TECHNOLOGY RATINGS

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Each Tech Rating (TR) is defined by some new idea, material, or process that completely changes everything. That defining thing is listed in the TR heading, along with the approximate historical eras that technology was available in the Middle East or western Europe (as a standard). Note : to keep it simple, only 4 kinds of early guns are considered – matchlock, wheellock, flintlock, and caplock.

Keep in mind that the level of technology doesn't have to be the same everywhere – technology can vary from continent to continent, and any concept or process can be lost and later re-discovered. Historically, cement and concrete were first discovered in TR 3, but were then lost and not discovered again until TR 6!

In addition, widely separated areas (like un-connected continents) could be an entire TR or more ahead or behind the others (like when the Europeans at TR 5 came to the Americas, arguably at TR 2).

The GM should feel free to move any feature of a TR that does not define it ahead or behind by one TR, within reason. For example, eyeglasses appear at TR 5, so there's no reason telescopes and microscopes couldn't appear then instead of TR 6 if you want.

Whatever TR you're in, be sure to check all the ones before it as well, to see **everything** that's available, and because many things that appear in earlier TR's may continue to be used for a long time. Geese (TR 2) may still be used as a "burglar alarm" up until TR 7! Pitch, tar, and resin which appear at TR 1 are still used as glues and varnishes up to TR 9! And, read ahead to make sure you're not including anything too advanced.

Governments and TR: in the absence of large organized governments, societies may be organized by the feudal system, where peasants work the land in exchange for protection by their baron, earl, or lord. Guilds reach their peak as they provide high-quality goods to the limited number of nobility (kings, barons, earls, lords, etc.). Historically this happened at TR 4 (the typical "Medieval & Magic" role-playing setting), but it really has nothing to do with TR! By TR 5 historically, large middle-class and low-class populations appear because the peasants had bought their freedom, and guilds are on the way out because this new large consumer base needed low-price, low-quality products. On the other hand, democracies have existed as early as TR 3. The GM should feel free to use whatever kind of government or social order they like, independent of TR.

Skills: Using skills between TR's is tricky, so some of your skills must be rated by their TR if you are going to be in a mixed-TR campaign. For example, someone trained in picking locks in TR 6 is going to be completely baffled the first time they come up against a TR 7 lock.

TR 0 (100,000 BC-70,000 BC)
Survival is tough, life is brutal and short – and that's about it!
Weapons & warfare: Clubs (branches, bones), held or thrown stones, fists.
Transportation: Walking.
Energy sources: Fire.
Communications: Spoken language.

TR 1 – shaped stone and agriculture (70,000 BC-4000 BC)
With the advent of agriculture (grains and beans grown in irrigated fields plowed by hand), people stay in one place and cities develop. Dogs, cats, goats, and cattle are domesticated. Barter is used to exchange goods.

Weapons & warfare: Handaxe, dagger, spear, bow&arrow, sling, boomerang. Spears and arrows can be sharpened wood or pointed with stone.
Transportation: Canoes, rafts.
Energy sources:
Medicine:
Communications: Clay tablets and pictographs (heiroglyphics/cuneiform).
Security: Dogs.
Materials, machines, knowledge: Specialized stone weapons and tools; cloth, wine, crude oil lamps, baskets, flute, earthen ovens, dried meat, honey, baked pottery, sun-dried clay bricks, polished-stone mirrors. Wood pitch, tar, and resin are used as glues and varnishes (see bottom of document).
Examples : Stone Age.

