Primitive, But Not Stupid

by Paul Drye

The Imperium abounds with low-tech worlds -- 25 in the Spinward Marches alone are between the Bronze Age and the first glimmerings of steam power. While there have been plenty of arguments about why they exist, another less-examined question is *how* they go about existing. This is probably because we picture them as close analogs of Earth's societies at the matching tech levels.

There is a problem with this, though: our ancestors never had the advantage of a high-tech society all around them, with the advanced ideas of that society at their disposal if they want them. Even putting aside the importation of advanced equipment, the mere introduction of some late-developing technologies well within the comprehension of a pre-industrial Human will make low-tech societies different from their pre-stellar Terran equivalents. If a world's people are not isolated by a Red Zone, or deliberately divorced from advanced ideas for non-economic reasons, it is worth examining what they could know, and guessing how that will affect them.

Railroads

When we hear the word "railroad", we naturally think of locomotives. But it is worth deconstructing the word and noticing what it implies: *rail* road. The key innovation in the mind of whoever coined the term was the rails, not the means of getting around on them.

In fact, rails were a separate innovation, which occurred some time before steam-powered locomotives came into use. Even without engines hauling cargo, a railway was of considerable use because it provided a smoother, easier surface to work with for animal-powered cars. Horses drawing cars from mines along rails date from the 16th century, and certainly could have been invented much earlier -- all one needs is draft animals, wood for the rails (iron didn't come to be used until the late 18th century), some very basic surveying techniques, and enough labor to grade the bed. All were available in the 10th century BC in Egypt, for example.

From the standpoint of a low-tech world -- even one so low-tech as to be able to produce only wooden rails -- a horse-drawn railway is a real advantage. A single horse can pull ten tons over a graded railway at about ten kilometers an hour (6 miles per hour) for an entire day. This is something like five times the load possible over dirt roads.

A variation on this idea, horse-drawn streetcars running along rails, also supplies a low-tech solution to mass transportation in cities. This can help thin out a city enough to keep population densities lower than the typical medieval city on Earth.

For travelers spending time on a low-tech world, a trip on a "horse"-drawn railway train will certainly be an unusual piece of local color. Virushi player characters may also find themselves with a unique role to play should the draft animals be killed or injured in dangerous territory.

Optical Telegraphy

The transfer of messages over distance was, for a very long time, restricted to the speed of a horse. While on campaign in Italy, Napoleon Bonaparte could communicate no more quickly with his superiors back home than Julius Caesar could while invading Gaul.

The electrical telegraph of Samuel Morse and others is rightly hailed as the breakthrough that shattered this restriction, but an abortive technology from a few decades earlier is worth examining. The optical telegraph first surfaced in Revolutionary France, but could have been invented and used at a much lower tech level. The French telegraph was, in essence, a wooden tower outfitted with pulley-operated arms, like semaphore flags wielded by a giant. This exact solution is perhaps a little too fussy for pre-medieval construction, but other simpler systems were used, such as dark-colored buildings with windows that could open to reveal white panels. Eight panels would even allow the transmission of ASCII text (or equivalent, assuming the Imperium still uses eight-bit text encoding). The high contrast between the black and white is easily visible from a distance of 15 kilometers (10 miles) with the use of a weak telescope -- another technology well within the reach of early societies if only the idea were available to them. With a turn-around time of about five minutes per sentence, a chain of stations could carry short messages at more than 150 kilometers per hour.

The optical telegraph is only good for line-of-sight transmission, was susceptible to fog and rain, and -- lights notwithstanding -- proved impractical in the dark. But with a suitable set of "telegraph hills", information could move around the countryside far faster than before.

For adventurers, one way they may encounter these is if they are trying to outrun the authorities for one reason or another. An optical telegraph can transmit warnings down the line faster than most land transportation. Even if they move elsewhere on the planet in their ship, they probably have less time before being discovered than they might think.

Germ Theory

"Many kinds of disease are caused by invisibly tiny animals, which can be stopped with heat or alcohol." This is not even technology, just an idea, but if applied it can have more effect on a pre-technological society than anything else in this list.

First, average life spans will increase by 50%, as infant and childbirth mortality drop. Most people attribute the major increases in the length of Human lives to 20th century medicines, but in fact a large fraction of it came before those were even developed. The work of Louis Pasteur, Edwin Chadwick, and Ignaz Semmelweis helped raise life expectancy by 20 years from the middle of the 19th century to the introduction of the first antibiotics in the 1930s.

