* +1 or +2 per die with Forced Entry (p. B196) at DX+1 or DX+2, respectively. Pry-bars (p. 126) deal swing+2 crushing. Swords dislike such abuse, and have a 3 in 6 chance (2 in 6 if fine, 1 in 6 if very fine) of bending, giving -1 to skill. Subtract the target's DR, multiply by 1.5 if your attack was cutting, and reduce the object's HP until it breaks (see pp. B483-484).

Door and grate DR and HP assume a 10-square-foot breach. This will admit most adventurers. A Skinny intruder requires an opening half as big (20% fewer HP); one with Fat, Very Fat, or Gigantism needs half again the area (15% *more* HP). When attacking the entire barrier – e.g., with a battering ram – calculate HP for a Homogenous object using its *total* weight (see p. B558).

Many doors can be forced with a well-placed shoulder or boot, destroying the attached hardware but not the door. Read the DR and HP of a bolt, hinge, latch, or lock from the "Bolt/Latch" columns under *Bars, Bolts, Latches, and Locks* (p. 120). Roll a Quick Contest: ST vs. object HP. Add Lifting ST, and bonuses for Forced Entry and/or tools (e.g., +2 for a pry-bar), to ST; subtract the hardware's DR. For a barred or wedged door, use the bar or wedge's DR and/or HP with these rules, where these exceed the metal hardware's scores. You must *win* to open the door. Repeated attempts are at a cumulative -1 and cost 1 FP each.

Traps

Traps are used mainly to hunt animals, but many can be adapted to catch human prey. The majority have two components: the *trigger* and the *delivery device.* Some also have a built-in bypass mechanism, enabling people in the know to avoid the trap. Most traps require knowledge of the Traps skill (p. B226), but not all call for a skill roll. To conceal traps effectively, use the Camouflage skill (p. B183).

Detecting a trap requires a *Per*-based Traps roll. The GM rolls secretly against the *best* skill in a group to see if they notice each trap.

Modifiers: Acute Vision (p. B35); any darkness penalty; any penalty for a *concealed* trap; -5 if fleeing or rushed.

Disarming a trap involves locating or improvising a bypass mechanism. For most traps, this means a *DX*-based Traps roll.

Modifiers: High Manual Dexterity (p. B59) or Ham-Fisted (p. B138); any penalty for a *complicated* trap; -5 for working by touch (p. B233), such as when the trap is inside a door or a chest and not visible from outside, forcing the burglar to feel for it and attempt to interrupt it *as he opens the door.*

Some traps can be rearmed by making a second disarm roll.

When picking a trapped lock, use the *lower* of Lockpicking or Traps. Success opens the lock and leaves the trap untriggered. Failure means the lock stays shut and the trap goes off.

Most low-tech traps list neither cost nor weight. They're applications of digging tools (under *Mining and Tunneling,* p. 30), rope (in *Rope, String, and Thread,* pp. 23-24), nets (use the ones under *Fishing,* p. 29), etc. The main investment is in labor.

Deadfall (TL0)

A heavy weight – traditionally a boulder or a log – attached to a tripwire (p. 123) or similar mechanism (such as a pressure plate). Activating the trigger drops the weight on the victim! Setting up a deadfall takes an hour plus an additional hour per 100 lbs. of weight it drops. Calculate damage from the deadfall's weight and the distance from which it's dropped (see *Damage from Falling Objects,* p. B431). Roll against Traps to hit the target. Final effective skill can't exceed 9 plus the deadfall's SM (e.g., SM +1 gives a maximum of 10); larger deadfalls are more likely to strike their prey.

Net (TL0)

Net traps work much like snares (p. 123), but cover a wider area and entangle the victim, making it harder to break free. A net for hunting takes 15 minutes to set – or 30 minutes, for large game. A spring trap that can engulf and suspend a man requires 90 minutes.

Someone suspended in a net can break free by being lowered to the ground – where he can disentangle himself – or by severing 2d strands. Since he's tangled in a net, he must make a DX or Escape roll to get his hands free to draw a blade and cut the strands. If he succeeds and subsequently cuts the net, he'll suffer a fall and injury (see *Falling,* p. B431). Failure means he can do nothing for a full minute, after which he can try again. Critical failure means he cannot move at all; somebody else must release him.

Pit (TL0)

A pit is an effective means of trapping prey. Since most creatures won't blithely fall into an open pit, the opening must be concealed – although it might be left uncovered if there's no light by which to see it. Start with the digging times on p. B350 and add 10% to camouflage the opening. Constructing a more complicated cover (e.g., spring-loaded trap door) takes even longer.

Victims of a pit trap take falling damage (see *Falling,* p. B431). Adding sharpened stakes at the bottom converts the damage from crushing to *impaling.*

A shallow pit can slow an enemy's charge on the battlefield. If it's *concealed,* potential victims must win a Quick Contest of Vision vs. Camouflage to spot it in the first place.

To avoid a known trap, roll vs. DX (on foot) or Riding (if mounted), applying the speed penalty for current Move (p. B550); e.g., Move 5 gives -2. Success avoids the pit; failure means a fall.

Snare (TL0)

A snare consists of a loop of rope set along the ground and camouflaged. A simple snare for birds and small animals can be set in 5 minutes. A trap line of 10 snares takes about an hour. For deer and other large beasts, *double* the time requirement.

Predators can chew through ropes, and humans can simply pull open loops, so snares for such prey must be more elaborate, often using springy branches to yank them off the ground. Setting a spring trap takes 30 minutes. A snared person can get free by being lowered to the ground – where he can loosen the loop – or by cutting the rope while suspended. The latter results in a fall and subsequent injury (see *Falling,* p. B431). Since the victim is upside down, damage is more likely to be to the head, upper torso, and arms than to the legs; treat as an attack from above (see p. B400).

Tripwire (TL0)

This is a thin, strong cord (TL0) or wire (TL2) strung across a path. It might trigger an alarm or defensive device, or be a trap in itself, causing the victim to stumble or fall. Installing and concealing a tripwire requires a Traps or Camouflage skill roll.

Alarms include bells (see *Bell and String,* below), stones falling onto a gong, and even fireworks. Defensive devices include the wire itself – which may cause a dangerous fall – and mechanical traps: deadfalls, pits, snares, etc. Make a DX roll to avoid falling when tripped, at +2 for fragile thread, no modifier for cord, or -2 for wire or rope.

A variant tripwire is useful against horsemen. It's strung high enough that the horse can pass underneath while the rider hits it with his chest or neck, knocking him from the saddle. To spot the trap in time, the rider must make a *Per*-based Riding roll modified by the speed penalty for current Move (p. B550); e.g., Move 5 gives -2. If he succeeds, the only defense allowed is Dodge. If he doesn't see *and* duck the rope, he takes (mount's Move)/5 dice of crushing damage; roll hit location randomly, as for attack from above (see p. B400). Use *Mounted Combat Results* (p. B398) to determine whether the victim is unhorsed. If the line inflicts more than its (DR + HP) in damage, it breaks; otherwise it survives to endanger future horsemen.

Needle (TL1)

Needles are commonly used to deliver poisons, usually blood agents (see *Poisons,* p. 128-130). With the exception of blowpipe darts (see *Muscle-Powered Ranged Weapon Table,* pp. 76, 78), they inflict no damage themselves and are stopped by any DR. Natural needles include the thorns of stinging plants such as nettles, which come complete with poison. Manmade ones can take many forms, such as:

- A merchant might have a spiked ball in his money pouch; grabbing the pouch without gloves means being stuck through the thin material.
- A false tumbler in a lock (p. 121) could include a needle, waiting for someone to stick a finger in the wrong hole.
- A spring-loaded needle may be attached to a trigger in a lock. Turning the key in the wrong direction, or attempting to pick the lock, activates it.

Caltrop (TL2)

A caltrop is a small antipersonnel device with multiple spikes arranged so that one always points up. The Romans called this a *tribulus;* the Japanese, a *tetsubishi.* On the battlefield, they were used as a passive defense to slow the enemy or direct him onto prearranged paths. On a personal level, they were scattered by a fleeing individual to discourage pursuit. They could also be placed in a hallway or under a window to deter intruders.

Anyone in a caltrop-strewn area must make a Vision roll every second while moving. Apply the speed penalty for his Move (p. B550); e.g., Move 5 gives -2. He has a further -2 if not specifically watching the ground (-2 on all *other* Vision rolls). Failure means he steps on a number of caltrops equal to his margin of failure, minimum one.

Each caltrop inflicts thrust-3 impaling damage, based on the *victim's* ST, on the foot. The DR of footwear protects normally; maximum injury is 2 HP. Injury can cripple the foot (see *Effects of Crippling Injury,* p. B421) – but even if it doesn't, damage equal to or greater than DR means the caltrop has become lodged and will inflict damage every turn if walked on. The victim must make a Will roll (at +3 for High Pain Threshold or -4 for Low Pain Threshold) to avoid crying out. Removing each caltrop takes two Ready maneuvers. Caltrops are sometimes poisoned or dung-covered (-2 or worse on rolls to avoid infection; see *Infection,* p. B444). Even if footwear is heavy enough to resist all damage, a caltrop-strewn area is treacherous ground (see *Bad Footing,* p. B387).

Large caltrops are used against cavalry, including camels and elephants. Damage is thrust-2. These are easier to spot when not riding; footmen are stuck only on a critical failure on their Vision roll.

Enough caltrops of either type to cover a hex on a combat map (large ones are bigger but scattered more thinly): $1, 0.5 lb.

Alarms

An alarm is any device that emits a noise to announce the presence of intruders.

Beaded Curtain (TL1)

Described under *Semi-Portable Housing Elements* (p. 32). When someone moves through the curtain, the beads make noise, alerting the occupants. Negotiating a beaded curtain *quietly* requires a Stealth roll at -2.

Bell and String (TL1)

This is a noisemaker activated by a tripwire (above). Examples include bells, gongs, and drums. The easiest way to neutralize this alarm is to avoid the tripwire, but it may also be disarmed (see *Traps,* p. 122).

Nightingale Floor (TL3)

This is a purpose-built squeaky floor. It has moving floorboards nailed in such a way that whenever somebody walks on them, the nails scratch along small metal plates. Some Japanese castles used these as alarms against intruders.

Make a Traps or Carpentry roll to notice a nightingale floor. Bypassing it involves jumping over it or climbing along the rafters. A ladder or long board laid over the entire floor can spread your weight enough to keep the floor from singing. Fixing boards with nails or gum may also work; make a Traps roll to disable the floor this way.

Sometimes, an intruder might encounter a single squeaky floorboard. He'll randomly step on this on a roll of 1-3 on 1d, unless the GM rules otherwise. Make a Carpentry roll to notice a floorboard that might squeak, at -4 if the floor is covered with a carpet or mat. Sprinkling talcum powder between floorboards can often lubricate them enough to prevent squeaking.

> *Singh pointed out another trip wire, grinning as he stood aside and triggered it with a long stick.*
>
> *– S.M. Stirling,* ***The Sunrise Lands***

Identification and Authentication

Identification of people and authentication of messages are important for the security of property and information. The GM should roll a Quick Contest whenever a person who isn't supposed to be somewhere tries to sneak past a guard (or observant worker!). The intruder must *win* to pass. If trying to pose as someone innocuous, he rolls Acting or Disguise vs. the sentinel's Body Language or Observation. If he's challenged, this shifts to Acting vs. Detect Lies. If he's actively attempting to con his way past, that's Fast-Talk vs. Detect Lies – or perhaps Sex Appeal vs. Will. And if he's bearing a fake document or seal, see *Forgery and Counterfeiting* (p. 128).

Brands and Tattoos (TL0)

Almost every historical culture has placed identifying marks on people and beasts. Such markings come in two major varieties:

Brands: Scars created via patterned cuts or searing metal (1 point of burning damage on application). The earliest such marks identified the ownership of domestic animals, and advertised the Social Stigmas of individuals such as convicted criminals and slaves.

Tattoos: Patterns created by cutting the flesh and marking the resulting wound with a coloring agent. Decorative tattooing requires Artist (Body Art); crude examples are often done at default.

A roll against a suitable specialty of Heraldry (p. B199) may be needed to identify marks that encode *subtle* meaning, such as a specific owner, clan affiliation, religious order, or crime. Sample specialties include Cattle Brands (defaults to Farming-3) and Punishment Marks (defaults to Criminology-3). While body marks are usually LC4, people with the brands or tattoos of outlawed groups may be arrested or even killed if their marks are detected.

Body Modifications (TL0)

These perform a function similar to brands and tattoos (above), except that the body itself is altered. Examples include Jewish circumcision, the Christian tonsure, Chinese foot-binding, and Mayan skull-binding.

Watchwords (TL0)

An easy way to verify someone's identity is with a prearranged password. Recalling a simple challenge-response code is automatic. If the *player* forgets a *complicated* coded phrase, though, the GM is free to require an IQ roll to remember it, with Eidetic Memory giving +5.

Linguistic Riddles: Some watchwords rely on having Native spoken comprehension in a language. When the Hebrews were at war with people whose native language didn't include the "sh" sound, their soldiers asked strangers to say the word "shibboleth." In 1282, during the Sicilian Vespers massacre, the Italians used the word "cicera" to identify the French, who had difficulty pronouncing it.

Invoices (TL1)

An invoice is a commercial document issued by a seller to a buyer. It lists purchased items alongside quantity and price. When the agreed amount is paid, the seller issues a receipt to prove transfer of ownership to the buyer.

Invoices can be used to establish identity – if you can show invoices for goods you possess, challengers may assume that you're the person to whom the documents were issued. Altering or falsifying an invoice or a receipt requires a roll against the *lower* of Merchant and Forgery. To *detect* a fake, roll a Quick Contest: Perception, Forensics, or Merchant vs. the skill used to create the forgery.

Seals (TL1)

Seals and signet rings (see *Hard Solid Media,* p. 46) are used to secure documents with wax or clay. The message is folded and sealed, after which opening and reading it means breaking the seal. In European society, this procedure was most often used to authenticate deeds and charters. Similar measures work for containers such as ceramic jars (see *Containers and Storage,* p. 34) – the vessel is closed or covered, and a seal stamped into a piece of clay that must be broken to open it. If someone wants to read a sealed message or inspect a sealed container without anyone knowing, he must reapply the seal using the same sealing material, and have an identical copy of the stamp; see *Forgery and Counterfeiting* (p. 128).

A signet ring can also serve as a *personal* identity token. The bearer is immediately identified as the holder of a particular office or title.

Intrusion

Intrusion is bypassing security to gain access to property or information. Equipment for doing so is often taken as evidence of illegal intent – treat LC as 2, 1, or even 0. Such gear is sometimes disguised as innocent (LC3-4) personal items; see *Disguised* (p. 14).

Note that plenty of *other* kit can be useful here – including many items under *Tools and Basic Equipment* (pp. 28-30) and *Diving Gear* (p. 143).

Climbing Gear

The best entry point isn't always at ground level! Adventurers must often climb up or down to reach their goal. Any thief or spy who knows his business possesses climbing equipment of some sort.

Rope (TL0)

See *Rope, String, and Thread* (pp. 23-24).

Climbing Pole (TL1)

This is a pole with a rake-like hook on one end. It's hooked over the top of a wall and aligned at an angle away from it. The climber pulls himself up with his hands on the pole while walking up the wall with his feet. This device is limited to walls up to about 15' in height. It may also be used in combat as an awkward (-2 to skill) long staff. $80, 5 lbs.

Grapnels (TL1)

Unless someone is at the top of a climb to secure a rope, you'll need something to hold the end in place while you climb.

Grappling Hook (TL1). The basic grapnel consists of three or four metal hooks fixed to a rigid spine with an eyelet in the end for attaching a rope. Roll at DX-3 or Throwing to hurl it to the target. See *Throwing* (p. B355) to determine how far you can throw it without mechanical assistance. When a grapnel lands on stone, concrete, or similar hard materials, it rings loudly – it has a Hearing distance of 4 yards (see p. B358). Padding can muffle the noise, reducing this distance to 2 yards. Unpadded: $20, 2 lbs. Padded: $30, 3 lbs.

Crossbow (TL2). It's possible to use the crossbows in Chapter 5 to throw a weighted rope or a grappling hook. For a weighted rope, *halve* Maximum Range for a horizontal shot or *quarter* it for a vertical one. For a grappling hook, divide by 10 for horizontal or by 20 for vertical.

Harpoon (TL3). A long spike with a hardened tip and an attached rope, this grappling harpoon *isn't* the hand-thrown weapon on the *Muscle-Powered Ranged Weapon Table,* but a projectile for a heavy crossbow or a scorpion. If any damage penetrates the target's DR, the harpoon lodges there, providing a fixed anchor point for a line. Launched with sufficient force, it may even be driven into stone or concrete (*loudly* – Hearing distance is 2 yards). Maximum weight supported is 60 lbs. per point of penetrating damage. $30, 2 lbs.

Ladder (TL1)

Made of wood, a ladder consists of a pair of side rails joined at regular intervals by crosspieces called *rungs* or *cleats*. A person typically ascends or descends at a rate of 1 rung/second (there's usually a little less than 1' between rungs), but in a hurry – as in combat – he may ascend at 3 rungs/second or descend at 2 rungs/second. See *Climbing* (p. B349). A Climbing roll isn't normally needed, although the GM may require one if the climber wishes to move faster. Cost and weight are $10 and 2.5 lbs., multiplied by the *square* of length in yards; e.g., the longest ladder practical at TL1-4 is 36' long, $1,440, and 360 lbs.

Rope Ladder (TL1)

Similar to a regular ladder, but with side "rails" made of rope. The rungs might also be rope, or may be more rigid. A rope ladder can be rolled up for easier transportation, but it's harder to climb because it won't remain stationary: climbers normally climb at one rung every 2 seconds, but in a hurry may increase this to 1 rung/second. A 30' ladder: $50, 22 lbs.

A large net can serve as an improvised rope ladder, but at -2 to Climbing skill.

Pitons (TL2)

A piton is a spike or a knife-shaped wedge with an eyelet in the end through which a rope or a cord is threaded. It's used to climb vertical surfaces that lack handholds. The piton is forced into a crack (or *hammered* into wood or ice) far enough to support the climber's weight. The climber steps on this piton and drives in a second one further up. Then he steps up to the second piton and yanks on the cord to remove the first one so it can be reused. This technique is tricky – the pitons must be driven in deep enough to support the climber's weight, but not so far that they cannot be removed by tugging on the cord. Used this way, pitons erase up to -2 in penalties for climbing a vertical surface.

Pitons may be driven in deeper so that they're more secure. This removes up to -3 in penalties, but the pitons cannot easily be removed – they may only be used once each per climb. This method is safer, as a rope may be attached to each piton to prevent falling.

A piton can be wielded as a dagger in melee (-2 to skill), or hurled as a crude small throwing knife (-4 to skill).

Per piton: $4, 0.75 lb. Suitable hammer: $10, 1 lb.

Spikes (TL2)

These devices attach to the hands and feet to improve a climber's grip on a surface – like "ninja climbing claws." They're useful on craggy surfaces: wood, soft stone, etc. It takes four minutes (a minute per extremity) to don the set. They cancel up to -2 in penalties for climbing a suitable vertical surface. Complete set of four: $150, 2 lbs.

Camouflage and Disguise

One way to avoid detection is to hide yourself – either by concealment or by changing your appearance.