TR 2 – worked bronze (4000 BC-1100 BC)
Multiple cities have organized into nations, with laws and calendars. Long-range (1000's of miles) overland trade routes are possible. Some nations may take to conquering larger areas, resulting in the first wide-spread empires, usually no bigger than 300-400 miles, and lasting no longer than a few hundred years. Large-scale stone-working is possible, but very slow. Impressive works of art appear : paintings, intricately decorated pottery, and statues.
Weapons & warfare: Bronze sword and axe, stone "mace", leather armor, scale mail, helm, horse-drawn war chariot. See "Greek Fire", below.
Transportation: Horse (not ridden due to lack of saddle, bit, bridle, stirrup – but can pull things like carts and war chariots), carts, small sailboats. Very short-span bridges (10 feet) made of wood or stone.
Energy sources:
Medicine:
Communications: Papyrus (scrolls) and alphabets.
Security: Dead bolt locks, geese.
Materials, machines, knowledge: Bronze weapons, armor, tools; beer, olive/sesame oil, wool, fired bricks, dyes, candles, lyre, harp, pottery wheel, copper mirrors. Basic mathematics (add, subtract, multiply, divide, fractions) develops for record-keeping. Animal-skin and flax-based glues. Sundials.
Examples : Ancient Egypt; pyramids, Stonehenge.

TR 3 – hard iron common and horse-riding (1100 BC-700 AD)
Hard iron makes warfare much more deadly, and many tools much more useful. Nations begin to develop sophisticated cultures with varied social classes. Large, well-organized governments (if they exist) can produce great feats of civil engineering such as long-span bridges, coliseums able to hold 65,000 spectators, and aquaducts up to 50 miles long (also assuming a knowledge of concrete). Actors, singers, etc. can make a living with public performances. Long-distance communication via the horse allows empires to grow up to 3000 miles across.
Weapons & warfare: Chainmail, breastplate, fighting on horseback becomes possible.
Transportation: Horse (easy to ride with saddle, bit, bridle, stirrup), gravel and stone-paved roads, sea-going (but coast-hugging) boats. Bridges spanning dry valleys up to 500 feet are possible using stone and concrete.
Energy sources: Water wheel, watermills. Heavy iron plows dramatically increase farm yields.
Medicine: Wound treatment, diagnosis based on observation of symptoms; early medical tools (scalpels, forceps, etc.); cauterization. Very crude prosthetics (legs, feet).
Communications: Parchment, quill pen; well-organized fire towers can send messages about 100 miles per hour (one tower every 5 miles or so); government-run postal/courier/delivery service for government use becomes possible (only if very well-organized).
Security: Keyed warded locks and crude padlocks, rarely made of metal. Simple encryptions appear.

Materials, machines, knowledge: Iron weapons, armor, tools; cement/concrete, soap, silk, glass-blowing, grappling hook, large gears, coin money, sundials, crude glass mirrors. Simple, crude, water pumps. The beginnings of geometry, trigonometry, algebra, anatomy, zoology, astronomy, etc.
Examples : Ancient Greece, Rome.

TR 4 – steel common (700-1300)
Trade becomes common and wide-spread over long distances, both by land and by sea (but generally not across oceans – ships are still coast-huggers). Universities are available in major cities, and banking is big business (only to nobility, usually lending money to finance wars).
Weapons & warfare: Ringmail, platemail, crossbow, longbow, trebuchet/catapult.
Transportation: Nailed horseshoes (often bronze) significantly reduce wear on horse's feet.
Energy sources: Windmills; horse collars allow horses to pull plows and carts with much greater force.
Medicine: University-trained physicians.
Communications: Carrier pigeons can deliver short one-way messages at 20-25 miles per hour.
Security: Warded locks (see key below), made of metal. Bells on a hook, metal coil, or string attached to doors.

Materials, machines, knowledge: Steel weapons, armor, tools; nitric acid, distilled liquor, scissors, clear-glass mirrors. Hand-powered geared calculators showing planetary motions.
Examples : Dark Ages/Middle Ages, King Arthur (early), Robin Hood (late), typical "Medieval & Magic" settings without guns.

TR 5 – gunpowder (1300-1550)
Guns change the nature of warfare dramatically, eventually making all metal armor obsolete. Relatively speaking, technology starts to take off. Water-powered grain mills, sawmills, water pumps, ore lifters, ore crushers, air pumps, and the like are common, due to the discovery of the crank (see below), but are mostly wooden, and limited to locations with running water. The mining, smelting, and making of metal alloys is pretty much an exact science.
Matchlock guns use a smoldering cord to ignite the powder. It is useless on boats, in fog or rain, and *the smell of the burning cord is a dead giveaway*. They require lighting the wick and placing it in the gun before using.
Wheellock guns use a spring that rotates pyrite against steel, creating sparks. It has a complex mechanism which easily jams and makes it much more expensive. Only wheellocks can be carried "ready to draw and fire". For either gun, the reloading times are significantly long (~30 seconds at best, up to 60 seconds).
Weapons & warfare: Gunpowder, matchlock gun, wheellock gun, grenades, mortars, cannon (with cast-iron cannonballs late). Crude time-bombs and bomb traps are possible, using the wheellock mechanism.
Transportation: Ocean-going sailing vessels with modern rudders can travel 400-600 miles per week; simple horse-drawn carriages. Magnetic compasses are available for land and sea navigation.
Energy sources:
Medicine: Amputations common (but often fatal).
Communications: The printing press makes books and posters available to many more people.
Security:
Materials, machines, knowledge: Sulfuric acid, eyeglasses. Clock towers (early) and "table" clocks (late). The crank (converts rotary to reciprocating motion) allows more kinds of useful machines to be built.
Examples : Renaissance, typical "Medieval & Magic" settings with guns.

TR 6 – flintlock gun and paper cartridges (1550-1775)
The flintlock is as cheap as the matchlock, more reliable than the wheellock, and can be carried ready-to-fire, while paper cartridges dramatically reduce reloading times (~15-30 seconds). Reliable ocean-crossing navigation means that other continents may be "discovered", possibly leading to colonization (if the discovered culture has a lower TR) and larger "empires", which may or may not end up in conflict with each other. The

use of the scientific method leads to the start of chemistry and classical physics, and the invention of the telescope turns astrology into astronomy.
Weapons & warfare: Paper cartridges for guns, flintlock gun, self-triggered land mines.
Transportation: Accurate E/W ocean-going navigation makes reliably crossing oceans possible for the first time; more comfortable horse-drawn coaches.
Energy sources:
Medicine: Human anatomy better understood.
Communications: Newspapers (infrequently published and limited distribution). Nation-wide postal/courier/delivery services for government use become more common.
Security: Telescopes.
Materials, machines, knowledge: Plate glass common, glues, microscopes, telescopes, electricity identified, Leyden jar (one-shot electrical discharge).
Examples : Colonial America (early), the Revolutionary War (late), the Three Musketeers, pirates in the Caribbean.

TR 7 – steam engine and caplock gun (1775-1850)
The development of a useful, reliable steam engine revolutionizes mining, farming, shipping, transportation, and manufacturing. It is the "Industrial Revolution".
Weapons & warfare: The caplock gun fires much more reliably, can be reloaded slightly faster, and barrel rifling significantly improves firearm accuracy. Shrapnel cannonballs can explode over enemy troops.
Transportation: Hot-air balloon, steamboat (15-20 mph).
Energy sources: Steam engine, crude (wet-cell) batteries. Cast iron stoves for home heating and cooking.
Medicine: Start of vaccines.
Communications: Semaphore towers send messages over 200 miles per hour, spaced about 5-8 miles apart (only in a well-organized government).
Security: Lever-tumbler locks (see key pic below) are much harder to pick than the older warded locks. Combination locks. More complicated cryptography is developed, but depend on using many "keys" to be effective.

Materials, machines, knowledge: Paper money, canned food, standardized nuts and bolts, metal nib pens. Surface-fed (manually pumped) diving suits. Electromagnets, first working parachutes. Understanding of "elements", dozens known.
Examples : The Civil War (late), Frankenstein, 20,000 Leagues Under the Sea, early "steam punk".