Camouflage (TL0)

Camouflage (p. B183) is the skill of concealment. It involves disguising an object in plain sight in order to prevent detection.

Colored Clothing (TL0). Clothing of a color similar to the background can benefit a Camouflage attempt. If torso, arms, legs, and head are covered in appropriate colors, apply +1 (quality) to Camouflage. An example would be the "Lincoln green" reputedly worn by Robin Hood and his men. Clothing in a bright color, or one that contrasts greatly with the background, actually *hinders* Camouflage, giving from -1 to -3 to skill. Cost and weight are as for regular clothing; see *Clothing* (pp. 97-100).

Camouflage Paint (TL1). Paint can be used to camouflage the skin. Suitable colors obtained from crushed leaves, moss, algae, mud, soot, and so on are applied to the face, neck, hands, etc. If *all* exposed skin is covered *and* appropriate camouflage clothing is worn, this gives an additional +1 (quality) to Camouflage. $10, neg.

Hunting Shirt (TL1). This is a baggy, thigh-length overshirt of durable material with straps, cords, or loops for attaching suitable foliage. Fringed sleeves help to break up the silhouette even further; optionally, a blotchy dye job completes the effect. A plain shirt gives +1 (quality) to Camouflage; a dyed one, +2. This bonus may be improved further through customization, which requires 20 hours and a Camouflage roll. Each point of success adds another +1, to a maximum of +3, for a total of up to +5. The shirt requires specific preparation for terrain, climate, and season – and like regular clothing, if it's inappropriate for the background, it might give a Camouflage *penalty*. Plain: $50, 5 lbs. Dyed: $100, 5 lbs.

Black

Black *isn't* the ideal night camouflage. On most nights, if there's even a faint light source, completely black clothing, paint, etc. appears as suspiciously dark shadows (no Camouflage bonus) – and if there's *no* light, camouflage serves no purpose. A darker shade of the patterns used for daylight camouflage gives +1 (quality) to Camouflage.

Hoods, Veils, and Masks (TL0)

These accessories serve two purposes. First, they prevent facial recognition. Second, they can be colored to assist camouflage. Any head covering that extends over the face can serve the same function as camouflage paint (above).

Padded Boots (TL0)

Footwear designed to muffle footfalls can improve Stealth. Use the rules for skill bonuses under *Hand and Footwear* (p. 98), and see also *Moccasins* (p. 98).

Disguise Kit (TL1)

A disguise kit is *required* for a decent disguise; it's basic equipment for the Disguise skill (p. B187). It includes things like hairpieces and makeup, as well as a reasonably large mirror. It takes from 30 minutes to an hour for an effective makeover. $200, 10 lbs.

Holdout Clothing (TL1)

For clothing that gives a Holdout bonus, see *Long Coat* (p. 99) and *Undercover Clothing* (p. 100).

Covert Entry

To break into a building, one *could* simply smash down the door with an axe or a maul (see *Breaking and Entering*, p. 122) . . . but finesse calls for dedicated tools.

Lockpicks (TL1)

Lockpicking involves manipulating a lock's components to open it without its key. Tumbler, rotary, and barb-spring locks can be picked one-handed, while warded rotary locks require two hands; see *Locks* (pp. 120-121). A set of lockpicks – possible at TL1, but unlikely before TL2 – would include probes and a set of blank keys of different sizes, and be basic equipment: $50, 0.2 lb. A good-quality kit (+1 to skill) includes a more complete set of blank keys: $250, 0.5 lb.

Housebreaker's Kit (TL2)

Lockpicks, a small pry-bar, a mallet, a chisel, a small saw, 10 yards of 3/8" rope, a padded grappling hook, and a lantern, packed in a sack capacious enough to hold some swag. $255, 16 lbs.

Pry-Bar (TL2)

A 30" crowbar (-4 to Holdout), smaller than the one under *Mining and Tunneling* (p. 30), optimized for forcing doors and snapping padlocks. It gives +2 to the ST rolls to open barred doors under *Breaking and Entering* (p. 122). Treat as a small mace in combat. $80, 5 lbs.

An even smaller 20" version is easier to conceal (-2 to Holdout) but less effective (+1 to ST). Treat as a light club in combat. $60, 2 lbs.

Smuggling Gear

Many articles can be modified to conceal something. A ring might contain a dose of poison, a hollow staff may hold a roll of paper or a weapon, a coat could have a hidden pocket, and a boot might have a hollow heel. Locating such hiding places requires a careful tactile search.

Bonuses to Smuggling (p. B221) depend on how well the container is made: +1 adds +1 CF, +2 adds +3 CF, +3 adds +7 CF, and +4 (the maximum) adds +15 CF. Weight is unchanged. The container can only hold something of appropriate size and shape. Note that the Smuggling bonus of a secret compartment differs from the Holdout modifier of the item it's in and the blanket Holdout bonus for gear like undercover clothing (p. 100).

Deception

Rather than sneak past a sentry, an infiltrator may *summon* him and present a forged document; a secret message could be encoded within a personal letter to avoid scrutiny; and a criminal might buy goods with counterfeit coins. Such ploys rely on deceptive documents and tokens – especially bogus money and identification. For more personal deceptions (lies and impersonation), see *Identification and Authentication* (p. 124). Gear for deceiving the eye (e.g., disguise kits) falls under *Camouflage and Disguise* (p. 126).

> *To conquer the enemy without resorting to war is the most desirable. The highest form of generalship is to conquer the enemy by* ***strategy.***
>
> *– Sun Tzu,*
> ***The Art of War***

Secret Messages

The invention of writing brought with it the need to prevent the wrong people from reading documents. The most common methods involved either concealing the text itself (invisible ink) or disguising the message using codes or ciphers. Equipment for sending secret messages is LC4.

Codes and Ciphers

Codes use symbols or groups of letters to represent words or phrases (a complex message requires a codebook), while *ciphers* substitute one letter for another using a predefined scheme. Any written language could serve as a secret code if only a select group of people understand how to read it. An example of a cipher was used by Julius Caesar (a cipher now called the "Caesar shift"): He replaced every letter in the alphabet with one three places down in position so that a = D, b = E, c = F, etc. To extract the original message, the recipient simply reversed the process.

It's almost impossible to read a short, coded message if you don't know the code or cipher. The longer the message, the easier it is to decode. See *Cryptography* (p. B186) for rules.

Skytale (TL2)

This seems to have been used first in classical Greece. It consists of a strip of leather or paper wrapped around a cylindrical baton in a helix. A message is written horizontally across the baton so that a single letter takes up the width of the strip. When unwound, the message becomes a jumble of letters. To read it, the strip must be wound around a baton of the same diameter as the original.

Cipher Wheel (TL4)

Invented by Italian scholar Leon Battista Alberti in the 15th century, this mechanism consists of two concentric discs that can be rotated about a shared axis. The discs are divided into equal partitions, and a letter of the alphabet is inscribed in each segment around the edge. The inner wheel is turned so that a predetermined letter (the "key") corresponds to the letter "A" on the outer wheel. With this done, the message can be ciphered by looking at the letter on the outer circle and writing down the corresponding letter on the inner circle. The message can only be deciphered by someone who has an identical cipher wheel *and* knows the key letter. Someone with the Jeweler skill (p. B203) can engrave a cipher wheel onto metallic discs the size of large coins to enable easy concealment (+1 to Holdout). $80, neg.

Inks and Papers

Instead of attempting to disguise a message using a code or a cipher, it's sometimes simpler to hide the whole thing!

Invisible Ink (TL2)

Lemon juice, onion juice, and various other kitchen recipes produce perfectly good secret ink, which becomes visible when heated. Philo of Byzantium (280-220 B.C.) is the first to write about using a reagent to make the writing visible; his recipe uses crushed gallnuts in water, with vitriol as the reagent. Another example, described by Pliny, makes use of the juice of the spurge; rubbing ashes on the paper causes the juice to darken. One curious method involves writing on a boiled egg with a mixture of vinegar and alum; the shell absorbs the writing, and when it's peeled off, the message is visible on the surface of the egg inside.

To use invisible ink requires skill; too much pressure leaves visible indentations, too little results in not enough ink being applied. When a scribe uses improvised equipment or writes a long message in such ink, the GM should roll secretly against DX, or against *DX*-based Artist (Calligraphy) at +6. Failure means the recipient cannot read the whole message. Critical failure means that anyone who makes a Vision roll *can* see it – a fact the writer fails to notice. For more about legibility, see ***GURPS Low-Tech Companion 1.***

Per vial: $10, neg.

Disposable Paper (TL3)

Some types of paper, such as rice paper, dissolve quickly in warm water, or can be swallowed. This makes them useful for secret messages. Once the recipient reads the message, he can quickly dispose of the evidence. Suitable rice paper was invented in China early in the Tang Dynasty (618-907 A.D.). Per sheet: $1, neg.

Forgery and Counterfeiting

Forgery is the art of creating false documents (see p. B196), while *counterfeiting* is that of falsifying currency (see p. B185). These arts are as old as written documentation and coinage, respectively. Perpetrators may be punished harshly – death and mutilation were common sentences (see *Enforcement and Coercion,* pp. 131-131).

Identifying Marks

Stolen property may bear identifying marks; for examples, see *Brands and Tattoos* (p. 124). These must be removed or altered to prevent the goods from being traced back to the original owner. Most are intentionally made difficult to delete, and have to be altered to resemble somebody else's mark or disguised as something else. Roll a Quick Contest of Forgery vs. Vision or Search whenever such a deception is examined.

Coinage

For most of history, a coin's value corresponded to that of the metal from which it was made. One way to profit from counterfeiting such coins is to use a metal that looks like the original but is worth less. This involves two steps. First, the precious metal must be debased with the less-expensive one; e.g., mixing silver with tin or gold with copper. Alternatively, coins can be made entirely from a base metal and plated with the precious one; e.g., gold-plated lead. Second, the design on the coin must be duplicated. All that's required is an original sample, some artistic talent, and engraving tools to make the die. For more information, see *Counterfeiting* (p. B185).

An easier method is to take an original coin and cut or shave around the edges (called "clipping") so that it weighs less than it should. The counterfeiter can simply pocket the shavings. Clipping a coin requires jeweler's shears (see *Smithing,* p. 30) and 2 minutes per coin. This still requires the Counterfeiting skill, but now the roll is *DX*-based. Each 5% that the counterfeiter wishes to shave off gives -1 to skill. However, don't actually roll against skill until someone examines the coin (see below).

There are several ways to detect fake coins. Pure gold coins are quite soft, and simply biting them will tell an experienced trader whether they're made from gold or debased with a harder, cheaper metal; this requires an unmodified Merchant skill roll. Clipped coins can be noticed if examined closely; this involves winning a Quick Contest of *Per*-based Merchant, at -2, vs. Counterfeiting modified as explained above. Plated coins can be discovered by digging a blade into them; this calls for a Merchant roll at +1. Another method is to compare the weight of the suspect coins with that of an equal number of authentic coins (or an equivalent scale weight; see *Weight,* p. 44); if the piles don't weigh the same, they aren't made of the same metal. The same test works for clipped coins. Appropriate scales and weights give +5 to Merchant skill rolls to spot fakes.

Documents

There are two steps to producing false documentation. First, the physical token – usually a signet or a seal (see *Hard Solid Media,* pp. 45-46) – must be duplicated. Second, the content must be believable. Falsifying the signet of a particular royal official is pointless if everybody knows that he died last year! Documents and seals can be duplicated from memory, but it's easier if the forger has access to the originals. Basic equipment for Forgery at TL1-4 is paper (see *Paper and Its Cousins,* p. 25) and ink (see *Writing Tools,* p. 46). To create false seals and signets, roll against the *lower* of Forgery and the relevant craft skill (e.g., Jeweler, for a ring). For further details, see *Forgery* (p. B196).

Poisons

Poisoning is a low-risk way to eliminate a foe. No fighting is required . . . simply slip something into his food or wineglass and wait. Some poisons do require the blade of a weapon – or at least a needle trap (p. 123) – to get into the bloodstream. Others work by coming into contact with the skin or by being inhaled. Many are slow-acting; they won't affect the outcome of a battle, but might prevent the enemy from fighting another day.

The ***Basic Set*** goes into detail about how to handle various types of poison (see pp. B437-439). A roll against Poisons (pp. B214-215) is required to extract and prepare any poison. While some individual agents can be deadly, many historical recipes called for several ingredients – some highly toxic, others mostly harmless (one common ingredient was a mouse that had been stung to death by scorpions!). For example, Herodotus wrote that the Scythians poisoned arrows with a concoction made from decomposed bodies of venomous snakes, horse dung, and human blood, mixed together and left to putrefy.

Several TL0-4 examples appear on p. B439. More are given below. Poisons range from LC3 (substances used for pest control or sanitation) down to LC0 (chemicals whose only use is assassination). Poisoning was often punished more harshly than open murder.

Belladonna (TL0)

The active ingredient of this toxic plant (*Atropa belladonna,* or "deadly nightshade") is atropine. Belladonna can be used as a follow-up agent *or* a digestive agent. As a follow-up poison, it has a one-minute delay; as a digestive agent, it has a 15-minute delay. In either case, it inflicts 1d toxic damage with *no* resistance roll, repeated at 15-minute intervals for 28 cycles with a HT-2 roll to resist. After injury reaches HP/2, the victim starts hallucinating (p. B429); this normally takes the form of distorted perception rather than visual imagery. Survivors must roll vs. HT to avoid a permanent -1 HT. $8/dose. LC1.

Cantharides (TL0)

Also known as "Spanish fly" (actually a beetle, *Lytta vesicatoria*), this can be used as a digestive agent *or* a contact agent. As a digestive agent, it has a one-hour delay and a HT roll to resist, and inflicts 4d toxic damage with symptoms of nausea (p. B428). As a contact agent, it has *no* delay but still allows a HT roll to resist; it deals 2d toxic damage and irritates the skin, causing blistering and moderate pain (p. B428). In either case, a victim who reaches 0 HP suffers convulsions; treat as a seizure (p. B429). $14/dose. LC1.

Curare (TL0)

This poison is extracted from the sap of a vine (*Strychnos toxifera*). It's a follow-up agent with a one-minute delay and a HT-6 roll to resist, repeated at 30-minute intervals for four cycles. It causes 2d toxic damage per roll regardless of the result, but any failure indicates paralysis (p. B429), while critical failure indicates choking (p. B428) which may lead to death by suffocation. $50/dose. LC1.

Deathcap Mushroom (TL0)

This fungus (*Amanita phalloides*) is a digestive agent with a one-hour delay and a HT-2 roll to resist. Failure means 1d toxic damage and hallucinations (p. B429). It inflicts an additional 2d toxic damage for two cycles at three-hour intervals, with a HT-2 roll to resist. Failure on the first HT-2 roll also causes unconsciousness (p. B429); failure on the second means a heart attack (p. B429). In addition to all this, it causes headache with *no* delay or roll to resist; treat as moderate pain (p. B428), rising to severe pain when injury reaches HP/2 and to terrible pain when it reaches HP (if the victim is still conscious), and lasting until a successful resistance roll. $25/dose. LC0.

Fugu (TL0)

The liver of the *fugu,* or Japanese pufferfish (several species), is deadly. The active ingredient is tetrodotoxin, also found in Australian blue-ringed octopus venom. This can be used as a digestive agent *or* a follow-up agent. As a digestive poison, it has a 15-minute delay and a HT-6 roll to resist; failure results in paralysis, and critical failure in choking, as for curare (above). As a follow-up agent, it has a one-minute delay and a HT-2 roll to resist; failure and critical failure have the same effects, but failure also causes 1d toxic damage. In either case, victims experience skin tingling during the onset period, have -5 ST and -5 DX after the initial roll, and must repeat the resistance roll at one-hour intervals for four cycles, with failure meaning 6d toxic damage. $30/dose. LC0.

Hemlock (TL0)

The plant *Conium maculatum* is a digestive agent with a one-hour delay; the victim is at -2 ST and -2 DX, and must make a HT-2 roll to avoid 1d toxic damage. Damage repeats at hourly intervals for five cycles. Injury equal to 1/3 HP causes paralysis (p. B429) of the feet; injury equal to 1/2 HP paralyzes the lower legs; injury equal to 2/3 HP paralyzes the upper legs; and injury equal to full HP paralyzes the abdomen. At this point, the victim must roll against HT to avoid blindness. If injury reaches 2×HP, the paralysis extends to the heart; treat as a heart attack (p. B429). $5/dose. LC1.

Monkshood (TL0)

Any of several plants of genus *Aconitum,* also called "blue rocket" or "wolfsbane"; the active ingredient is aconite, which acts on the nervous system. It can be used as a digestive agent *or* a follow-up agent. As a digestive agent, it has a five-minute delay, after which the victim feels a tingling sensation on his skin, tongue, and throat, and must make a HT-3 roll to resist; it inflicts 1d toxic damage, repeating at one-hour intervals for six cycles. It also causes nausea (p. B428) after the initial failed roll, persisting until the poison is shaken off; after one hour, it causes retching (p. B429), with a HT+1 roll to resist. As a follow-up agent, it has a one-hour delay and a HT-3 roll to resist; it deals 2d toxic damage, repeating at one-hour intervals for six cycles. In either case, a victim who loses 1/3, 1/2, or 2/3 HP has -2, -4, or -6 DX, respectively. At 0 HP, he has difficulty breathing; treat him as Very Unfit (p. B160) until he shakes off the poison. $6/dose. LC1.

Viper Venom (TL0)

Extracted from a live viper (snake of family *Viperidae*) and used as a follow-up agent on weapon points. After a delay of 1d seconds, make a HT roll to resist. Failure inflicts 1d toxic damage per wound; success reduces this to 1d-3 per wound. A viper yields up to four doses; extracting each dose requires a separate Animal Handling roll. Failure means obtaining no further venom from that snake. Critical failure results in snakebite: 2d toxic damage with a HT-2 roll to resist. $10/dose. LC0.

Lacquer (TL1)

Tapped from the lacquer tree (*Toxicodendron vernicifluum*) in the spring, this sap is used to preserve wood and leather, but can serve as a contact agent *or* (when mixed with incense and burned) a respiratory agent. As a contact agent, it has a 10-second delay and a HT roll to resist; failure causing blistering like poison ivy (treat as moderate pain, p. B428) and 1 point of toxic damage. As a respiratory agent it has *no* delay and a HT+4 roll to resist, inflicting 1d toxic damage; in addition, it causes immediate coughing or sneezing (p. B428). $2/dose. LC3.

Lime Powder (TL1)

Powdered quicklime (see *Mortars and Mineral Adhesives,* p. 19) can be used as a respiratory agent *or* a blood agent (mainly against the eyes). As a respiratory agent, it has a one-second delay and a HT roll to resist. It causes immediate coughing or sneezing (p. B428); if not resisted, it deals 1 point of toxic damage, repeating at one-second intervals for 10 seconds. As a blood agent, it has *no* delay but allows a HT roll to resist. If not resisted, it causes severe pain (p. B428) – and, if in the eyes, blindness. Both conditions last until the location is flushed with water for 5 minutes. Lime powder loses potency in days unless kept dry, which calls for a sealed container. Free to $1/dose. LC3.

Enforcement and Coercion

Not everyone does what he's told. Sometimes, more *forceful* means are needed to gain compliance. In many societies, specialized enforcement equipment is controlled by and restricted to the legal authorities (LC2).