TR 8 – revolver (1850-1900)
Things begin to speed up, in many ways. Rapid-fire guns change the nature of warfare yet again. The train allows for high-speed travel between major cities, and the telegraph delivers messages faster than ever before possible – messages that used to take weeks or months to cross an ocean or continent are now delivered in hours. Indoor plumbing starts to become common in cities.
Weapons & warfare: Revolver, cartridge shotgun, crude machine guns, TNT, nitroglycerine, dynamite, ironclad warships, self-propelled (but unsteerable) torpedoes, contact naval mines. Useful telescopic sights for guns become available. Benzene could be used in molotov cocktails.
Transportation: Train (early : 15 mph; late : effectively 30 mph with frequent stops, 90 mph with no stops), bicycle, steam-powered steerable airships, screw propeller makes modern boats possible.
Energy sources: Lead-acid batteries (heavy but high-current and rechargeable). Kerosine. Coal-powered furnaces for steam engines and home "central heating". Public and home use of coal gas for lighting.
Medicine: Understanding of germs, better wound care, ether and chloroform as knock-out gasses, strong pain killers (opium, morphine, cocaine, heroin), hypodermic needles, antiseptics used in surgery.

Communications: Telegraph, including trans-continental and trans-oceanic cables. Low-res and slow but workable fax machines. Printing presses able to print millions of pages/day lead to mass-printed daily newspapers. National postal/courier/delivery services for public use.
Security: Pin-tumbler (modern) locks (see key pic below), dial-combination locks, simple electric alarms using switches, with either on-site or remote (police station) alarms. Development of encryption analysis.

Start of forensics (fingerprints, detection of some poisons).
Materials, machines, knowledge: Crude photography, vulcanized natural rubber, mechanical adding machines and typewriters, matches. Tanks of compressed gasses, rebreathers, and regulators make underwater construction possible but awkward and dangerous.
Examples : The "Old West", Sherlock Holmes, late "steam punk".

TR 9 – gasoline engine and electric motor (1900-1950)
Technology continues to improve at an accelerating rate – virtually everything in the lists below started out very crude "early" in this TR, but is much improved by "late" in the TR (for example, silent black-and-white movies become full-color talkies). The gasoline engine revolutionizes shipping and personal travel, providing people the freedom to travel long distances when and how they want. The electric motor provides small, quiet, local sources of power to the home and factory for the first time ever. Cheap, reasonable quality goods become available in mass quantity, from far-away places.
Weapons & warfare: "Smokeless" gunpowder, thermite; semi-automatic(self-cocking) pistols with clips; silencers, submachine guns, bullet-resistant vests. Incendiary and explosive bullets (generally large-caliber). Missiles, bazooka, tanks, submarine; mustard gas, tear gas, gas masks, other chemical and biological weapons; fission atomic bomb. Every company (100 soldiers) has a radio.
Transportation: Motorcar (15 mph early, 100 mph late) and motorcycle, ocean-going vessels can travel 3500 miles per week, airplanes at 200 mph with no air service early, to 500 mph with massive air service late. Liquid-filled compasses.
Energy sources: Gasoline engine and electric motor; portable (dry-cell) batteries, electricity to the home from hydroelectric and fossil-fuel generators.
Medicine: Start of modern medicine – the first antibiotics (cures) and good anesthetics lead to reliably successful major surgeries (wound repair, amputations) and infectious disease treatment; x-rays, first "life support" (iron lung), muscle-powered prosthetics. Plastic surgery can change your looks. Understanding blood types greatly improves survival rates for transfusions.
Communications: Telephone (including trans-continental and trans-oceanic cables), radio (short-range and telegraphy early, long-range and FM and large walkie-talkies late). Phonograph (record and play), movies (silent B&W early, sound&color late), TV late. Car radios (police, etc.).
Security: From now on, it's all about the sensors – contact switches, sound sensors, light sensors ("photoelectric eye"), low-sensitivity heat sensors (thermostats), sonar, radar, metal detectors. Small, strong padlocks. Blood types between crime scene and suspects can be checked. Paraffin tests can detect gunshot residue (but not reliably). Electric and/or mechanical encryption machines are developed, making cracking an encrypted message much more difficult than ever before.
Materials, machines, knowledge: Aluminum, tungsten, bakelite, nylon. Light bulb, neon lighting, flashlights, electric refrigeration and air conditioning, electric typewriters. Dry-film negative-image photography. Large room-sized (vacuum tube) calculators. Cause and treatment of the "bends" understood; modern scuba suits, late. Welding metals together becomes possible. First understanding of atoms and gravity.
Examples : World Wars I & II, film "noir" private detectives.

TR 10 – transistor (1950-1980)
Transistors revolutionize electronics, replacing large fragile hot tubes. Computers start to shrink in size and grow in computing power, and large companies use them for business. Medicine increases the quality and length of life. This is the era in which electronics *starts* to replace machines as the driving force.
Weapons & warfare: Better bullet resistant vests (first used by local police); mace, pepper spray; fusion atomic bombs and missiles. "Homing" missiles, Neutron bomb; electromagnetic pulses understood; nuclear-powered submarines. Every squad (10 soldiers) has a radio. Tranquilizer guns (takes minutes to affect, dosage is critical).
Transportation: Helicopter, hang-glider, high-speed (125 mph) trains. Chemical-powered rockets for orbiting satellites, manned trips to a nearby moon, orbiting space stations, and unmanned space probes to the entire solar system (all extremely expensive, requiring a massive, well-organized government).
Energy sources: Natural gas to the home; nuclear- and solar-generated electricity.
Medicine: Understanding of DNA; organ transplants, heart-lung machine, dialysis machine. Widespread mandatory public vaccinations and better antibiotics severely limit infectious diseases. Severed limbs can often be re-connected.
Communications: Commercially-owned satellite-relayed telephone. Car telephones (for personal use). Modern-day fax machines.
Security: Bulky night-vision – IR illuminated ("active"), and low-light. Miniature sound "bugs" using radio transmitters that broadcast for a few hundred feet (cigarette-pack sized early, nickel-sized late). Better gunshot residue tests. Spectrographs can identify a wide range of compounds (large and expensive). Encryption becomes complex and essential.
Materials, machines, knowledge: Many plastics, including Teflon and Kevlar. Polyurethanes replace pitch, tar, varnish. Chemical-powered spaceflight, satellites. Lasers, solid-state electronics and computers. Tape recorders (record and play). Fluorescent lighting (early) and LED's (late). Contact lenses. Commercial video tapes (reel-to-reel). Large room-sized computers (early), hand-held electronic simple calculators (late).
Examples : 1950's-1980.

TR 11 – cheap computers (1980-2000)
The home (and office) desktop computer revolutionize everything yet again. Electronics equipment developed in TR 10 becomes smaller, cheaper, faster, and more powerful. Mechanical devices (machine guns, etc.) become cheaper and more reliable.
Weapons & warfare: Kevlar bullet-proof vests; tasers.
Transportation: Ultralight airplanes; propeller and jet VTOL planes.
Energy sources:
Medicine: Crude cloning; internal artificial organs.
Communications: First- and second-generation cell phones; wired computer networks become common.
Security: Passive IR sensors can see body heat at night. Lasers can pick up speech from window vibrations, and radios can monitor computer keyboards from their EM "noise". Very crude facial recognition. Mass spectrometers available to police, allowing matching of specific substances (such as gunpowder residue). Electronic keypad locks become available. DNA testing can match individuals to crime scenes.
Materials, machines, knowledge: Desktop computers; solid-state lasers, home video cassettes. LCD screens, touch screens. Start of the World Wide Web. GPS for military and civilian use. First practical "stealth" technology for airplanes, etc.
Examples : 1980's-2000.