Restraints

Restraints are used to hold someone still or to prevent escape. They sometimes serve as a way to cause deliberate discomfort, too – whether alone or as part of more elaborate torture (see *Torture,* p. 131). Options range from a simple cord around the wrists to metal manacles and shackles.

Someone with his hands bound behind his back can't perform tasks that require free use of the arms and has -1 to DX in general. He can attempt things that require only the hands, but at *-4* to DX – and he must work blind if trying to manipulate something behind his back. A successful Acrobatics or Escape roll lets the prisoner bring his legs up and slip his arms around to the front.

Someone with his hands bound in front of his body suffers no general DX penalty and -1 on tasks that use only the hands. Activities that require free use of the arms (including most one-handed attacks) are still impossible, but two-handed attacks and weapons wielded with the hands close together – pistols, two-handed swords, etc. – incur no penalty. Other weapon use is at -1 to -4 to skill.

Someone who's completely trussed up is immobile. Treat him as both *grappled* and *pinned* (see p. B370).

Bindings (TL0)

Rope or cord (see *Rope, String, and Thread,* pp. 23-24) is the most common way to bind a prisoner. Divide his BL by 50 to determine the needed weight of rope in pounds. Make a Knot-Tying roll to estimate this amount and tie him up. Failure means he'll wiggle free as soon as nobody is looking. Critical failure lets him burst out immediately!

For a successfully bound prisoner to escape, he must untie the knot, loosen the bonds so that he can wriggle free, or break the cord. If his hands are bound, then the only way to untie the rope is using the *teeth.* Roll a Quick Contest of Knot-Tying between captive and captor. The prisoner is at -3, and must *win* to free himself. If he's gagged or unable to touch hands to mouth, this option isn't available to him.

Loosening the bonds requires the prisoner to *win* a Quick Contest between his Escape and his captor's Knot-Tying. Wet leather strips (TL0) contract while drying, giving -1 to Escape. Metallic wire (TL2) gives -2.

Breaking the bonds requires the prisoner to *win* a Quick Contest between his ST and the rope's effective ST; he may use extra effort (pp. B356-357). To calculate the rope's ST, treat its *dynamic* load limit as its Extra-Heavy encumbrance level, take 1/10 of this as BL, and find ST from BL (see p. B17); in one step, ST is square root of (dynamic load limit/2). Each extra coil around the prisoner (about 2 yards of rope for a normal-sized man) gives +1 to the rope's ST. Losing means remaining bound – and if the bindings are thin wire, they bite into the skin, causing 1 point of cutting damage. Critical failure on the ST roll means a temporarily crippled arm (pulled muscle). Each try takes a minute and costs 1 FP; repeated attempts have a cumulative -1.

Iron Shackles (TL2)

These work like bonds (above), with a few differences. First, shackles are *metal,* and cannot be broken with normal human strength – their load limit is 1,000 lbs. As well, they're locked or riveted closed, so they can't be untied. If they have a lock, this can be opened with the right key or by making a Lockpicking roll at the lock's usual modifier, with an extra -3 if trying to open your *own* shackles. If they're riveted shut, then only blacksmithing tools will release them. Finally, it's possible to slip out of shackles with an unmodified Escape roll. DR 4, HP 10. $50, 2 lbs.

Stocks (TL2)

These are a pair of hinged wooden boards with either two holes for the ankles or three holes for the wrists and neck. The victim is thus restrained while undergoing whatever punishment is meted out. If his ankles are restrained, he sits on the ground with the soles of his feet exposed for abuse. If his wrists and neck are restrained, he's free to walk around while being abused. Treat stocks as shackles (above) when trying to break free.

Pillory (TL2)

This device involves stocks (above) attached to a pole or a wooden frame so that the victim's hands and head are restrained, and he's forced to stand, exposed to the elements (see *Cold,* p. B430 and *Heat,* p. B434) and unable to move. The prisoner is also exposed to projectiles and filth thrown by hostile crowds, and will eventually suffer from lack of food and sleep (see pp. B426-427) . . . with possibly fatal results. Thus, the pillory was reserved for *serious* crimes. It was also used as a whipping post, holding a criminal in place while punishment was administered (see *Torture,* p. 131).

Barrel Pillory (TL2)

This consists of a hinged wooden barrel with a hole for the neck. One type has a solid bottom so the prisoner is forced to crouch in his own filth. The other has an open bottom, enabling the victim to walk around to face ridicule and abuse. It was commonly used to punish drunkards.

TORTURE

Torture was part of many cultures' justice systems. Death sentences were commonly carried out by agonizingly painful methods, while less-lethal torture was considered a legitimate means of extracting information or a confession. Indeed, the Romans didn't consider a slave's testimony to be legitimate *unless* obtained through torture.

As explained under *Interrogation* (p. B202), torture need not involve physical injury. Exposing someone to his phobia is torture; so is depriving him of sleep. The techniques described here are mainly forms of physical torture, though. All give +6 to Interrogation rolls. Many involve specialized equipment. Simply displaying such an instrument to the victim is worth +1 to Interrogation – more, if he suffers from appropriate disadvantages (Cowardice, Phobias, etc.). Implements hideously decorated with spikes and monstrous faces (see *Decorated Equipment,* pp. 37-38) might give another +1 for this initial display.

Water Torture (TL0)

There are many ways to torture someone with water. The simplest is to hold his head underwater – or place a cloth over his face and pour water onto his mouth and nose – and drown him slowly (see *Suffocation,* pp. B436-437). Another is to force him to swallow an excessive amount of water (inflicting agony) until intoxication causes death. These methods are TL0. Such torture is *risky* at TL0-4, when techniques to clear the lungs and restart breathing weren't generally known (see *Ventilation,* p. 154.). A mistake may mean that your victim dies before you intend.

A *water dungeon* is a water-filled chamber. One version involves placing the victim in such a prison so that only his head is above water. After a few days, he develops skin sores and muscle deterioration. Roll vs. HT daily; each failure means -1 ST and -1 DX. Another variant involves continually pumping in water and giving the prisoner a hand pump. As long as he continues to operate the pump, he won't drown. These tortures were TL4 in the real world.

Most fanciful was so-called "Chinese water torture." This allegedly involved dripping water on victim's head continuously for weeks until he went mad. Supposed examples appeared at TL4.

Whip (TL1)

The whip is a simple, direct torture method, provided that the victim is restrained and unable to flee. Whipping, or *flogging,* was also a common form of corporal punishment. *Caning* is similar, but uses a thin cane rather than a whip; it was more common in Asia. These methods call for little more than the Whip skill (p. B209) and a suitable weapon.

If using a weapons-grade implement – like those in Chapter 5 – the victim will suffer damage as if he were in combat and is unlikely to survive for very long. Thus, less-lethal whips and canes are commonly used for torture and punishment. A light, flexible cane, a knotted rope, or similar specialized device does 1d-4 crushing damage, and is $10, 2 lbs.

Punishment whips do less damage but cause great pain. After being hit, the subject suffers moderate pain for the next second only – but if struck repeatedly over successive seconds, this progresses a step a second to severe pain, terrible pain, and agony. Further blows extend the agony's duration. For rules for pain and agony, see p. B428. Flogging customarily involves the target being pinned or tied down and lashed until he's in agony, giving agony's usual +3 to Interrogation and Intimidation if you stop and make demands.

The Rack (TL2)

This is a wooden frame with wrist and ankle restraints attached to either end. The top restraints can be adjusted by means of a roller and ratchet system. The victim is slowly "stretched" to death as the restraints are ratcheted up, suffering extreme pain at first, then dislocation of joints, and finally separation of limbs from body. Each time the rack is adjusted, roll a Quick Contest: the rack's ST vs. the *higher* of the victim's ST or HT. If the victim loses, inflict swing crushing damage for the rack's ST on *each* limb *and* the spine (see ***GURPS Martial Arts,*** p. 137). Natural DR with the Flexible or Tough Skin limitation has no effect on this damage. A ST 20 rack: $800, 150 lbs.

Iron Maiden (TL3)

Reputedly used in medieval Europe, this grisly device was in fact a Victorian fabrication. As customarily described, it was an iron box shaped in the likeness of a woman, its halves hinged and equipped with adjustable, inward-protruding spikes. The victim was placed within, the box closed, and the spikes slowly inserted, causing much pain . . . but avoiding the vitals to prevent a quick death. If a torturer *did* have such a device, he could inflict 1 point of impaling damage whenever he liked on any body part except the vitals. $5,600, 300 lbs.

Torture Kit (TL2)

This consists of a variety of small devices for causing pain: knives, pincers, hammers, metallic slivers or bamboo splinters, irons for heating in a fire, vises for crushing bones (e.g., thumbscrews), etc. Only the torturer's imagination limits variety and complexity! $150, 8 lbs.

Surgical equipment (pp. 147-149) can also be used as improvised torture equipment.

Chapter Eight
Mobility and Transportation

The pirate's hemiolia was no match for a trireme, and he made no attempt to stand and fight, but set his crew to the oars, abandoning his attack on the merchant's round ship. But Martialis didn't intend to let him get away. "Ready the ballista," he ordered, "and bring up the pitchpots!"

His first shot went over and past the hemiolia – but that was enough to alarm its crew, who redoubled their efforts at the oars, eager to get out of range. Before they could do so, Martialis' men improved their aim, and one of the pitch-filled vessels struck the enemy amidships. Several of the pirate crew abandoned their oars, and before the ballista was ready again, Martialis' bow officer, Lepidus, called out, "I see smoke, captain. We've caught them on fire."

"Let's give them some more, before they put it out," Martialis said – and watched, a moment later, as another pot of burning pitch arced toward the pirate craft. Already some of the pirates were going over the side, seemingly preferring Neptune's cold embrace to Vulcan's hot one.

The cost and speed of long-distance travel influence everything from what imported goods are available at the market to the reach of a ruler's power. Battlefield mobility can decide wars. And exactly how adventurers get around determines where they can seek their fortunes – and at what risks. In short, transportation shapes campaigns.

Unless otherwise noted, equipment for travel and transportation is LC4.

On Land

Travel over land is the oldest form. It's also the most laborious – virtually every TL0-4 option is powered by human or animal muscle. Technological advances help to apply that effort more efficiently, putting more of it into actual travel and less into overcoming gravity and friction.

Personal Land Mobility

The simplest land transportation devices don't carry riders or passengers. Instead, they enable men on foot to cross difficult ground or bring along heavier loads.

Bone Skates (TL0)

The earliest skates were curved pieces of bone strapped to the feet with leather, developed in Finland around 3000 B.C. As they lack sharp edges, they don't cut into the ice but glide over it. The skater can't push against the ice with his feet; he uses hand-held wooden poles. Skating Move is *half* normal land Move. Lack of good traction gives -2 to DX-based Skating rolls to negotiate hazards. $25, 2 lbs.

One-Man Sledge (TL0)

A small platform mounted on two runners, used to drag heavy loads. The runners support all the weight, so the rider doesn't need to lift it. This divides effective load by 2 on snow or ice, or by 1.5 on grass or hard, smooth ground; see *Pulling and Dragging* (p. B353). $50, 20 lbs.

Skis (TL0)

The oldest known skis were used in Scandinavia around 5000 B.C. Skis allow cross-country movement over snow at normal hiking or running speeds; uphill, *halve* Move. Downhill, the rules for gliding flight (p. B56) apply to movement over snow: descending 1 yard adds 1 yard/second to velocity, up to Basic Move × 4. To decelerate, the skier moves onto level ground, where he loses 1 yard/second each turn; on rising ground, he loses an additional 1 yard/second per yard of ascent. Deceleration stops when he's at normal level or uphill speed. A skier may brake more aggressively, making a *DX*-based Skiing roll at -1 per 5 yards/second to stop in one second; he may travel up to his Basic Move while doing so. Anyone within 3 yards downhill of him must make a Dodge roll or be blinded for 1d seconds by a spray of snow! $175, 10 lbs.

The simplest transportation devices enable men to cross difficult ground.

Snowshoes (TL0)

Used by tribal people in cold regions of both the Old and New World since the Paleolithic, the snowshoe was later lost by Europeans, and then rediscovered when Canada was explored. The usual design is elliptical, and both longer and wider than the wearer's foot, allowing movement on top of snow at -1 to Move. Treat all snow as "ankle-deep" regardless of its actual depth (see *Hiking,* p. B351). For long-distance movement, use the Hiking skill; those unfamiliar with snowshoes are at -2 (see *Familiarity,* p. B169). $100, 5 lbs.

Travois (TL0)

This aid to hauling loads consists of two notched poles lashed together at the raised forward end, while the rear ends drag separately on the ground; a flexible platform of basketry, leather, or netting is suspended between them. More elaborate designs have small crosspieces. Divide the weight of any load by 2 on snow or ice, or by 1.5 on soft ground; see *Pulling and Dragging* (p. B353). Some models can be laid flat and hauled over harder ground like a one-man sledge (above).

Travois to be pulled by a man: $25, 12 lbs. Smaller travois, to be pulled by a dog: $12, 6 lbs. *Horse travois* (TL1), to be pulled by a horse: $100, 50 lbs.

Wheelbarrow (TL2)

A Chinese invention, attributed to a general named Liang Chuko (181-234 A.D.). The Chinese model has one large wheel in the middle and storage space on both sides. Divide the effective weight of any load carried in it by 5; see *Pulling and Dragging* (p. B353). The design is difficult to maneuver: -2 to DX rolls for tight turns or sudden stops. $60, 18 lbs.

Ice Skates (TL3)

Modern-style ice skates developed in the Netherlands between 1300 and 1400, when good steel blades became available. By actually cutting into the ice, they provide better traction and maneuverability: no penalty to DX-based Skating rolls to cope with hazards. Improved traction also allows pushing against the ice to attain higher speeds; treat ice skates as granting one level of Enhanced Move (p. B52). $60, 3 lbs.

Riding Gear

Horseback riding was a major mode of transportation over much of Europe and Asia, especially after TL2. Camels and elephants were also ridden, albeit to a lesser extent. All such animal use – for both travel and warfare – benefited from improved riding gear. For additional equipment of interest to mounted warriors, see *Animal Armor* (p. 117).

Equines

Horse-taming goes back to the Chalcolithic; archaeological remains in Ukraine dated to 4000 B.C. show evidence that bits were in use. This technology only became widespread in the Bronze Age; the culture that first developed it is classified as TL0 but advanced in transportation. Since the oldest known wheels developed centuries later in the Middle East, it's almost certain that horseback riding preceded harnessing horses to vehicles. The Asian steppes have been the source of many innovations in riding gear since then.

Riding a horse without gear is difficult in several ways:

- Mounting the horse requires an Acrobatics, Jumping, or Riding roll to leap astride, at -3 plus a penalty equal to encumbrance level (p. B17). The encumbrance penalty also affects Riding rolls to stay seated or use weapons.
- Controlling it by leg pressure requires a Riding roll at -3; see *Hands-Free Riding* (p. 12).
- Riding bareback gives -2 to Riding rolls to stay mounted. It's uncomfortable and fatiguing for both horse and rider, who get -2 to all HT-based rolls to resist FP loss.
- Hard surfaces (such as rock or many city streets) can damage an unshod horse's hooves. Roll vs. HT after a full day of travel, or after any run that lasts long enough to cost FP, at a penalty equal to the *horse's* encumbrance level. Critical failure means one of the horse's feet is crippled.

Any other failure means a sore foot; treat it as crippled, but it will recover after one day of rest.

The equipment bonuses below are cumulative with and offset the penalties above; e.g., a war saddle gives +3 to Riding to stay mounted, canceling out the -2 for bareback riding and giving a net +1, as stated on p. B289. Skill bonuses from basic equipment are limited to negating penalties; they never give a net bonus to Riding.

Similar gear can be used with mules and donkeys – but as these aren't used as war mounts, specialized war tack is unavailable.

Blanket (TL1). A moderately heavy cloth, placed over a horse's back before it's ridden. This prevents chafing of the rider's legs and the horse's sides, and partially cushions the rider's weight, giving both horse and rider +1 to HT-based rolls to resist FP loss. $25, 2.5 lbs.

Bridle (TL1). Developed in Ukraine around 4000 B.C., the bridle is a band that goes around a horse's nose, with straps to keep it in place. It provides an attachment point for reins, and can also be used to lead the horse. A bridle gives a Riding bonus that partly offsets the -3 for controlling a horse by leg pressure: +1 if the reins are held one-handed (net -2), or +2 if they're held two-handed (net -1). $10, 2 lbs.

Bridle and Bit (TL1). A bridle augmented by a mouthpiece – usually made of metal – that fits into a gap between the horse's teeth. This gives the rider enhanced control: +2 to Riding if the reins are held one-handed (net -1), or +3 if they're held two-handed (no penalty). $35, 3 lbs.

Halter (TL1). A piece of harness designed for tying up or leading a horse; it gives +1 to Animal Handling for this purpose. It resembles a bridle but provides no Riding bonus. Conversely, a bridle can't safely be used to tether a horse; a horse struggling to free itself from a bridle can injure itself, suffering thrust-1 crushing damage based on its own ST. Halters are available for many other species of domesticated animals. $5, 1.5 lbs.

Riding Crop (TL2). A length of cane, typically 2'-3', wrapped in braided leather, with a short length of flexible leather at the end. Used to tap or strike a horse's sides, it gives +1 to Riding to control the mount. It *can* be wielded in the same hand that holds the reins. $10, 1 lb.

Saddle, Cushioned (TL2). Developed by the Scythians around 400 B.C., this is a pair of cushions, one for each side of the horse's back, held together by wooden arches front and back. It distributes the rider's weight more effectively, giving horse and rider +2 to HT-based rolls to resist FP loss. It also makes the rider's seat more stable, giving +1 to Riding to stay mounted and *halving* encumbrance penalties to Riding (drop fractions). With horse blanket: $100, 10 lbs.

Saddle, Horned (TL2). Used by the Celts around 100 B.C. and adopted by the Roman army 300 years later, the horned saddle has a rigid frame with vertical protrusions at the four corners. These improve the bracing of the rider's thighs, giving +3 to Riding to stay mounted; even an unconscious rider remains mounted on 10 or less on 3d. Dismounting quickly is tricky: -2 to skill rolls to jump off. A horned saddle *eliminates* encumbrance penalties to Riding, and gives horse and rider +2 to HT-based rolls to resist FP loss. With horse blanket: $200, 20 lbs.

Saddle, Riding (TL2). Used by the Thracians around 300 B.C., the standard riding saddle has a rigid frame that provides a more stable seat than a cushioned saddle, with a low *pommel* in front and a low *cantle* in back. It grants +2 to Riding to remain mounted, *eliminates* encumbrance penalties to Riding, and gives horse and rider +2 to HT-based rolls to resist FP loss. With horse blanket: $150, 15 lbs.

Saddlebags (TL2). Hold 40 lbs. $100, 3 lbs.

Spurs (TL2). This Roman invention dates to the first century B.C. In the later Middle Ages, spurs became emblems of nobility, and were often ornate, usually by being gilded or made of silver. Spurs give +1 to Riding to control a horse. $25, neg.

Horseshoes (TL3). Developed around 1000 A.D., horseshoes protect the horse's feet, especially when it's carrying heavy loads. They give the *horse* +2 to HT-based rolls to resist FP loss; as well, they prevent crippling on hard surfaces. Per set: $50, 4 lbs.

Saddle, War (TL3). This saddle has a pommel in front and a high cantle in back for the rider to brace against. It gives all the benefits of a horned saddle (above), but no penalty to dismount. With horse blanket: $250, 30 lbs.

Stirrups (TL3). Most likely invented in Central Asia, stirrups are shown in Chinese art dated 322 A.D., and reached Western Europe by 700 A.D. They allow vaulting onto a horse with *no* skill penalty, or climbing on more slowly without a skill roll (see p. B396). They give +1 to Riding to control a mount. The rider can stand in his stirrups to attack, gaining the benefit of an extra foot of height over his foe. With a war saddle (but *not* a horned saddle), he can use his leg muscles to press his back into the cantle, creating a firm base for a couched lance; this is standard for Lance skill. $125, 5 lbs.

Holsters (TL4). See p. 96.

Sidesaddle (TL4). Invented by Catherine de Medici, the sidesaddle allows a woman in a full skirt to ride facing forward. Medieval and earlier contraptions forced her to face sideways, with both feet on a footrest, and were unsafe at speeds above a walk: -3 to stay mounted and -2 to control the mount. The version described here has the rider's right leg curled around the pommel so that it can dangle over the horse's left side, braced by a secondary pommel at the saddle's right side; it includes a single stirrup. This design improves effective Riding skill: -1 to stay mounted and *no* penalty to control the mount. It also gives the *horse* +2 to HT-based rolls to resist FP loss; the rider gets only +1, as the saddle requires an awkward twisted posture. Dismounting quickly is tricky: -2 to skill rolls to jump off. $225, 20 lbs.

Camels

One-humped camels, or *dromedaries,* were domesticated in southern Arabia in the Bronze Age, originally for meat, milk, and fiber. Merchants exported them to Somalia, where they were used to carry loads. Trade caravans to northern Arabia introduced them to tribes ancestral to modern Arabs. Camel saddles were invented around 1000 B.C.; saddles suited to combat developed between 500 and 1,000 years later.

Riding a camel offers more options than riding a horse: the rider can sit behind, on top of, or in front of the hump. A rider seated atop the hump gains an extra foot of height in combat. A bareback rider is at -1 to stay seated behind the hump, -2 in front, and -5 on top – the hump has no skeletal support! Riding rolls to control the mount are at -1 for a rider behind the hump, +1 for one in front of it. Riders without bit, bridle, or reins have additional penalties, as for horses (see *Equines,* pp. 133-134). Equipment can compensate for these penalties but not provide a net bonus. On the other hand, camels can be trained to kneel down; no skill roll is needed to mount a kneeling camel.

The two-humped or Bactrian camel – found in India, Persia, and Central Asia – was domesticated as a draft animal after 1000 A.D. It wasn't ridden. Cold-tolerant dromedary breeds later replaced it.

Mats (TL1). An early design for camel gear: several thick mats piled up in front of the hump, creating a high platform. This is normally used for cargo; riders have -2 to Riding to stay seated. The weight is a major burden. $75, 100 lbs.

Bridle and Bit (TL2). Developed when camels came into use as riding animals, these items resemble similar horse equipment; differences of detail reflect the different mouth structure. Bridle and bit give +2 to Riding to control the mount when used one-handed, or +3 when used two-handed. $35, 3 lbs.

Camel Stick (TL2). Used by riders seated behind the hump to reach forward and tap or strike the camel's sides, this stick gives +1 to Riding skill to control the mount. $10, 2 lbs.

Saddle, Cushion (TL2). This is purely a riding saddle. It consists of a loop of padding that circles the camel's hump, held in place by wooden poles at front and back. It grants +1 to Riding to stay mounted. $150, 50 lbs.

Saddle, Early Riding (TL2). Developed in southern Arabia around 1200 B.C., this is the oldest design for a camel saddle. A saddlebow in front of the hump provides support for a cushion behind it. Cargo can be placed on the saddlebow. It gives +1 to Riding to stay mounted. $150, 25 lbs.

Saddle, Framed (TL2). The most familiar sort of camel saddle, this was developed in northern Arabia around 500 B.C. and allowed the use of camels in combat. Saddlebows at the front and back, supported by cushions, are linked by frames along the sides that support a platform on top, where the rider sits, atop the hump. The weight is transmitted to the camel's ribs rather than resting on the hump. This gives +5 to Riding to stay seated (cancelling the -5 for sitting on the hump). $350, 50 lbs.

Saddle, Shoulder (TL2). This North African camel saddle puts the rider on the camel's shoulders. A high pommel and cantle give +2 to Riding to stay seated; in addition, the rider can use his toes to help control the camel, for +1 to Riding. $250, 25 lbs.

Elephants

Elephants have never been truly domesticated, but capture and training of wild elephants goes back to Vedic times in India (1100 B.C.). Ancient empires used them in war, with kings and soldiers riding in *howdahs* and shooting at their foes; the elephants themselves could attack with tusks or trunks, or trample the enemy (see p. 117). Elephants served as war beasts until the development of gunpowder made them too easy to kill.

The elephant's handler, or *mahout,* sits on the elephant's neck, which is broad enough that no skill roll is required to remain mounted. Any passengers ride further back, in a howdah.

Ankus (TL1). This goad is used by riders to control elephants. One end has a sharp metal hook used to tug at sensitive points on the elephant's head or body, especially its ears. It can also be reversed and used to strike the elephant. An ankus gives +1 to Riding or Animal Handling rolls to control an elephant. To use it as a weapon, see its entry in *Melee Weapons* (p. 54). $45, 1 lb.

Howdah (TL2). A platform carried on an elephant's back, strapped in place with ropes. Dimensions are 5' long, 3' wide, and 2' from top to bottom. It provides seating for four riders. Often, a large umbrella is attached as a sunscreen. $675, 450 lbs.

Land Vehicles

The earliest land vehicles traveled on runners (TL0), which work best over snow and ice; thus, they developed mainly in regions with colder climates. Invention of the wheel (TL1) led to the adoption of wheeled vehicles in *many* environments. The wheel wasn't universal, though – New World civilizations used it only as a toy, while the Near East abandoned it after the fall of Rome.

Land vehicles were almost always animal-drawn, and developed where draft animals were available.

Sleds and Sledges (TL0)

These vehicles move on runners. Runners give a smaller contact area with the ground, thereby decreasing friction. On snow or ice, divide effective load by 2; on other smooth surfaces, such as grass or packed sand, divide by 1.5. Skis (p. 133) use the same principle.

For short hauls – as at construction sites – smoothed logs may be laid side by side as rollers. This expedient divides effective weight by 5. It's a crude substitute for wheels, with the revolving surface on the ground rather than being part of the vehicle. Rollers are also used to launch water vehicles from work sites ashore.

Dogsled (TL0). The classic arctic vehicle, as used by Inuit tribes. Long enough for a man to lie down on; alternatively, he can load it with gear and run alongside. The version in the table is drawn by 14 dogs, each on a separate leather trace. It's made of bone and leather rather than wood.

Fifty-Man Sledge (TL1). Used for such tasks as hauling construction materials, this is similar to the one-man sledge (p. 133), but much more massive. The load sits on a flat platform, which rests directly on two runners.

Sleigh (TL4). Dating to the 17th century, this is a horse-drawn vehicle with runners, designed for use on snow. The model in the table is a one-horse vehicle with a seat wide enough for two people.

Litters (TL0)

Litters are passenger carriers supported on the shoulders of porters instead of contacting the ground directly with wheels or runners. A litter moves no faster than walking speed, limited by its weight and that of its rider, but can be used on almost any terrain that can be walked over. Those carrying it use the Hiking skill – and if they try intricate maneuvers, each must make a *DX*-based Hiking roll at a penalty equal to the number of bearers.

Litters aren't on the *Land Vehicles Table* (p. 137) because they use the lifting and hiking rules, not those for vehicles. Indeed, they could be seen as personal mobility devices – or even as riding gear!

Litter (TL0). The simplest litter is a stretcher made from two wooden poles with leather or heavy cloth fastened between them. The passenger lies down between the poles, which are lifted to the shoulders of two bearers. The design isn't unlike a travois, but held up at *both* ends; thus, the porters must be able to support the full load. $100, 25 lbs.

Sedan Chair (TL1). This conveyance carries a seated passenger. The seat rests on two poles that extend to the front and back, which are carried on the shoulders of two bearers. A basic sedan chair is an exposed seat, but a common feature of ornate models is enclosure. Curtains add 5 lbs. to basic weight; actual walls and doors add 25 lbs. Such embellishments are common because sedan chairs are used mainly by the wealthy, and by ordinary people on special occasions (e.g., Chinese brides traditionally went to their weddings in enclosed sedan chairs). $250, 60 lbs.

Palanquin (TL2). A larger sedan chair used in ancient India. It's long enough for the rider to stretch out on a cushioned floor, and always enclosed. The poles are more widely spaced and supported by *four* bearers. Often, six porters are employed, allowing pairs to take breaks in rotation. $1,000, 100 lbs.

Horse Litter (TL3). Developed by the Normans in about 1100 A.D., this device resembles a stretcher, but is borne by two horses harnessed between its shafts. Thus, it's wider but requires longer poles. It enables faster transportation of the wounded. Controlling the horses requires a Teamster roll at -2. If the passenger is desperate enough to stand up and attack, he has -3 to combat skills for bad footing. $250, 75 lbs.

Carts and Wagons (TL1)

The wheel evolved through several stages. The earliest wheels were made from logs by cutting away most of the wood in the middle, leaving a narrow shaft joining two discs near the ends. Wheels and axle were a single, solid piece. Because such wheels couldn't rotate at different speeds, vehicles that used them were hard to turn.

This design gives -2 to Handling. At the GM's discretion, this flaw may be added to the oxcart or straddle car in the *Land Vehicles Table* (p. 137). Treat it as a variation on the *cheap* modification (see *Cheap and Expensive Gadgets,* p. 14): -0.5 CF.

Later wheels were separate from the axle and turned freely on it. The first such wheels were solid discs cut from single trees or, eventually, pieced together from smaller planks, making them heavy and stiff. More advanced models, starting with Egyptian and Chinese chariot wheels, had spokes.

Riders in a vehicle with wooden wheels endure considerable jolting. With spoked wheels, this costs 1 FP/hour on Good terrain, 2 FP/hour on Average terrain; with solid wheels, *double* these costs. Such vehicles can't negotiate Bad or Very Bad terrain (for definitions of terrain types, see *Terrain,* p. B351). However, travelers can avoid the FP costs for carrying baggage by putting it on their vehicle.

Oxcart (TL1). One of the world's oldest utility vehicles, found over most of Europe and Asia, where it has hauled farm products to market for millennia. Two oxen, yoked together, pull a two-wheeled cart. The "driver" usually walks, leading the oxen; this still calls for the Teamster skill, since he's guiding animals that are pulling a vehicle. Oxcarts are driven at a walk, for no more than five hours a day; this limits the distance they can cover.

Wagon (TL3). This is a heavier vehicle drawn by two draft horses, with a seat in front for the driver.

War Wagon (TL3). The *tabor* or war wagon (*hradba vozova,* in Czech), developed by Jan Žižka during the Hussite revolts of the early 1400s, turned the wagon into a kind of early armored personnel carrier. The vehicle is drawn by four draft horses and has a 20'-long rectangular body. Its heavy wooden sides are 3'-4' high, above which can be raised hinged boards with firing slits to provide cover to soldiers shooting bows, crossbows, or handheld gonnes; some tabors have additional hinged boards that swing down to provide shelter *under* the wagon. A typical force consists of 10 wagons, which are drawn up in a square formation with the protruding front wheels of one vehicle chained to the rear wheels of the next; the horses are unhitched and led into the formation's interior by the drivers. The side of the tabor facing into the square may have doors for easier access. Pavises (see *Movable Cover,* pp. 116-117) can be placed to screen the gaps between wagons. The result is effectively a mobile fort that can be set up anywhere wagons can be driven. A tabor's standard crew is two drivers, two men with gonnes, six crossbowmen, four men with flails, four halberdiers, and two men to handle the pavise. As a combat vehicle, the tabor is LC1 – but the Hussites who developed it were rebels who weren't worried about legality!

Chariots (TL1)

Chariots were primarily war vehicles. From the Celtic tribes of Britain to the Chinese kingdoms, they dominated late Bronze Age warfare and remained in use for specialized functions into the Iron Age. They acquired nonmilitary functions during the latter period, from prestige transportation for rulers to racing in the Roman Coliseum.

Attacking from a chariot is *challenging* – it isn't a smooth ride at the best of times! If the chariot has spoked wheels, all ranged attacks are at -1 even on good roads or level, smooth terrain. This falls to -3 on bad roads, mildly hilly terrain, or level ground with a slightly uneven surface. Melee attacks at Move 7+ are at -1; over uneven ground, apply another -2 to melee attacks and -1 to active defenses for bad footing. Solid disc wheels on early chariots absorb shock poorly, giving a *further* -2 to *all* attacks and -1 to active defenses.

While chariots are fundamentally military vehicles, any noble might own one. Treat them as LC2 prestige goods (see *Luxuries,* p. 36).

Heavy Chariot (TL1). A large, massive chariot, drawn by four ponies and carrying three men: driver, warrior, and shield carrier. A U-shaped wooden screen rises to waist height at the front and sides, protecting the riders against attacks from foot soldiers. Such chariots are used to charge directly at infantry or other chariots, with the aim of forcing them to break formation. This design was particularly favored by the Hittites of Anatolia (now part of Turkey); it was also used in China during the Warring States period (481-221 B.C.). The *scythed chariot* (TL2) is a heavy chariot with cutting blades mounted on its axles at an angle, introduced by the Assyrians and later adopted by the Persians. Treat this as inflicting cutting damage, based on the chariot's Move and HP as for a collision (p. B430). This only works well against close formations; soldiers in open formations normally have time to step aside.

Light Chariot (TL1). A vehicle designed as a shooting platform for an archer armed with a powerful composite bow. It carries two standing men – driver and archer – and is pulled by two ponies. It has a waist-height screen like the heavy chariot, but this is usually made of leather or basketry with a light wooden frame. The standard tactic is to ride past the enemy army, shooting at them. Such chariots are made light enough to be carried by one or two men over rough terrain.

Straddle Car (TL1). This early precursor to the chariot is drawn by an onager (a kind of donkey), not by a pony. It has *no* protection for the rider – and indeed, no floor! The driver sits just above the axle, legs dangling to either side of the central pole, on a seat resembling a low-tech bicycle saddle. Straddle cars normally aren't driven into combat; they're used mainly to ride to the battlefield, where the warrior fights on foot.

Battle Car (TL2). This Irish light chariot variant weighs even less than the usual Near Eastern version, and lacks a screen for the two riders. The warrior carries several javelins rather than a bow; he may throw them at foes, or run out onto the yoke to strike at them. Typically, he later dismounts to fight on foot.

Coaches and Carriages (TL4)

Coaches and carriages provide a smoother, more comfortable ride than any earlier wheeled vehicle. The body isn't mounted directly on the axles, but suspended by leather straps, providing shock absorption. *Halve* any FP costs for jolting, rounding down.

Carriage (TL4). A small vehicle, used for city transportation; both London and Paris had fleets of carriages for hire in the 17th century (from 1605, in London). The *hackney carriage,* described here, was drawn by two horses.

Coach (TL4). The coach on p. B464 is a *stagecoach,* one of the major types of four-in-hand coach, pulled by four horses with an advanced harness that lets a single driver manage them. This arrangement is also called a "coach and four." It entered use around 1640.

Land Vehicles Table

Terms and notation are as defined in *Vehicle Statistics* (pp. B462-463).

TL	Vehicle	ST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ.	DR	Range	Cost	Locations
TEAMSTER													
0	Dogsled	27†	0/2	12	6/6	0.29	0.14	+1	1	2	F	$400	14DER
1	Fifty-Man Sledge	77†	-4/5	12c	2/2	4.0	0.5	+2	–	12	F	$2.5K	50DR
1	Heavy Chariot	23†	0/2	11c	3/7*	0.39	0.3	+2	1+2	2	F	$660	4DE2W
1	Light Chariot	16†	+1/1	11c	4/9*	0.23	0.2	+1	1+1	1	F	$330	2DE2W
1	Oxcart	34†	-3/3	11c	1/1	0.9	0.6	+1	–	2	F	$340	2D2W
1	Straddle Car	14†	0/2	12c	2/5	0.12	0.1	+1	1	0	F	$165	1DE2W
2	Battle Car	14†	+2/1	11c	4/10*	0.22	0.2	+1	1+1	1	F	$250	2DE2W
3	Wagon	35†	-3/4	12c	4/8*	0.84	0.5	+2	1	2	F	$680	2DE4W
3	War Wagon	50†	-4/5	12c	3/6*	3	2	+4	2+18	5	F	$2K	4DE4W
4	Carriage	47†	-1/2	10c	4/10*	1.6	0.8	+2	1+6	2	F	$7.5K	2DO4W
4	Coach	54†	-2/3	12c	4/9*	2.4	1.2	+3	1+9	2	F	$11K	4DO4W
4	Sleigh	23†	0/2	10c	4/6	0.3	0.2	+1	1+1	1	F	$2K	1DOR

On Water

People have been going into the water for a long time – one very speculative theory claims that many human traits are adaptations to a partially aquatic lifestyle! Mankind's most notable adaptive mechanism is *technology.* This has certainly played a major role in our activity on the water, in forms ranging from inflated leather floats through sailboats to nuclear-powered warships. While it's unclear when such innovation began, Paleolithic societies were island-hopping on rafts or canoes 30,000 years ago, and improvised floats could be even older.

Personal Water Mobility

Even before boats, early man developed aids to swimming, or to crossing water in other ways.

Floats (TL0)

Floats are the starting place for all watercraft. A float is any small object, lighter than water, which a swimmer can hold onto or fasten to his body for added buoyancy. Its buoyancy subtracts from the user's encumbrance, and if buoyancy exceeds encumbrance, the float gives a Swimming skill bonus equal to (excess buoyancy/swimmer's weight) × 8, rounded down, to a maximum of +8. Floats don't improve swimming speed. Indeed, they may *reduce* it by increasing water resistance or by occupying the arms to such an extent that the user has limited mobility.

Floats can vary greatly in construction, and be of any size. Some are solid blocks of a material that's less dense than water; others are hollow, and get their buoyancy from the air they contain. Most can be described by their buoyancy, weight when carried on land, and cost – all given *per cubic foot* (cf) here. Buoyancy and weight sum to 62.5 lbs. per cubic foot (the density of water).

Float	*Buoyancy*	*Weight*	*Cost*
Clay Pot	55 lbs./cf	7.5 lbs./cf	$3/cf
Inflated Skin	60 lbs./cf	2.5 lbs./cf	$7.50/cf
Reed Bundle	47.5 lbs./cf	15 lbs./cf	$12/cf
Wood Block	32.5 lbs./cf	30 lbs./cf	$12/cf

Logs: It's convenient to figure a log's statistics from *length* rather than volume. For a 12"-diameter log, buoyancy is 25 lbs., weight is 25 lbs., and cost is $6 – all per foot of length. For other diameters, multiply these three figures by the *square* of (diameter/12"); e.g., a 6"-diameter log has a multiplier of 0.25, making buoyancy and weight 6.25 lbs., and cost $1.50, per foot.