TR 12 – portable wireless communications (2000-????)
(Anybody reading this grew up in this TR, so only the high points are hit, since you know what's available!)
Wireless networking, cell phones, and the internet connect everyone to everyone all over the world.
Weapons & warfare: Every soldier has a radio. Fire-and-forget missiles. Drones.
Transportation: limited private access to space orbit and space stations (millionaires!).

Energy sources: Longer-lasting, lightweight batteries (lithium).
Medicine: Genetic manipulation of cells. Drugs appear for specialized problems, better drugs replace older drugs.
Communications: Wireless networking everywhere; 3G, 4G, and smart phones; satellite phones allow communication in remote places.
Security: Passive IR sensors see thru clothing and walls. Ground-penetrating radar. Micro-cameras with web connections. Biometric (palm/fingerprint, retina, iris, veins in hand/finger) locks become available. High-powered networks of computers may be able to break all but the most complicated encryptions. DNA forensic databases.
Materials, machines, knowledge: palm-sized computers; digital photography, audio, and video. RFID chips. Robotics takes off, with specialized autonomous robots able to sense and manipulate their environment. Humanoid walking robots are possible, but expensive and limited. Miniature airplane and helicopter drones, controlled by remote operators.
Examples : modern day.

Greek Fire (TR 1 to 5)

Disclaimer : the following is generally historically true, as attested to by ancient documents and modern-day experiments, but makes no claim to be 100% accurate in every detail. It is meant as background concepts for game-playing purposes only.

Various formulas for "Greek fire" were known as early as TR 2, and it can be formulated into something as sticky as napalm, or as fluid as water, and can even be used to create pre-gunpowder "grenades".

First, a quick lesson in early hydrocarbons :

- Heating pine wood produces *tar* (thick liquid), *pitch* (solid), and *turpentine* (watery liquid).
- Distilling *resin* (pine sap) makes *rosin* (solid) and *turpentine*.
- *Bitumen* (asphalt) is a petroleum-derived "pitch" that can be found naturally ocurring in certain areas (lakes, wells, mines); it can be distilled to produce *naphtha* (watery liquid).

All of these are flammable to some degree or another.
TR 1 has access to small quantities of resin, tar, pitch, and bitumen.
TR 2 also has access to turpentine.
TR 3+ also has access to rosin and naphtha.
By TR 4, production of these valuable materials is big business, and stays so thru TR 9!
Now pick any combination of the above to get the consistency you want (more liquid vs. more viscous) :

Liquids – tar (thicker), turpentine and naphtha (thinner)
Solids/Thickeners – resin/rosin/pitch, bitumen, animal fat, beeswax

Then maybe add some extras :

Sulfur – creates blinding and toxic smoke
Quicklime – toxic and blinding smoke, bursts into flames on contact with water
Gunpowder (TR 5+) – explodes for wider spread

Any combination of the above not only floats on water but burns on water!

None of the above info is needed by the players (or really even the GM) as in-game mechanics, but to show that all of the following items/uses are easy to justify as existing in the game, in settings as far back as the ancient Greeks or Romans.

Options for use in combat

- By TR 2, the solids could be mixed with a little bit of tar and straw, forming a "napalm" that sticks to skin and armor.
- Large quantities of the thickest compounds (very little liquid) can burn for hours, and burn hot enough to melt bronze!
- By TR 3, mostly-liquid mixtures can be pumped thru pressurized nozzles to form a burning stream of liquid tens of feet long that ignite whatever they touch – a crude, non-portable flame thrower!
- Also by TR 3, turpentine and/or naphtha could be put into a glass bottle, making a crude molotov cocktail!
- A napalm "grenade" would be a formula thin enough to splatter easily on impact, but sticky enough to cling to whatever it hits. In TR 5, throw in some gunpowder to spread the material a little farther.

These could be used in combat for some time even after gunpowder is discovered (TR 5), eventually being replaced by cannons (once they became reliable, accurate, and common).