Surfboard (TL0)

The surfboard was developed in Hawaii before European contact. There, riding the waves was a sport for chiefs, comparable to jousting for medieval Europeans. Surfing uses the Sports (Surfing) skill. Speed on the best waves might reach Move 12-15, but paddling is seldom faster than Move 1. A nobleman's board (15'×18"×5"): $100, 150 lbs. A commoner's board (smaller, averaging 10' long): $75, 100 lbs.

Float Bridge (TL2)

A fourth-century Roman military text describes this contraption as the *ascogefyrus.* Skins are worked to form flattish air sacs instead of round ones, inflated with bellows, and rolled up and carried to a river, where they're unrolled and tied into place. Unrolling takes a second per yard and produces a 4'-wide walkway. Footing is unreliable; use the rules under *Rafts* (below). Buoyancy is 720 lbs./yard, but the top can only support 310 lbs./yard without buckling. Per yard: $200, 30 lbs.

Riding on Logs

Instead of clinging to a log while floating in the water, one can sit astride it or even stand on it. Of course, the log may roll over! Straddling a log, roll vs. DX at +4 to complete your journey without getting dunked; make one additional roll per stretch of rough water encountered. Standing on a log, these rolls are against *unmodified* DX. Walking carefully along the log at Move 1 requires no additional rolls – but if running any faster, roll every second. Perfect Balance gives +6 to all these rolls.

Rafts

A raft consists of floats of any kind lashed together with ropes or thongs. The result is a flat surface for passengers to stand on. Individual floats may be solid or hollow, but the raft gets all its buoyancy from their lightness – it has no interior space.

A raft's surface flexes with the water beneath it or the shifting of its load. Roll vs. DX at -4 to move around or at -2 to stand in place. Combat is at -4 to attack and -2 to defend for bad footing. A raft made from logs or reasonably long reed bundles only flexes in one dimension; *halve* all these penalties. One held together rigidly with wooden crosspieces, pegs joining adjacent logs, or very tight cords causes combat penalties only (still halved, if made from long pieces); make rolls for balance only if the whole raft shifts because of water turbulence or large waves, and use unpenalized DX. Perfect Balance grants +6 to these DX rolls.

The *Rafts Table* describes two-yard-square sections of raft; for bigger rafts, assume multiple sections of this size. One section provides footing for up to four people, but is crowded for more than one; in a fight with two combatants, the loser may go over the edge! The specified load has the top of the raft barely above the waterline, with low waves washing over it; cutting the burden by 50% gives freeboard equal to 25% of the raft's thickness.

Rafts Table

Terms and notation are as defined in *Vehicle Statistics* (pp. B462-463).

TL	Vehicle	ST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ.	DR	Range	Cost	Locations	Draft
BOATING/TL (UNPOWERED)														
0	Logs, 4"	58†	-2/2	12c	1/1	0.29	0.10	+2	1	4	F	$95	E	0.3
0	Logs, 7"	66†	-2/2	12c	1/1	0.48	0.20	+2	2	7	F	$140	E	0.5
0	Logs, 10"	73†	-2/2	12c	1/1	0.68	0.30	+2	3	10	F	$195	E	0.7
0	Logs, 12"	79†	-2/2	12c	1/1	0.88	0.40	+2	4	12	F	$240	E	0.9
0	Reeds, 6.5"	58†	-2/2	10c	1/1	0.59	0.40	+2	4	2	F	$330	E	0.5

Rafts often simply drift with water currents. They can be propelled in shallow water by *poling* with a wooden pole from 12' to 20' long. The pole must be held at an angle to produce horizontal thrust, so the maximum depth of bottom that can be reached is 85% of pole length. Poles can also be used to fend off obstacles. At TL1+, a raft may have a square sail.

Unlike boats and ships, which have complex structures and are treated as Unliving, rafts are considered Homogenous.

Boats and Ships

Where a raft works like a solid float made of light material, a boat functions as a *hollow* float that gains buoyancy from its air content. Typical boats have interior spaces open at the top, with the water kept out by walls that rise above the water level.

At TL0, boats are normally made from a single piece of material. This may be a solid object that has been painstakingly hollowed out (such as a dugout), or it might consist of something flat that has been shaped to enclose an interior space, usually with some sort of framing (e.g., a bark canoe or a skin boat). Ceramic vessels large enough to serve as boats, used in parts of India, are TL1; they're too breakable for rocky or fast-moving streams, and none are described here.

The major change at TL1 is the development of the plank boat, such as the European rowboat or East Asian *sampan.* Where TL0 craft can't easily be enlarged beyond the limits of the material, TL1 designs add planks to build up the sides. This allows scaling up to much larger craft, from wider boats to full-scale ships (for *big* ships, see ***GURPS Low-Tech Companion 2*** and ***3***).

Propulsion for boats at TL0 involves poling or paddling, or occasionally improvised towing methods. The more efficient technology of rowing is TL1. Paddling uses only the arm muscles; in rowing, the oarsman can brace against a seat within the boat, letting him use his full body strength. A less common technique is single-oar sculling, in which a large oar that pivots at the stern – such as a *yuloh* (from Chinese *yaolu*) – is swept from side to side. Use of harnessed draft animals for towing also starts at TL1.

The most important TL1 innovation, however, is the sail – initially in single-masted craft, usually with square sails that are best-suited for running before the wind (although the Polynesian *proa* design can sail into the wind quite efficiently). Vessels with small auxiliary sails emerge at TL2, as do early fore-and-aft rigs, which are more capable of sailing into the wind. By TL4, craft may have three or four masts, and ships with two or more masts can be full-rigged, combining square and triangular sails to great effect.

Warships up through TL3 find sails too unreliable. Two important TL2 developments are multiple rows of oars down each side of a ship (as in the *trireme*) and multiple men working the same oar (as in the *quinquereme* and, later, in Byzantine warships). Variants on both designs remain in use into late TL3. At TL3, the Chinese experiment with paddlewheels powered by men on treadmills (see ***GURPS Low-Tech Companion 2***).

Boats at TL0 are steered with a paddle dipped into the water at the stern. At TL1, this evolves into the permanently attached steering oar. Ships at TL3-4 usually have rudders, attached at two points rather than one, so that they can be rotated around a vertical axis. Early European ships have single or paired side-mounted rudders; later European ships, and most Chinese junks, have one rudder mounted at the ship's rear, on its midline.

Bark Boats (TL0)

A bark boat, or *canoe,* is made from a single piece of bark taken from a tree whose bark can be stripped off in large sheets; e.g., birch, elm, or hickory in North America, eucalyptus in Australia, or spruce in North America and Scandinavia. This is bent into a semi-cylinder with width between 1/8 and 1/5 of length, with its ends curving up. Then the ends are sealed, usually by sewing them up – although improvised boats may have the ends blocked off with grass and clay, or simply bent up out of the water. Such vessels are speedy but unstable. Most have some internal framing to hold their shape, but not enough to support oarsmen; they're usually propelled by paddling. Construction is very light, with walls averaging just half an inch thick.

Large Bark Canoe (TL0). A large but comparatively light canoe, 20' long and 3' wide, that holds four men seated in a single row.

Voyageur Canoe (TL4). A distinctive, very large bark canoe used for trade in Canada after European contact. The body is 35' long and 5' wide, and holds 14 paddlers seated side by side in seven pairs, plus a steersman and 4 tons of cargo. The construction, influenced by European boatbuilding traditions, is sturdier than for traditional canoes.

Hide Boats (TL0)

Animal-skin boats have been in use since the Stone Age in area without large trees, including arctic, desert, and plains environments, and rocky regions like western Ireland. Skins are stretched over a light wooden frame that gives them a definite shape, chosen by the builder; this may be anything from a nearly circular *coracle* to a narrow *kayak* with two pointed ends. Construction is extremely light – one man can carry a small hide boat. These vessels are usually paddled; the frame isn't rigid enough to support oarlocks.

A variation on this design is a circular or oval boat with a basketry frame. It's made watertight by stretching hides over the frame or by sealing it with tar – in Mesopotamia, for example, thanks to its petroleum deposits.

Kayak (TL0). A one-man watercraft used by Inuit hunters; the Siberian *baidarka* is similar. The design is fast and maneuverable, with a long, narrow body, traditionally three times the owner's height (15'-18') and no more than 27" wide. The deck is roofed-over and the rider's torso protrudes through a narrow opening, which fits too tightly for water to enter. Kayaks are famously easy to right if capsized; this calls for a Boating (Unpowered) roll at -3. Propulsion comes from a double-ended paddle. Made of sealskin framed with wood or whalebone, the vessel is light enough for one man to carry. A few kayaks have two or even three seats.

Oblong Hide Boat (TL0). Comparable to the Irish *coracle,* this craft is fairly round but somewhat longer than it is wide. Use the same statistics for Vietnamese fishing boats made of bamboo matting and sealed with resin. Typical dimensions are 5' long and 2/3 as wide. Propulsion is by paddling.

Round Hide Boat (TL0). A circular watercraft made of hides with a light wooden frame, such as the Plains Indian bull boat or the bamboo-framed *parical* of South India. The Mongols used a similar boat, called *pi* in Chinese. Use the same statistics for the ancient Mesopotamia *quffa* (TL1), made of basketry with an external coat of tar. The boat on the table is 5' in diameter.

Large Hide Boat (TL1). A craft framed with substantial timbers and covered with several large hides, such as the Inuit *umiak,* the similar Siberian *baidara,* or the Irish *currach* (used into modern times – and the vessel in which legend claims St. Brendan made his voyages over the Atlantic Ocean). These craft are "boat-shaped," with curved sides, steered by an oar at the stern, and propelled with oars or a sail. Typical dimensions are 36' long, 6' wide, and 3' high.

Log Boats (TL0)

A basic log boat, or *dugout canoe,* is made by taking a large tree and hollowing it out with fire or cutting tools, leaving a roughly U-shaped rigid shell. Such a vessel is much heavier than a bark canoe, with walls averaging 2"-3" thick. It's also more seaworthy; the ancient Polynesians crossed the Pacific Ocean in craft like this. Log boats can be produced wherever good-sized trees grow.

There are ways of increasing a log boat's size that don't work for a bark canoe. It can be *extended* by joining two logs end to end. It can be *expanded* by using hot water, hot oil, or smoke to soften the wood and then bending the sides outward. And it can be *built up* by adding a board along each side – a first step toward a plank boat (below). A dugout can also have a second log parallel to the first, yielding either a comparatively small outrigger canoe or a full-scale double canoe; both designs are common around the Pacific.

Dugout Canoe (TL0). A very basic log boat, suitable for one man, made from a log 8' long and 2.5' in diameter.

Long Dugout Canoe (TL0). A basic dugout made from a bigger log, 30' long and 3' in diameter. It can accommodate more paddlers for its length by placing them alternately on the left and right sides, taking advantage of its width.

Outrigger Canoe (TL0). A long dugout canoe equipped with an *outrigger:* a smaller log, 15' long, attached to its midsection by several 3' poles. This provides added stability in the water. Such craft are well-suited to lengthy ocean voyages, such as the Polynesian expansion through the Pacific Ocean. The outrigger is designated R, like a runner or skid, on the *Boats and Ships Table* – and like those components, is treated as vehicle hit location 15-16.

War Canoe (TL0). A very large dugout canoe, such as the Maori war canoe of New Zealand, carved from a single kauri pine whose sides are expanded to provide room for two paddlers side by side. Its length is 60' and its beam 5'. Similar craft are found in the Pacific Northwest; in areas with smaller trees, they may be made by joining two trees end to end. Treat war canoes as LC1.

Double Canoe (TL1). This sailing vessel is similar to those used by the Polynesians who colonized the Pacific. Two long dugout canoes are held side by side, 10' apart, by a frame that supports a mat platform 15' square. Above this is a mast bearing a *proa* sail, a distinctive design that can be used to beat upwind by shunting (see *Sailing Against the Wind,* p. 141). There's room for half a dozen paddlers in front of the platform and behind it; the portion of the canoes that's under the platform is used for storage. The two canoes together make up the craft's body; if an attack could hit either, assign it randomly to one or the other. If one canoe leaks, the craft may be threatened by tipping.

Plank Boats (TL1)

The first vessels made entirely of planks had one bottom plank and two side planks. The East Asian *sampan* – meaning "three boards" – was of this type. Larger boats, and eventually ships, could have many side planks rather than just one per side.

Plank boats can be any shape that has a definite fore and aft. Barges have rectangular hulls with straight sides; other craft have curving sides. Bow and stern may be pointed, rounded, squared-off, or "boat-shaped" (pointed in front and squared-off at the rear). The bottom may be flat, rounded, or V-shaped. Cargo carriers are commonly rounded or rectangular, to give them more interior space; warships tend to be narrow, with pointed prows and V-shaped bottoms, for better speed.

The simplest designs are nothing but shells made from planks, either edge-joined or overlapping ("clinker-built"). Planks can be held together by sewing, wooden pegs, or metal nails (mainly at TL3+). Waterproofing comes from the shell's tight fit. In larger plank boats, adding an internal frame can increase structural strength – partly by preventing the craft from flexing into shapes that strain the hull.

At TL3, a radically different approach emerges: building the frame first, fastening the hull timbers to the frame, and then caulking in between to waterproof the vessel.

The heavier framing of plank boats lets them carry oarsmen, or support one or several sails on masts. Small auxiliary masts were introduced on Roman ships at TL2. Two- and three-masted ships came into use in Europe at TL3 – and the Chinese in the same period built junks with as many as *nine* masts!

River Barge (TL1). A fairly large, flat-bottomed, rectangular vessel suited to hauling bulk cargo up and down river, or ferrying freight and passengers *across* a river. This is effectively a big open box, 40' long, 7.5' wide, and 1' high, very slightly tapered toward the ends. As a ferry, it's poled by four men on each side; the table entry assumes this. For travel up river, it must be towed.

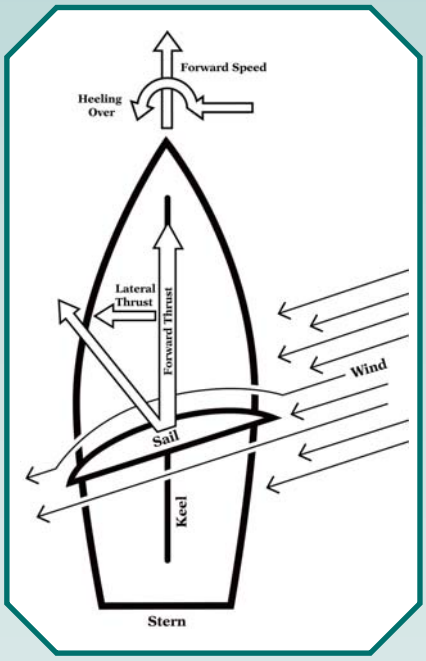
Sampan (TL1). This is the starting point for East Asian boat and ship design: a flat-bottomed boat made from one bottom plank and two side planks. Typical dimensions are 15' long, 4' wide, and 1.5' high. The side planks converge in front in a pointed prow; the stern is squared-off. The craft has one advanced design feature, thought to have been inspired by the structure of bamboo: bulkheads divide its interior into several watertight segments, making it very hard to sink. Propulsion is normally single-oar sculling with a *yuloh;* in shallow waters, it can be poled.

Sewn-Plank Riverboat (TL1). A boat in the Egyptian style, assembled from planks of acacia (or expensive imports such as cedar) averaging 3' long, sewn together edge to edge. Dimensions are 30' long, 7' wide, and 2.5' high. Both ends taper to points. It's usually propelled with paddles wielded by four pairs of crewmen. A lookout on the bow uses a sounding pole (p. 52) to feel for snags, while a helmsman in the stern steers with a paddle held in the water.

Fishing Boat (TL2). A boat constructed in the shell-first style of the ancient Mediterranean, with planks joined edge to edge and pegged together. Construction is light, with minimal framing. Dimensions are 27' long, 7.5' wide, and 4' high; the bow is pointed, while the stern is squared-off. Propulsion is by two pairs of oars. Primarily used for fishing, but can be adapted to carry cargo or up to 10 passengers.

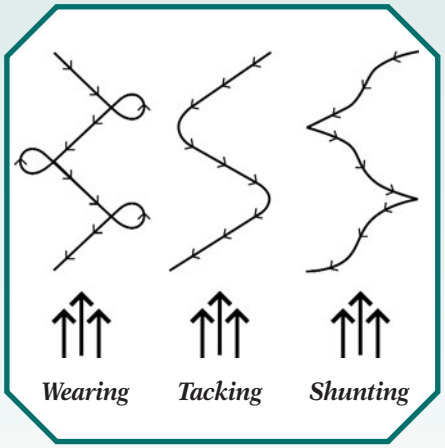
Sailing Against the Wind

Many sailboats can travel in a direction opposite to that in which the wind is blowing. If the sail is parallel to the wind rather than across it, then as the wind blows past, it generates aerodynamic lift that pushes at right angles to it. If the boat has a keel (or the equivalent, such as a canoe's long body or a junk's deep rudder), setting the sail at an angle to the hull means that the part of the thrust that's directed along the hull propels the ship, while the component that's directed sideways has little propulsive effect. Rather, it makes the ship heel over.



No ship can sail straight into the wind; it must always sail at an angle to the airstream. Holding a steady course into the wind necessitates zigzagging back and forth, putting the wind alternately to port and starboard. There are three different methods of doing this:

- *Wearing* is turning to sail away from the wind, and then looping around to sail upwind at the opposite angle, so that the ship turns through roughly three-fourths of a circle, tracing a series of loops. This is the only method of beating upwind available to square-rigged ships.
- *Tacking* is turning the ship's prow straight into the wind, losing speed while doing so, but then continuing the turn until the wind is coming from the other side.
- *Shunting* is turning to face at right angles to the wind, and then turning the sails completely around to sail the ship stern-first, pointing the stern into the wind. This requires a hull that's pointed at both ends, as in Polynesian canoes. The sail is turned by picking up and rotating the entire mast.



Square-Rigged Sailboat (TL2). This is a Romano-Celtic craft of the British Isles under the later Roman Empire. Its planks are laid edge to edge, but not fastened together.; rather, they're nailed to framing timbers, and the gaps are caulked. Dimensions are 37.5' long, 10' wide, and 3' high; both bow and stern are pointed. A single 25' mast a third of the way back from the bow holds a square sail. Construction is sturdy enough for use in bays and coastal waters.

Faering (TL3). A boat constructed much like the square-rigged sailboat (above), but with 3-4 pairs of oars, used in the Viking era – although the same stats can represent a variety of medieval oared boats. Typical size is 20' long, 4' wide, and 2' high. It can be used in coastal waters for fishing or transport, or as a tender for a larger ship.

Sewn-Plank Sailboat (TL3). A boat of the design traditionally used in the Indian Ocean, with long planks stitched together, and little or no frame. The hull's flexibility is actually an *advantage* for operating in coastal waters. A single mast carries a large lateen sail, which is efficient for sailing into the wind but too heavy for tacking; instead, the ship relies on wearing (see *Sailing Against the Wind,* p. 141). At 22' long and 5' wide, this craft is comparatively small, and suited for fishing or local travel.

Brig (TL4). This two-masted sailing vessel carries square sails – a configuration that requires a larger crew to handle the sails than on a fore-and-aft rigged ship (such as the sloop, below). The example in the table is fairly small: 50' long, 18' wide, and 10' from top to bottom. Its sail configuration is best suited to long sea voyages running before the wind; it's less efficient for beating upwind, and thus not ideal for working in close to shore.

Rowboat (TL4). Not a specific vessel but a broad category of European boats – all propelled by a small number of oarsmen, and built with overlapping planks, pointed prows, and flat sterns. The table offers two examples. The *longboat* is 30' long and 4.5' wide, with four pairs of rowers and a coxswain; it was used between 1515 and 1867 as a ship captain's boat. The *jolly boat* is 18' long and 4' wide, with three pairs of oarsmen, and used as a ship's small utility boat, customarily lowered off the stern.

Sloop (TL4). A one-masted sailing vessel, developed in the Netherlands in the early 1600s. The mast is placed in the craft's forward third, and carries two triangular fore-and-aft sails, giving it the classic triangular "sailboat" silhouette. The one in the table is comparatively small: 21' long, 7' wide, and 6' high. A 3' bowsprit gives added sail area. Good maneuverability and the ability to sail close to the wind make this design useful to adventurers; larger sloop-rigged ships were favored by pirates. A *cutter* is similar, with the mast further aft.

Boats and Ships Table

Terms and notation are as defined in *Vehicle Statistics* (pp. B462-463).

TL	Vehicle	ST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ.	DR	Range	Cost	Locations	Draft
BOATING/TL (SAILBOAT)														
1	Double Canoe, 30'	60†	+1/3	12c	1/3	3.2	1.5	+5	6+6	2	–	$14K	EMOS	2
1	Large Hide Boat, 36'	25†	0/2	12	1/4	3.34	3.22	+6	2+1	2	–	$1K	MO	2
2	Square-Rigged Sailboat, 37.5'	61†	-1/2	12c	1/4	7	5.25	+6	3	1	–	$15K	MO	1
3	Sewn-Plank Sailboat, 22'	40†	+1/2	11c	1/3	2.2	1.7	+4	4	1	–	$1.4K	MO	1
4	Brig, 50'	131†	-2/3	12c	0.25/4	70	52.5	+7	15+10	3	–	$165K	2M	5
4	Sloop, 21'	43†	0/2	12c	1/3	2.4	1.8	+4	3+3	2	–	$5K	M	3
BOATING/TL (UNPOWERED)														
0	Dugout Canoe, 8'	24†	+1/1	12c	1/2	0.26	0.15	+1	1	2	F	$920	O	1
0	Kayak, 18'	14†	+2/1	12	2/3	0.12	0.1	+3	1	1	F	$500	E	1
0	Large Bark Canoe, 20'	22†	+1/1	12c	1.25/3	0.88	0.8	+3	4	1	F	$220	O	1
0	Long Dugout Canoe, 30'	40†	0/1	12c	1/3	2.75	2.25	+4	12	2	F	$4K	O	2
0	Oblong Hide Boat, 5'	16†	0/1	11c	1.5/2	0.18	0.15	+1	1	1	F	$85	O	1
0	Outrigger Canoe, 30'	45†	0/2	12c	1/3	2.95	2.25	+5	12	2	F	$6K	OR	2
0	Round Hide Boat, 5'	23†	-1/2	10c	0.4/1	1.3	1.2	+2	2	1	F	$280	O	1
0	War Canoe, 60'	66†	-2/2	12c	1.25/4	5.8	3.6	+6	30+1	3	F	$18K	O	2
1	Fowling Boat, 16'	29†	0/1	12c	1/1	0.52	0.32	+2	2+1	0	F	$560	3E	1
1	Large Hide Boat, 36'	25†	0/2	12	2/4	3.34	3.22	+6	10+1	2	F	$1K	O	2
1	River Barge, 40'	56†	-2/3	12c	0.5/1	4.2	2.8	+6	9	3	F	$12K	O	1
1	Sampan, 15'	22†	+1/2	13c	1.5/3	0.28	0.2	+3	1+1	2	F	$1.8K	O	1
1	Sewn-Plank Riverboat, 30'	40†	0/2	11c	1.25/3	2	1.5	+4	10+2	2	F	$1.4K	O	1
2	Fishing Boat, 27'	43†	0/2	11c	0.6/3	2.1	1.5	+4	5	1	F	$5K	O	1
3	Faering, 20'	32†	+1/1	12c	1.25/3	1.25	1	+3	6	2	F	$2.5K	O	1
4	Jolly Boat, 18'	36†	0/1	12c	1/3	1.35	1	+3	6+2	2	F	$3K	O	0.7
4	Longboat, 30'	43†	+1/1	12c	1.25/3	1.75	1.15	+5	9+2	2	F	$5K	O	1
4	Voyageur Canoe, 35'	33†	+1/2	14c	1.25/4	5.78	5.5	+5	15	2	F	$1.9K	O	2

Reed Boats (TL1)

Strictly speaking, a reed "boat" is a kind of *raft* – it has no hollow interior, but floats because its material is lighter than water. It's called a boat because of its shape (oblong or pointed) and the way it handles in the water. Reed boats become waterlogged with use; tight binding of the reed bundles prolongs their useful life. Small, tapering logs can be bound together to form comparable watercraft.

Reed boats made from papyrus were common in early Egypt. The top surface was sometimes covered with planks to give better footing; historians speculate that this development may have been a step toward boats made entirely of planks. The unusual Egyptian wishbone mast – attached to either side of a boat's hull – might have been developed for use with reed boats, which had no keel to provide a stable attachment point. Comparable boats were used in other parts of Africa, Brazil, and similar tropical areas.

Fowling Boat (TL1). A papyrus raft boat built for pharaohs and nobles to use for duck hunting along the Nile, suitable for travel over still or slow-moving water anywhere. The 16'-long body tapers from a 3' beam at the midsection to a blunt prow and a sharp stern, both curved up out of the water. Two crewmen pole the craft, while a passenger rides up front.

Under Water

The ocean's depths were a mystery to preindustrial societies. Divers could go a few yards underwater, and stay down for a minute or two. Human inventions extended some of these limits, but only added marginally to attainable depth.

Diving Gear

These items let a diver go deeper, or stay underwater for longer than he can hold his breath.

Diving Stone (TL0)

The human body weighs nearly the same as an equal volume of water. Reaching any significant depth quickly requires either jumping in from a height or actively swimming downward. An early solution to this difficulty is a stone with a cord tied around it. The diver thrusts one foot into the cord, as through a stirrup, and is carried down at Move 1 without active effort. He can move horizontally at the same time by making a Swimming roll at -1. To allow reuse, tie the stone to a length of rope that a companion in a boat can use to pull it up. $5, 15 lbs.

Breathing Tube (TL1)

Ancient Egyptian fowlers developed an early snorkel analog to help them sneak up on waterfowl: a papyrus reed used like a huge straw to inhale air while submerged. A 2' tube allows submergence 16" below the water. Any deeper and water pressure prevents the lungs from taking a breath. Observers are at -2 to Vision to spot the swimmer. $5 (or *free,* with a Naturalist or Survival roll), 0.5 lb.

Air Bladder (TL2)

An Assyrian relief dated to the eighth century B.C. shows divers using air-filled animal skins to prolong their dives. The bladders are inflated before the diver enters the water, and provide several breaths' worth of air. Multiply the times under *Holding Your Breath* (p. B351) by four when using an air bladder. It also acts as a float (p. 138), so the diver must carry additional weight (60 lbs.) to remain submerged. $15, 2.5 lbs.

Underwater Vehicles

In 1620, Cornelius Drebbel, a Dutch experimenter living in England, designed and built the first known submarine for the Royal Navy. It worked well enough that he constructed two more, larger models. In 1624, James I rode in the last one on a test dive under the Thames. The navy wasn't impressed enough to use it in combat, but later experimenters could have copied the design.

Diving Boat (TL4)

The diving boat is basically a 15' rowboat with a roof, covered with greased leather. Six pairs of oars protrude through leather gaskets to supply thrust. As it uses oars rather than a propeller, operating it requires the new Unpowered specialty of the Submarine skill (p. 11). Buoyancy control is handled by filling bladders under the rowers' benches to submerge, and squeezing out the water to surface. Metal ballast supplies extra weight to make up the full load of 3.2 tons needed for neutral buoyancy. The boat can submerge to 15'; the longest recorded trip took 3 hours.

Air tubes attached to floats enable crew and passengers to breathe. Some accounts claim that Drebbel invented an "alchemical" means of keeping the air breathable, though. The GM may choose to give the diving boat TL(4+1) rebreather technology.

Diving Boat Table

Terms and notation are as defined in *Vehicle Statistics* (pp. B462-463).

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ.*	*DR*	*Range*	*Cost*	*Locations*	*Draft*
4	Diving Boat, 15'	85†	0/2	12c	0.25/4	8	3.2	+3	7+9	2	F	$40K	–	2.5

Chapter Nine
Medicine and Surgery

"Lay him down here," said Caelius Calvus. "Carefully, now."

Despite the sailors' efforts, Martialis felt the arrow shift in his side as they lowered him to the walkway. The first shock of the wound had left him, now that the battle was over. He clamped his teeth to keep from crying out; any deep breath seemed to make the pain worse.

Calvus' fingers tugged at the silk of his undertunic to pull it away from around the wound. Meeting resistance, he pulled harder. Martialis felt something shift between his ribs, and heard Calvus mutter an oath to Isis. Then the surgeon said, "No need for the spoon. Bring vinegar to wash the wound."

One of the sailors pried his mouth open and put a rope between Martialis' teeth. "Bite down," said the surgeon. "The gods have saved you, but for a little while, you won't feel grateful."

Few low-tech societies have a single profession of "healer." Instead, a variety of scholars, priests, and craftsmen coexist, each focusing on one group of illnesses or method of treatment. Generalists adept at most or all of these arts might be called "physicians," but they don't normally have what ***GURPS*** calls the Physician skill.

Medical equipment is usually LC4. If a society has medical licensure or a guild of healers, though, some articles may be LC3.

Diagnostic Methods

Low-tech diagnosis relies on the healer's unaided senses. At TL3-4, it might include checking urine specimens for blood, sugar, or sediment. For many physicians, the most important function of diagnosis is determining whether a condition is treatable! To save their own reputations, practitioners may turn down hopeless cases, take them on without promising success, or advise simply keeping the patient comfortable.

A successful roll against Diagnosis (p. B187) identifies the patient's condition, if it's medically recognized, and predicts whether treatment is likely to do any good. Failure leaves it unidentified. Critical failure *misidentifies* it, leading to refusal of treatable cases or fruitless treatment of hopeless ones.

In many societies, some "diagnosticians" actually use Fortune-Telling (p. B196) to give the patient the answer he wants to hear. This may be based on astrology, consulting the *I Ching*, or similar methods. Even reputable practitioners might utilize these methods alongside empirical diagnosis.

Overview: Medical Tech Levels 0-4

This summary expands and clarifies the one under *Biotechnology/Medicine* (p. B512), and lists the healing skills available at various TLs.

TL0 – First aid and field-expedient surgery for injuries, using common tools and materials rather than specialized medical gear. Other surgery includes amputation, bone-setting, and trepanning. Anesthesia, antisepsis, and sterile operating rooms are unknown. Pharmacy uses local herbs in their natural forms; treatment focuses on symptoms. Curing rituals, divination, and exorcisms are a large part of medical practice. Medical methods are based on practical folk knowledge or oral traditions. *Skills:* First Aid/TL, Fortune-Telling, Pharmacy/TL (Herbal), Religious Ritual, Surgery/TL (Trauma Surgery).

TL1 – Densely populated cities bring about a rise in infectious diseases. Literacy makes possible written manuals of diagnosis and recommended treatment, but medicine remains linked to magic and religion. Long-distance trade in medicinal herbs begins, along with preparation of herbal extracts. *Skills:* Add Diagnosis/TL.

TL2 – Speculative physiological and environmental theories of illness and health as natural processes; e.g., Greek and Roman humoral medicine. Surgical procedures and equipment become more sophisticated. *Skills:* Add Esoteric Medicine.

TL3 – Mainly a period of consolidation, as scholars compile encyclopedias of diagnosis and treatment. Religiously supported hospitals provide care for the poor and bring physicians together, encouraging exchange of knowledge. *Skills:* No change.

TL4 – Older theoretical frameworks coexist with new scientific investigations in medicine and physiology: anatomical dissections, microscopy, toxicology, and pharmaceutical use of toxic inorganic substances. Philosophers begin to describe the body as a machine. *Skills:* Individuals with Anachronistic Skill (p. 9) may learn Pharmacy/TL (Synthetic) and Physician/TL.

Diagnostic Manual (TL1)

A book or collection of scrolls listing medical conditions, visible signs, recommended treatments, and likely outcomes allows an unmodified Diagnosis roll. A diagnostician without this is at -2 when facing a condition with which he has no personal experience.

A large, comprehensive manual amounting to a medical encyclopedia, or a collection of multiple books, gives +2; an extensive medical library, +5. Either offsets penalties for rare diseases but can't give a net bonus. At the GM's option, these bonuses may be those under *Time Spent* (p. B346), with extra time representing research. In that case, extensive reference works are needed to profit from added time; checking a comprehensive manual takes four times as long, while consulting an extensive library multiplies time by 30.

Book prices and weights vary widely; see ***GURPS Low-Tech Companion 1.*** As a rough average, a printed diagnostic manual is $35, 2 lbs. A comprehensive one (+2 to skill for *known* conditions) is $175, 20 lbs. Hand-copied works are ×10 base cost, ×4 weight.

Urine Flask (TL3)

A glass vessel similar to a modern test tube, used to collect urine specimens, is standard equipment for TL3-4 diagnosticians. Without it, Diagnosis rolls for diseases affecting the urinary tract are at -2. $40, neg.

First Aid

The most basic medical techniques don't require specialized training – anyone can attempt them with a default First Aid roll (IQ-4). Some methods are available at any TL, but advancing technology makes superior treatments possible. While TL0 societies have little specialized equipment, they can adapt both general tools and materials from the natural environment to the task.

Tourniquets

A *cutting, impaling,* or *piercing* wound causes bleeding. Whether or not the GM chooses to apply the optional rules for ongoing HP loss (see *Bleeding,* p. B420), part of first aid is stopping the bleeding. If the wound is on a limb, then a tourniquet is one way to accomplish this. If no tourniquet is available, see *Blood Vessel Pressure* (p. 11).

Tourniquet (TL0)

A length of cord long enough to tie tightly around a wounded limb, restricting blood flow to allow the surface of the wound to clot. This is effectively a garrote. See *Rope, String, and Thread* (pp. 23-24) and p. B288 for suitable cord. In societies that haven't developed rope, a leather thong will do. $2, neg.

Improvised Tourniquets: In the wilderness, a length of vine can serve as a makeshift tourniquet. This gives -2 to First Aid skill. There's no cost, but finding a suitable plant requires 5 minutes and a Naturalist roll. The GM may apply modifiers based on how likely the surroundings are to contain vines, from +5 for jungle to -5 for desert. He may rule that no attempt is possible in some environments – notably, arctic ones!

Optional Rule: Tight Tourniquets

The GM may opt to use this rule alongside *Bandaging* (p. B424) and *Bleeding* (p. B420). Save it for emergencies – it's too risky for minor bleeding! It works with standard tourniquets, but not with improvised ones.

A tourniquet can be tied exceptionally tightly, severely restricting blood flow. This gives from +1 to +5 to the First Aid roll to stop bleeding; the caregiver picks the bonus he wants. Even if the First Aid roll fails, leaving the tourniquet in place means its bonus cancels out penalties for wound severity when making HT rolls for bleeding to stop naturally, although this can never give a net bonus.

The risk of this technique is harm to blood-starved tissues. After the wound stops bleeding and the tourniquet is removed, the subject must make a HT roll at a penalty equal in size to the bonus claimed above. If the First Aid roll failed, this roll is at a further -1 per extra minute the tourniquet was left in place. Success indicates no ill effects. Failure means HT rolls for natural recovery, and medical skill rolls for faster healing, are at -1, plus another -1 per 2 points of failure. On a critical failure, the limb has suffered major tissue death; it's permanently crippled, and the patient must roll to avoid infection (p. B444), at -3 to the usual HT+3 roll (that is, roll vs. unmodified HT).

Bandages

Bandages are used to treat *burning, cutting, impaling,* and *piercing* injuries, and the split skin, small cuts, and abrasions included in *crushing* damage. They enter systematic use at TL1, with ancient Egyptian linen cloth; other fabrics, such as cotton and silk, are also suitable. Various substitutes exist at TL0.

Cobwebs (TL0)

Applying cobwebs to a wound is an old home remedy for bleeding. Treat cobwebs as improvised equipment for First Aid, giving -5 to skill. A successful roll stops bleeding and restores 1 HP – as for *Bandaging* (p. B424) – but provides none of First Aid's other benefits. The web is too flimsy to provide lasting protection or keep out dirt. In fact, cobwebs are seldom sterile; the patient must roll for infection (p. B444), treating a fresh web as ordinary "clean" dirt (+0) and an older one as moderately unclean (-1).

Cobwebs are free. Finding one requires a minute and a Housekeeping or Naturalist roll in a suitable environment. Success locates a fresh web; failure by 1 locates an old, moderately unclean one. Webs are too fragile to store for later use.

Bandages (TL1)

These are cloth wrappings for wounds. Benefits are discussed on p. B424; in addition, bandages can keep dirt out of a wound and prevent infection (see *Infection,* p. B444). A *tight* bandage can substitute for a tourniquet for basic First Aid rolls. A basket of precut clean cloth (typically cotton, linen, or silk) sufficient to dress half a dozen wounds, and which counts as basic equipment for First Aid, is $10, 2 lbs.

Improvised Bandages: At TL0, bandages can be made from the cloth manufactured by some Neolithic societies, or from barkcloth (see *Paper and Its Cousins,* p. 24). Broad, flat leaves are another option, where available; roll against Naturalist as described for finding vines under *Tourniquet* (p. 145), and note that some leaves have medicinal effects (see *Drugs,* pp. 150-152). At TL1-4, bandages can be cut from garments, bedding, etc. Primitive cloth bandages are half-price ($5); leaves and scraps are free. All give -2 to skill and are rarely sterile – roll for infection (p. B444), assuming ordinary "clean" dirt.

First Aid Kit (TL1)

In addition to bandages, this kit contains medicinal substances (see *Drugs,* pp. 150-152) – raw materials for poultices, and infusions or decoctions suitable for making compresses. At TL2+, add ointments, and possibly soap (see *Grooming,* p. 36) for cleaning. Such gear gives +1 to First Aid rolls. $50, 2 lbs.

> *For extreme diseases*
> *extreme strictness of treatment*
> *is most efficacious.*
> – *Hippocrates,* ***Aphorisms***

Splints and Casts

For broken bones to mend, the rejoined ends must be held together while they heal. Setting the bone requires the Surgery skill (see *Surgical Techniques,* p. 12, and ***GURPS Low-Tech Companion 1*** for bonesetting rules), but anyone can use First Aid to create a rigid framework for an arm or a leg. A crippling injury won't recover without at least this much treatment.

Splints (TL0)

Flat strips of wood, thick enough for rigidity, placed against a broken limb and tied or strapped in place. Arm splints: $25, 1 lb. Leg splints: $50, 2 lbs.

Cast (TL1)

A cast is made by wrapping a broken limb tightly with bandages and then plastering over it to provide support. Arm cast: $50, 5 lbs. Leg cast: $100, 10 lbs.

Transporting the Injured

More effective treatment of injuries may be available at a long-term campsite, home, or military base. The challenge is getting the patient there without worsening his condition, and preferably without causing much added pain. Purpose-built transportation for the wounded is preferable; see the litter and horse litter under *Litters* (p. 136). Almost any vehicle in Chapter 8 could work, though – particularly a boat, cart, sled, or travois.

Surgery and Surgical Equipment

Low-tech surgery is a scary business! Without X-rays or ultrasound, surgeons must often work blind – and in civilizations that forbid dissection, they may have only a vague idea what they're working on. Many surgical patients bleed to death or die of infection. And lack of anesthesia can mean pain comparable to that of torture. Few people visit a surgeon unless they're desperate; some prefer to kill themselves.

The standard surgery rules (pp. B223, B424) resolve operations with a few quick dice rolls. These have modifiers that take into account certain details, but abstractly. Below are some further options to reflect the conditions of low-tech surgery. For optional rules that define *all* the grim details – treating surgery in about as much detail as combat – see ***GURPS Low-Tech Companion 1.***

Expanded Modifiers

The GM may opt to apply these modifiers to applicable low-tech Surgery rolls:

Awkward Reach: A surgeon working without specialized instruments may need to reach into tight places with his fingers. This gives -3 for the mouth or other natural body cavities, or -6 for a piercing or impaling wound, or a surgical incision. To avoid these penalties, use forceps (p. 148) and other surgical equipment.

Tech Level Modifiers: Surgical equipment itself gives TL-dependent skill modifiers, as noted on p. B424. These are actually the sum of two different bonuses or penalties. One is for the general quality of the surgeon's paraphernalia; for this, see *Surgical Instruments* (below). The other is for lack of anesthesia. Low-tech surgery always has an extra -2 for being done sans anesthesia – in part due to the surgeon's emphasizing speed over accuracy, to minimize the patient's suffering, and in part due to the difficulty of keeping the patient still.

Undiagnosed Conditions: An operation for an undiagnosed problem is performed at -5 to skill. This doesn't apply to battle wounds; the surgeon can tell what type of injury he has to deal with and where it was inflicted. But wounds may include internal injuries, or bullets or arrows lodged inside the body. Surgery on such conditions has a lesser penalty: -4 if the surgeon is guessing at the problem, or -2 if he has probes (see *Other Instruments,* p. 148).

Additional Risks

The patient, too, may face added complications at TL0-4:

Minor Surgery: The standard rules provide for injury due to a failed Surgery roll: 2d for a simple amputation, 3d for other procedures. Under low-tech conditions, even *minor surgery* that's far less invasive than amputation may inflict 1d. Examples include cutting for the stone (surgical removal of bladder stones; see *Surgical Techniques,* p. 12), dental surgery, and extracting arrowheads or bullets. Eye surgery is technically minor – but it doesn't take much damage to cripple the eye!

Infections: Low-tech societies don't have sterile surgery; thus, surgical wounds may become infected. Use the rules on p. B444. Several techniques can modify the HT roll:

Cauterization (see *Cautery,* p. 149): +1

Treatment with antibacterial substances (see *Herbs,* pp. 150-151): +1

Washing wound and instruments with wine, vinegar, etc.: removes infected matter that might otherwise give -1 or -2

Surgical Instruments

Surgeons use a *lot* of specialized implements. A small tool kit can hold from 12 to 20 instruments; a large one, from 30 to 60. Skill modifiers for such equipment derive from several considerations:

Tech Level: Basic equipment gives -4 at TL1, -3 at TL2-3, and -2 at TL4-5. This progression mainly reflects improvements in design, although the wider selection of materials extends what's possible. These modifiers *don't* include the -2 for anesthesia being unavailable; see *Expanded Modifiers* (above).

Size of Tool Kit: A small tool kit is *basic* equipment. A large one is *good* equipment: +1 to skill.

Superior Workmanship: Surgical instruments often have fine moldings on their handles. This isn't just decorative; it gives a better grip: +1 to skill. Better-quality materials can also contribute to such a modifier; e.g., Roman smiths could carburize the surfaces of small tools such as scalpels, providing steel cutting edges. At the GM's option, very expensive implements might give +2 to skill. These modifiers may be applied to either individual items or everything in a kit; in the latter case, quality modifiers for workmanship and kit size are cumulative, giving up to +3 in total.

Improvised Equipment: A surgeon without surgical instruments can operate with general-purpose tools. Ordinary, well-made tools of other trades – such as knives, razors, or pliers – give -2 to skill. If these items are themselves of improvised construction, then skill is at -5.

Specific Tools: Individual tools don't normally modify Surgery rolls. Instead, they enable specific procedures. Many operations can't be performed at all without the proper gear; others are at -1 per missing item. In some cases, one high-quality instrument useful for a particular task *can* give +1 to that Surgery roll. To this end, a number of equipment descriptions below name individual procedures. Most instruments lack such notes; they go into surgical kits and provide quality bonuses only as part of a bonus for the entire kit.

Barber's Kit (TL1)

This modest collection of tools – knife, razor, scissors, small whetstone, spoon (TL2), tiny file (TL2), and one or two others – is mainly for shaving beards and cutting hair, but in an emergency, it's useful for minor surgery. It gives -1 (quality) to Surgery, over and above the standard TL modifier. $100, 3 lbs.

Forceps (TL1)

Forceps are tools for grasping an object or a body part. They afford a better grip than unaided fingers. Treat this as the opposite of Bad Grip (p. B123): +2 to skill for fine tasks that benefit from a firm grip. They also eliminate penalties for awkward reach (see *Expanded Modifiers,* p. 147). $25, neg.

At TL2, several specialized varieties of forceps enter use:

Dental Forceps. Designed to grip a tooth and pull it out. This requires a *ST*-based Surgery roll; add the +2 for a firm grip. Basic forceps will work, but at -2, canceling out the bonus for a good grip. Critical success gets the entire tooth; ordinary success leaves 1d/2 splinters (round up) that must be extracted separately; ordinary failure leaves the tooth in place; and critical failure inflicts 1d-3 HP of injury to the face. $50, 0.5 lb.

Dental Splinter Forceps. Used to extract the roots of a broken-off tooth; no additional skill roll required. $50, neg.

Fixation Forceps. These have a sliding ring that can lock them shut. $50, neg.

Staphylagra. Fixation forceps with toothed jaws, used to crush chronically inflamed uvulas or hemorrhoids, allowing removal without risk of bleeding. $75, neg.

Other Instruments (TL1)

Hook (TL1). A rod with a sharp or blunt hook at the end, used to pull back the sides of a wound or an incision, or to manipulate a piece of tissue. $10, neg.

Needle (TL1). Designed to pull thread or sinew through flesh. Ordinary sewing or leatherworking needles count as improvised gear, giving -1 to overall Surgery skill. $5, neg.

Probe (TL1). A long, flexible rod – usually bronze – used to locate foreign objects in a wound or assess the body's internal state by touch, reducing the penalty for undiagnosed conditions (see *Expanded Modifiers,* p. 147). $10, neg.

Scalpel (TL1). Used to make incisions. $30, neg.

Arrow Spoon (TL2). Used to extract an arrowhead without causing further injury in the process. $30, neg.

Catheter (TL2). A narrow tube that can be inserted into the bladder to displace a bladder stone and drain urine, providing temporary relief but not a cure. Roll against Esoteric Medicine, Physician, or Surgery to use it. $50, neg.

Speculum (TL2). Used to dilate a body cavity, giving a better view for Diagnosis and reducing awkward reach penalties to Surgery from -6 to -3. Different body cavities call for different designs. $60, 1 lb.

Trephin (TL2). A specialized drill used to cut plugs of bone out of the skull, in the form of a hollow metal tube with saw teeth at the end. See *Surgical Techniques* (p. 12). $120, 1 lb.

Stone Age Surgeons

The ***Basic Set*** provides no Surgery modifiers for TL0, and Stone Age tribes didn't have professional surgeons. Still, human remains give evidence of surgical procedures in this era – even healed holes drilled through the skull! Handle this with the following rules.

As always, TL decides the basic equipment modifier. Paleolithic instruments are mostly chipped from flint, with somewhat wavy edges (-6); however, some are obsidian, which takes at least as good an edge as steel (-4). Neolithic tools are ground to a smooth edge from either ordinary stone (-5) or dense stone such as jadeite (-4).

There are normally no specialized *surgical* instruments. Surgeons adapt ordinary tools: stone knives for cutting, bone needles for stitching, firebows (see *Fire-Starting Gear,* p. 35) for cauterization, etc. Therefore, the -2 for improvised equipment usually applies. However, the GM may assume that specialized gear *does* exist in a TL(0+1) society that's advanced in medicine, or in a TL1 culture that hasn't developed metallurgy. For instance, cauteries can be made of stone.

Before each major operation or *day* of minor surgical procedures, Paleolithic instruments must be made from raw materials, while Neolithic ones have to be reground. Obsidian is particularly fragile – each minor operation requires new tools, while major surgery consumes 1d sets. Each set of implements prepared calls for a Machinist/TL0 roll, plus two hours of labor to produce with Paleolithic methods or one hour to regrind with Neolithic techniques. Ordinary stone is free; superior materials such as jadeite or obsidian may need to be imported and paid for, at the GM's discretion.

If the GM allows dedicated TL0 instruments, then a (Neolithic) ground-stone surgical kit costs the same as a set of metal tools. Chipped-stone (Paleolithic) implements cost 1/5 as much but must be replaced after use, as explained above.

Surgeon's Kit (TL1)

Surgeons' kits come in two sizes: small, portable sets and larger ones kept in an infirmary or a surgeon's house.

Small Kit (TL1). A typical kit would have forceps, hooks, needles, probes, and scalpels, plus a supply of thread or sinew for stitching up wounds, and material for bandages. Basic equipment for Surgery. $300, 15 lbs.

Large Kit (TL1). A typical kit would include the equivalent of two small kits, with more specialized forms of the basic instruments, plus bone chisels and small hammers – and at TL2, arrow spoons, catheters, cauteries, and specula. Good equipment, giving +1 (quality) to Surgery. $1,500, 40 lbs.

Cautery (TL2)

An instrument for controlled burning of human tissue, with a sharp metal point at the end of a long rod with an insulated grip, designed to be heated on a brazier. It's made of iron, which resists heat better than bronze; thus, cauteries are sometimes called "irons." A heated cautery can inflict serious burns – most surgeons regard cauterization as a desperate measure!

Roll vs. Surgery to use a cautery. Critical success inflicts 1 point of burning damage. Ordinary success *or* failure causes 1d-3 damage, minimum 1 point. On a critical failure, roll damage as for a failure and *double* it.

Cauterization can end bleeding from wounds that don't stop bleeding after a First Aid roll. Any success on the Surgery roll stops further HP loss. Any failure doesn't.

Cauterizing a wound destroys bacteria as well as flesh. If a wound becomes infected (see *Infection,* p. B444), cauterization may arrest the infection's progress – usually with less damage than excising the infected tissue, and without amputation. Roll vs. Surgery, as above; an infection that has inflicted 3 HP or more, or any infection of an impaling or piercing wound, is internal and treated as an undiagnosed condition (see *Expanded Modifiers,* p. 147). Regardless of the outcome, the patient gets +1 on his next HT roll for infection. Success gives a further bonus equal to half the margin of success (rounded *down*). Critical success ends the infection without a HT roll.

A cautery is $50, 0.5 lb.

Eye Surgery Instruments (TL2)

Surgery rolls for eye surgery are *DX*-based and benefit from High Manual Dexterity. Standard surgical instruments give -2 to skill. To avoid this, eye surgeons use a variety of specialized tools:

Cataract Needles. A cataract needle is a very fine, sharp piece of metal, designed to pierce the eyeball with minimal injury. It can push a cataract away from the pupil, sever pieces of it, or press it down to fix it into place. See also *Surgical Techniques* (p. 12). $50, neg.

Eyelash Cautery. A fine iron needle with a handle, this is heated and used to burn out the root of an ingrown eyelash after the hair is plucked out. $125, neg.

Eyelash Forceps. A tiny set of grippers that can seize and pull out an ingrown eyelash (see *Forceps,* p. 148). $125, neg.

Traction Bench (TL2)

Recorded in ancient Greece as early as 500 B.C., this bench supports a patient and applies traction to a broken limb, making bonesetting independent of the surgeon's physical strength. Compute the relative ST bonus (see *Surgical Techniques,* p. 12) as if the surgeon had ST 20. Ancestral to the rack (p. 131)! $600, 125 lbs.

Early Prosthetics

Medical care made it possible to survive loss of body parts through injuries or surgical amputations, leading artificers to develop prosthetic replacements.

Artificial Eye (TL1)

Low-tech artificial eyes don't restore sight! The oldest known artificial eye was worn by a woman in ancient Persia, in around 2900 B.C. It was made of bitumen paste coated with a thin layer of gold. Its brightly reflective surface wouldn't have resembled a real eye (treat as Unnatural Features, p. B22), and would have caused chronic irritation. $350, neg.

Glass eyes are mentioned in Shakespeare's *King Lear* (1606), and seem to have been invented in Venice a few years earlier (TL4). These were not solid balls, but hemispherical cups that covered a damaged eyeball. They were heavy and somewhat painful to wear. $50, 0.1 lb.

Treat either sort of artificial eye as causing mild Chronic Pain (p. B126), relievable by not wearing the prosthetic.

Wooden Hand (TL2)

A purely cosmetic replacement for a lost hand, elaborately carved to look like the real thing, but nonfunctional. $600, 1 lb.

Wooden Leg (TL2)

Around 500 B.C., Herodotus wrote about a man with a wooden foot. A wooden leg lessens the detrimental effects of Missing Legs, as described under *Lame* (p. B141). Kicking with it inflicts thrust+1 crushing damage because of its hard surface! $250, 10 lbs.

Hook (TL4)

Metal hooks were developed as replacements for lost hands around 1600. See *One Hand* (p. B147) for effects. $200, 1 lb.

Drugs

At TL0-4, the Pharmacy skill (p. B213) is limited to the Herbal specialty – although a partial exception can be made at TL4 (see *Inorganic Substances,* p. 152). Pharmacy (Herbal) includes formulating, administering, and prescribing medicinal substances. It can be used alone, as an aspect of Esoteric Medicine (see *Bleeding and Purging,* p. 153), or in conjunction with other forms of Esoteric Medicine. It primarily treats symptoms – fever, headache, nausea, etc. – rather than underlying causes.

Herbs

Herbal medicine may predate humanity. Chimpanzees suffering from gastrointestinal parasites have been observed swallowing leaves of plants that human communities in the same area use medicinally. At any rate, preindustrial societies' knowledge of local plants definitely includes medicinal uses.

Herbal medicines can have diverse physiological effects. Several important categories are described below. Regardless of a drug's specific action, though, a few general rules apply.

Medicinally useful herbs are *physiologically active* – taking them disturbs the body's functioning. In game-mechanical terms, such disturbance amounts to mild toxic effects *for medicinal doses*. These cost FP, not HP. The pharmacist chooses to administer a low dose or a high dose, and then rolls vs. Pharmacy.

Critical success delivers the therapeutic benefits without side effects. Regular success also inflicts 1 FP. Ordinary failure costs 1 FP and has no therapeutic effects for a low dose, *or* inflicts 1d FP and possibly other symptoms, but gives therapeutic benefits, for a high dose. Critical failure costs 2d FP and may cause other symptoms, and has no therapeutic value.

Larger doses or more potent herbs may inflict actual damage. See *Poisons* (pp. 128-130) for examples.

Honey

Starting in ancient Egypt (TL1), honey – sometimes mixed with salt – is used to treat wounds. While honey isn't directly derived from plants, an herbalist may be able to exploit its natural bactericidal properties. Roll vs. Pharmacy (Herbal), as for herbal drugs. Success gives the patient +1 to HT rolls to resist infection.

Raw herbs often contain several different physiologically active compounds. Apply -2 to Pharmacy rolls in such cases. Various parts of a plant may have different effects; Pharmacy includes knowing which part to use.

At TL0, herbs are mostly used singly, as *simples*. At any TL, though, it's possible to combine different herbs, using one to neutralize another's toxicity, or mixing plants that jointly produce the desired medicinal effect but that contain different toxins, so that the patient gets only a low dose of any one toxin. Treat such *herbal preparations* as Hard techniques based on the Pharmacy skill, with an upper limit of Pharmacy+4.

To gather fresh herbs, roll against Naturalist (p. B211) to find and identify the plant species. In Neolithic and higher-TL societies, an alternative is growing them; this calls for a roll vs. Gardening (p. B197). In societies with marketplaces, it may be possible to buy herbs; treat this like a search for a Pharmacist hireling (pp. B517-518), but at +1 to search rolls. Fresh herbs are only available during their growing season. Dried herbs may be available year-round, but they're usually less potent: -1 to Pharmacy skill.

The usual way to take raw herbs is to chew them up and swallow them. But some are chewed and spat out, taken as snuff, or smoked (see *Drinking and Smoking,* p. 37). For other methods of preparation and use, see *Herbal Extracts* (pp. 151-152).

Important categories of herbs include:

Analgesic. Decrease the patient's pain sensitivity, reducing the intensity of pain by one level (see *Pain Control,* p. 152). *Local* analgesics suppress the sensory receptors for pain; the main low-tech examples are taken orally for toothache. *Central* analgesics decrease the brain's response to pain. Drugs that treat headache, especially migraine, have similar effects on headache pain.

Antiemetic. Counteract nausea (p. B428) and prevent vomiting, giving +2 to HT rolls to avoid retching (p. B429).

Anti-infective. Enhance infection resistance, giving +1 to HT to rolls to resist bacterial diseases and infections – and in some cases viral diseases, such as colds and influenza.

Anti-inflammatory. Decrease inflammation of the muscles and joints, reducing the intensity of pain due to conditions such as arthritis (see *Pain Control,* p. 152).

Aquaretic. Promote urination, helping to flush out bladder infections, and preventing the recurrence of kidney stones. Give +1 to HT rolls to throw off the infection.

Astringent. Counteract skin inflammation and suppress itching. Often contain tannin.

Calmative. Non-narcotic herbs that diminish anxiety or excitement, and encourage sleep, giving +1 to HT rolls to resist insomnia and +1 to Will for Fright Checks.

Carminative. Lessen abdominal pain from gas (see *Pain Control,* p. 152).

Cathartic/Purgative. Speed the passage of food through the digestive system, leading to rapid and/or voluminous excretion; see *Bleeding and Purging* (p. 153). Side effects include penalties equivalent to those for being nauseated (p. B428), but without the chance of vomiting, as well as the standard loss of 1 FP.

Cholagogue. Enhance the secretion of bile, reducing the intensity of pain due to inability to digest fatty foods (see *Pain Control,* p. 152).

Coagulant. Help stop bleeding, giving +1 to the HT rolls under *Bleeding* (p. B420).

Demulcent. Soothe throat pain from respiratory infections and prevent coughing, giving +1 to HT rolls to resist coughing.

Emetic. Promote vomiting. Make a HT roll at -6 to resist, if you wish to. Beneficial against many ingested poisons, but can lead to worse injury in some cases; see *Treatment* (p. B439).

Expectorant. Promote the flow of nasal phlegm, giving +1 to HT rolls against upper respiratory infections and acting as a demulcent.

Febrifuge/Antipyretic. Reduce the severity of a fever, giving +1 to HT rolls to throw off a fever.

Rubefacient. Applied to the skin, producing mild inflammation that counteracts muscle pain. This relieves temporary crippling after straining a muscle (for instance, due to a critical miss in combat; see pp. B556-557) and halves penalties for muscle pain (see p. B428 and *Pain Control,* p. 152).

Sedative. Suppress central nervous system activity, with the effects described for sedatives on p. B441. At TL1-4, the standard sedative is opium, which is also used as an analgesic. Large doses of opium have the effects described for painkillers on p. B441. Addiction to opium in sedative or analgesic doses develops only slowly; if a user *does* become addicted, opium is legal in most TL1-4 societies and not unusually expensive. Taken orally rather than smoked, opium risks irritating the stomach; roll vs. HT to avoid nausea.

Stimulant. Produce alertness and counteract sleepiness and fatigue. Mild stimulants give +2 to Will to resist drowsiness (p. B428), and restore 1 FP for (12 - HT) × 10 minutes, minimum 10 minutes – but at the cost of 2 FP when the drug wears off. Strong stimulants act as described on p. B440.

Tonic. A term used for two different classes of herbs:

- Herbs that promote overall HT and fitness. These relieve Unfit or reduce Very Unfit to Unfit. Treat this effect as a Mitigator (p. B112).
- Herbs that stabilize women's hormonal cycles. These reduce the intensity of pain from menstruation or menopause – and any penalties to DX, IQ, and self-control rolls – for a woman who suffers painful menstruation. They also give +1 to HT rolls connected with hormonal cycles.

Vermifuge. Promote expulsion of worms from the digestive system, allowing a HT roll to be freed of the parasites. Treat the patient as nauseated (p. B428) for 1d×30 minutes after taking such herbs, but without the chance of vomiting.

Vulnerary. Applied externally to a wound to aid healing and resist infection, giving +1 to HT rolls both to resist infection (p. B444) and for natural recovery (p. B424).

Belladonna

Many herbal substances have nonmedical uses. A famous example is deadly nightshade or *belladonna* (p. 128). Its active ingredient, atropine, prevents the pupils from contracting. At TL5+, it's administered in drops to dilate the pupils for eye examination and treatment. But dilated pupils are a sign of interest or attraction – and earlier in history, Italian courtesans used belladonna to look as if they found their male companions fascinating! A suitable extract is TL3.

Using belladonna drops requires a Pharmacy (Herbal) or Professional Skill (Courtesan) roll. Success grants +2 to Sex Appeal, and to Acting rolls to feign attraction. Failure has the consequences noted under *Herbs* (p. 150). Either way, the user suffers blurred vision, handled as Bad Sight (Farsighted). On a critical failure, treat toxic effects exceeding FP/3 as crippling injury to both eyes.

Herbal Extracts

Starting at TL1, pharmacists develop ways to extract active ingredients from herbs. Extracts are purer and may be absorbed more effectively. As the range of methods advances, healers enjoy a bonus to Pharmacy (Herbal) rolls for treatment: none at TL1, +1 at TL2, and +2 at TL3-4.

Preparing an extract doesn't normally require a separate skill roll. If one seems called for (e.g., for an apothecary making up a preparation for later sale), roll against Pharmacy, Chemistry at -2, or Housekeeping at -4. Producing pure forms requires laboratory equipment and suitable media.

Some specific techniques include:

Compresses (TL1). A cloth is soaked in an infusion or a decoction and applied to an afflicted area; e.g., a wound. Compresses must be used as soon as they're prepared.

Decoctions (TL1). Roots, barks, and fruits must be simmered in boiling water to release their active principles. This takes an hour, which includes time to cut the material into small pieces; these solids are removed at the end. Decoctions can be taken hot or cold. Once prepared, they last a week.

Infusions (TL1). Dried or green leaves, stems, or flowers are soaked for 10 minutes in hot water. Infusions can be taken hot or cold. Once prepared, they last a week.

Poultices (TL1). Crushed fresh or dried herbs are mixed with a moist adhesive substance, such as flour mixed with water, and applied to the skin. Poultices must be used as soon as they're prepared.

Syrups (TL1). To make them more palatable – especially for children – decoctions and infusions can be mixed with honey or sugar (if available). In addition to improving taste, the sweetness can lessen the pain of a sore throat. Once prepared, syrups last a week.

Creams (TL2). A mixture of oil or fat with water and an emulsifier, intended to be applied externally. It's permeable, letting the skin breathe and sweat, and can moisten and soothe irritated skin. Either the oil or the water might carry the active ingredient. Once prepared, creams last three months.

Oils (TL2). Some active ingredients can be extracted with vegetable oils such as olive oil. The process may be hot (for hard parts) or cold (for leaves and flowers). This takes a full day or more. Oils keep for up to five years if stored properly.

Ointments (TL2). Made by heating herbs in solids such as beeswax, fat, or paraffin without water, ointments adhere well to the skin. They also seal it off, which can cause irritation; treat this as a possible toxic side effect. Once prepared, ointments last a year.

Essential Oils (TL3). Volatile oily substances extracted from aromatic plants by a variety of techniques: pressing, steam distillation, extraction with a volatile solvent that's then evaporated, or *effleurage* (a two-step method using first animal fat and then alcohol). These are all long processes and produce a small amount of essential oil from a large volume of raw material. Essential oils keep indefinitely.

Tinctures (TL3). After the achievement of distillation, the active ingredients of herbs can be dissolved in alcohol, producing extracts, cordials, and similar substances. These can be applied externally, by massage, with a cooling effect as they evaporate, or taken internally. Tinctures keep for up to two years if stored properly.

Herbal medicine may predate humanity.

Inorganic Substances

Renaissance Europe (TL4) saw the beginning of a movement toward synthetic pharmacy, with the medicinal use of inorganic substances such as arsenic. This was primarily thanks to Philippus Aureolus Theophrastus Bombastus von Hohenheim (1493-1541), an alchemist and physician best known as Paracelsus. His work was based on scientific toxicology, whose principles he largely established – in particular, that every substance is toxic at a high enough dosage, but that a low dose of a poison may be harmless, even beneficial.

Inorganic drugs use the rules under *Herbs* (pp. 150-151), but require Pharmacy (Synthetic) and have more severe toxic effects than most herbal cures – they cost HP, not FP. For a typical treatment, success inflicts 1 HP but grants +1 to the patient's next HT roll to recover from the disease; critical success means *no* toxicity and +2 to the HT roll. Ordinary failure causes toxic effects without curative ones. On a critical failure, treat the subject as having ingested 1d-3 doses (minimum one) of the poison. Physicians may attempt heroic cures with multiple doses; this increases both therapeutic and toxic effects in proportion to the number of doses, but is also riskier: -1 to skill per additional dose. In all cases, the patient receives the poison's usual HT roll to resist its toxic effects, except after a critical success, when it isn't required.

Taoist physicians and alchemists in China experimented with similar treatments, but without systematic testing, making them riskier. For patients treated under this tradition, failure counts as having ingested 1d-3 doses (minimum one) of the poison. On a critical failure, roll this number and *double* it.

Nondrug Therapies

In addition to herbal and inorganic medications, low-tech physicians employ a variety of other cures. The skill for most of these is Esoteric Medicine (p. B192), representing not mystical powers but what's now considered "alternative medicine" – Ayurvedic medicine, Hermetic medicine, Taoist medicine, etc. Practitioners try to piece their chosen methods into the theories of their particular school; as a result, they may overgeneralize those theories, giving useless or harmful treatments. If something works, though, most healers *will* fit it in, explaining its success as best they can.

Note that general supportive care of the injured (see *Medical Care,* p. B424) is within the competence of low-tech practitioners. Either Esoteric Medicine or Pharmacy (Herbal) at 12+ can substitute for Physician at 12+.

Acupuncture and Moxibustion

Acupuncture is among the best-known of Chinese and Japanese medical techniques. Practitioners are taught about channels that conduct *chi* (vital energy) through the body, coming to the surface at points on the skin; one school identifies 365 of these. Inserting fine needles into these points is said to improve the functioning of internal organs. Some practitioners forego needles and press the points with their fingers; this method, known as *acupressure,* gives -2 to Esoteric Medicine.

In the related practice of *moxibustion,* small cones of dried mugwort (*Artemisia vulgaris*) leaves are placed on the same points and burned. This technique is often regarded as Japanese, but is used throughout East Asia.

The best-established effect of all three methods is pain control (below); for instance, to treat conditions such as migraines. Acupuncture is also used for anesthesia during minor surgery; a successful Esoteric Medicine roll grants the patient High Pain Threshold (p. B59). The latter is a modern innovation (traditional Chinese medicine discouraged surgical methods), but might be part of a TL(1+1) through TL(4+1) society's medical practices.

Pain Control

Many low-tech therapies aim to decrease pain; some may actually succeed. Roll against Esoteric Medicine for nondrug treatments or Pharmacy (Herbal) for herbal ones. Critical success makes pain *two* levels less severe on the following progression: *agony* to *terrible pain* to *severe pain* to *moderate pain* to no pain. Success reduces pain by *one* level. Failure offers no relief. Critical failure causes some harmful effect; details depend on the treatment used. See *Afflictions* (pp. B428-429) for definitions of pain levels – and note that the "agonizing" severity of the Chronic Pain disadvantage (p. B126) corresponds to terrible pain, not agony.

Numerous other benefits are claimed for such methods. If the GM accepts these, then a successful skill roll could give +1 to the patient's next HT roll for almost anything.

Acupuncture Needles (TL0). Extremely fine needles used in acupuncture, made of bronze at TL1-2 or of steel at TL3+. Per 100: $50, 0.25 lb.

Moxa Bundle (TL1). A cone of dried mugwort leaves for moxibustion. Free, if leaves are gathered in the wild; this requires a Naturalist roll, followed by a Pharmacy (Herbal) or Esoteric Medicine (Moxibustion) roll at +2 to prepare them. A prepared bundle costs $1. Negligible weight.

Antidotes and Detoxification

There *are* ways to counteract poison at TL0-4, but most work against ingested toxins. Little can be done about blood or contact agents.

Geophagy (TL0). A very ancient method – used even by pre-humans and beasts – is eating clay, particles of which bind to toxic substances in the digestive system. This can be done either preventively, with foods known to be somewhat toxic, or curatively, after the first toxic effects occur. A dose of clay gives +1 to later HT rolls to resist the poison, but doesn't restore any previously suffered HP or FP loss. To locate suitable clays, make a Survival or Poisons roll. Clay itself may irritate the stomach, if taken in amounts large enough to be effective; make a HT roll at +2 to avoid 2d fatigue from digestive upset, with nausea following if fatigue exceeds FP/3. Critical success on the Survival or Poisons roll finds high-quality clay without this effect.

Milk (TL1). Societies with domesticated milking animals may use milk against ingested poisons. Milk works like clay, but doesn't cause digestive upset unless given to a lactose-intolerant adult. Treatment requires a Pharmacy (Herbal) or Poisons roll.

Immersion (TL2). Prolonged immersion in water can aid against poisons; see *Immersion* (p. 154).

Bleeding and Purging

Bleeding and purging were characteristic of Western medicine from ancient Greece until the 19th century. They began as trial-and-error methods, but humoral theory systematized them. Purging supposedly got rid of excess bile, while bleeding removed excess blood, associated with fevers and high blood pressure.

Actual effectiveness is debatable. The *bad* effects described below certainly apply. The GM decides whether the proposed benefits are real. Regardless, critical failure on any of these treatments causes 1d fatigue and leaves the patient at -2 to HT overall until he recovers these FP through sleep.

Bleeding (TL1)

Bleeding is done via *incisions, cupping,* or *venesection.* An incision is made with a scalpel, knife, or razor. The resulting cut is small, so a Surgery roll isn't mandatory; an Esoteric Medicine roll at -2 will suffice. Cupping and venesection require specialized tools (below).

A related technique is applying leeches. These can be found in swampland with a Naturalist roll. They permit an unmodified Esoteric Medicine roll.

Successful treatment *might* give +1 to HT rolls to resist injected poisons, fight local blood infections, and avoid heart attacks – or +2 on a critical success. Succeed or fail, blood loss causes fatigue, normally 1 FP, and may produce sedative effects (treat as drowsy, p. B428). Bleeding can be used deliberately for sedation, but critical failure means massive anxiety that costs an entire night's sleep, in addition to its other effects.

Cup (TL1). This horn or metal cup is heated and then pressed against the skin over an incision. As it cools, a partial vacuum seals it to the skin and draws out blood. Roll vs. Esoteric Medicine roll to use it. A TL0 variant has a small hole; the user sucks out air through it and then seals it with wax. $25, 0.5 lb.

Lancet (TL2). A specialized knife for opening a vein. Use requires Surgery *and* Esoteric Medicine rolls. Failure at Surgery causes useless superficial bleeding. Critical failure opens an artery! Handle this using *Bleeding* (p. B420), with -2 to the required HT rolls. $25, neg.

Purging (TL1)

Purging involves herbal preparations; see *Drugs* (pp. 150-152). The result, attained after 1d×30 minutes, amounts to retching (p. B429). Treatment calls for a Pharmacy (Herbal) or Esoteric Medicine roll. Success *might* give +1 to HT rolls to resist ingested poisons and infections of the digestive system – or +2 on a critical success.

Dietary Regimens

Many Esoteric Medicine specialties include observations of the physiological effects of foods. Healers will recommend suitable diets to improve the condition of the sick and injured. This counts as part of the "rest and decent food" mentioned in *Natural Recovery* (p. B424). A well-prepared meal of suitable foods (roll vs. Cooking or Housekeeping) can restore an extra FP; see *Recovering from Fatigue* (p. B427). Lack of a suitable diet gives -2 to HT rolls for natural recovery – although a caregiver with Esoteric Medicine, Pharmacy (Herbal), or Physician at 12+ can still bestow +1, for a net -1.

Electrical Therapy

Ancient Roman physicians described the use of the torpedo (probably *Torpedo marmorata,* an electric fish related to sharks and rays) to deliver shocks to their patients. Treat this as a stunning electric shock, but with the desirable side effect of relieving certain types of chronic pain, such as headache and gout. Roll vs. Esoteric Medicine for pain control (p. 152). Critical failure means the subject suffers electromuscular disruption (p. B432).

Heat

At Neolithic TL0, Native American tribes built *sweat lodges:* huts that could be filled with steam by dropping heated rocks into water. Similar customs appeared in higher-TL societies; e.g., Finland's *saunas.* Roman farmhouses favored dry sweating in front of a hot stove; as Rome grew richer, public baths offered both wet and dry heat. Sweating is often used simply to get clean, but the elevated body temperature and the flushing of the system give +1 to HT rolls to resist many infections.

Immersion

Immersion is a TL2 method for flushing poisons from the body, developed by Greek physicians. It involves prolonged bathing, lasting at least six hours. Water is absorbed through the skin, diluting water-soluble poisons and later flushing them out. It can also help with *toxemia:* the generation of blood agents within the body during illness or late pregnancy.

Make an Esoteric Medicine roll. Success gives +1 to HT rolls to resist poison or illness, rising to +2 after 12 hours. Failure causes no harmful side effects; the treatment is simply ineffective. The only equipment required is a tub (see *Grooming,* p. 36), water, and optionally a way to heat some of it.

Soaking in *hot* water, as in Roman baths, can give benefits similar to those of a sweat lodge; see *Heat* (above). It also lessens discomfort from strained muscles (such as from a critical miss in combat; see pp. B556-557).

Lotions and Salves

Since the Stone Age (TL0), people have applied thick fat- or oil-based fluids to the skin for cleaning (see *Grooming,* p. 36), healing, and ritual (*anointment* means putting oil on someone). These can act as lubricants during massage (see *Massage,* below), serve as media for herbal medications (see *Herbal Extracts,* pp. 151-152), and soothe dry, irritated, or burned skin directly. Treat this last application as pain control (p. 152) for skin conditions – including skin inflammation caused by disease or contact poison.

Olive Oil (TL0). Oil pressed from olives has been used around the Mediterranean since the Neolithic. This is a high-quality oil, and thus expensive, but counts as basic equipment. Treat standard fuel oil (p. B288) as improvised, for -2 (quality) to skill. Per pint: $6, 1 lb.

Lanolin (TL1). A waxy substance extracted from sheep's wool by washing it in water. It naturally penetrates human skin, giving +1 (quality) to creams and ointments prepared with it. It also gives +1 to HT rolls to regain lost HP after skin injuries. Per pint: $20, 1 lb.

Lotion (TL1). An emulsion prepared from water and some form of fat or oil. Herbal additives provide texture, scent, or therapeutic effects. Basic lotion gives the same benefits as olive oil; good or fine lotion gives +1 or +2 (quality) at +4 or +19 CF. Per pint: $8, 1 lb.

Massage

Massage has been used for therapeutic purposes over much of the world, starting at TL0. Its main effect is pain control (p. 152) – primarily for discomfort caused by tense or strained muscles, such as tension headaches and wrenched backs. It can relieve suffering from Bad Back (p. B123) and the crippling effects of straining a limb in combat (due to a critical miss; see pp. B556-557). Techniques based on massage play a role in midwifery (see ***GURPS Low-Tech Companion 1***). Finally, massage can be used for acupressure (see *Acupuncture and Moxibustion,* pp. 152-153).

For effective massage, roll vs. Professional Skill (Masseur) or a suitable Esoteric Medicine specialty. Basic equipment is a massage table. Any flat surface can serve as improvised equipment (-2 to skill). More elaborate equipment can provide quality bonuses.

Massage Supplies (TL1). Includes a small brazier, vessels for heating oil and water, a towel that can be warmed and applied dry or wet, and a stock of consumables: oils and lotions to provide lubrication, scents, compounds to stimulate the skin, and fuel (usually charcoal) for heating. $50, 10 lbs. Replacement supplies: $10 after each day of use

Massage Table (TL1). A table large enough for an adult to lie on at full length, with a smooth surface. It normally has a pillow or a cushion to support the ankles (for someone lying prone) or the knees (for a supine subject). $150, 50 lbs.

Massage Chair (TL2). A chair designed to sit in while being massaged. It provides optimal exposure of the body to the masseur, and can be adjusted to different body sizes and postures. The typical posture has the subject leaning forward with his back exposed. Gives +1 (quality) to skill. $250, 30 lbs.

Ventilation

Low-tech societies had no truly effective treatment for someone who had stopped breathing. They equated respiratory failure with death – which may be why "breath" and "spirit" have the same root word in many languages. Still, occasional attempts were made to restart breathing: rolling the subject over a barrel to compress his lungs at TL3, or blowing air into his throat with bellows at TL4. If the GM wishes to be optimistic about such methods, he might let them work on a successful First Aid roll at -5 (the penalty for improvised equipment).

Variolation

Variolation was developed in China in the 10th century (TL3). It wasn't a treatment but a preventive measure: the earliest recorded method of immunization. It used material from smallpox lesions to infect healthy people with a milder form of the disease, either by putting it under the skin or by blowing powdered scabs up the nose. Roll vs. Esoteric Medicine or Physician to expose the patient. This is somewhat risky – the recipient must make a HT roll at +6 to avoid coming down with smallpox! If he succeeds, he's immune to smallpox thereafter.

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