Some of this increase can be attributed to better nutrition, but even that falls under the sway of germ theory. Long-term preservation of food becomes possible once one understands bacteria. Classical civilizations could seal wine jugs using pitch to prevent their contents from spoiling, but they never knew they could preserve almost anything if

they only boiled the contents before sealing. Not only does nutrition improve in the lean months of late winter -- probably critical if the planet has a year longer than Terra's -- long sea voyages become much more practical. Food can be carried indefinitely, and vitamins are preserved; in fact, the sailors might even know that they need vitamins in the first place: this is another late discovery of a rather simple idea.

The water supply becomes much easier to secure as well. A recent discovery is that a simple, clear plastic or glass bottle is a fantastic water sterilizer. Fill it with water, place it on a black surface in the sun, and within a few hours its contents will go above pasteurization temperature (somewhat short of boiling), killing almost all of the living organisms within. The water will still carry any unappetizing load of mud or other solids it had before, but now at least it won't kill you. Enterprising players may find that useless soda bottles from New Rome are valuable cargo on Craw.

Waterwheels

Power generation is a problem for any early civilization; most are restricted to muscle- or animal-powered machines. While the steam engine is the first quantum leap above these technologies, an earlier solution merits some attention. The waterwheel was invented quite early on, and with the discovery of the geared undershot wheel in Roman times, we had the only significant alternative to muscles for much of the world (windmills notwithstanding).

However, the undershot wheel is quite inefficient, extracting only about a fifth of the available energy, and relies on a considerable flow of water. A slight variation on it, known as a Pelton Wheel, was discovered in the mid-19th century. The water is channeled through a small pipe (which, by Bernoulli's Principle, greatly increases its speed), and is played against the edge of a cup-shaped blade instead of the center of a flat one. The efficiency of a Pelton Wheel is three times that of a regular undershot wheel, and approaches the sort of energy densities needed for useful generation of electricity -- in fact, the water turbine used in modern hydroelectric dams is a direct descendant of the Pelton Wheel.

This means that the sort of infrastructure necessary for electric lighting is possible, if expensively and on a small scale. Wires would be made by hand, and Roman-era light bulbs would be ridiculously chunky and prone to burning out without a noble gas to surround the filament. Arc lamps are another possibility. The point is, it all would be within the reach of the very wealthy. It would probably be a status symbol in the palace of a king or great noble, lit for a few hours at night for balls and other events. A large millpond on the estate, used to feed the wheel's pipe, would be a sure sign of who had an installation.

Gunpowder

A caveman could make gunpowder, if he only knew how. Charcoal is, to a pre-industrial society, about as common as dirt. Saltpeter is found *on* dirt (or rather on animal manure), and sulfur is not too hard to find. Even some of the techniques that were developed after

gunpowder was first invented are relatively easy. For example, corned gunpowder is more powerful than powder, safer to make, and less inclined to separate when transported. Yet the entire secret to it is mixing the ingredients with water, then breaking the dried cakes into small pieces. The best proportions (13 saltpeter/3 charcoal/2 sulfur) will also be known, instead of taking hundreds of years to discover.

Using the gunpowder is a bit trickier. Guns probably developed about as quickly as technology would allow, thanks to the Human obsession with weapons. Metallurgy and machining tolerances simply have to be met, and that is hard at lower levels of technology. There is some room to maneuver here, but not a lot.

A hybrid weapon is possible quite early, however. Having a mason hollow out a stone, then filling the cavity with gunpowder, produces a crude shrapnel grenade. Adding a fuse that won't blow the charge too soon or too late for the grenade user's health is a bit more difficult, but twisted cotton thread embedded with gunpowder can be cut to lengths corresponding to a particular time, "give or take." Now cross a very large stone grenade, a give-or-take fuse, and a trebuchet. One has a passable substitute for a cannon when it comes to reducing a castle, and an extremely nasty piece of battlefield anti-personnel artillery. One of these dropped near a far trader's landing gear can ruin your whole day.

Gunpowder is also a very useful item in a variety of non-violent applications, such as mining, and the building of tunnels or leveling of mountain passes. PCs, being as PCs are, will probably not encounter these non-weapon applications as much, but they will increase the general livelihood of a low-tech civilization.

And There's More....

The items listed above are the ones most likely to impact travelers: they are the most visible, and the most different from how real-world cultures approached things in the past. Plenty of other changes will lurk in the background, however, and may jump up to bite an adventuring party.

The list of these includes:

- Crop rotation and fertilizers -- food will be more abundant and cheaper.
- Positional arithmetic and alphabetic writing -- many more people could be literate.
- Bicycles -- cheaper than horses for personal transport, if a Roman-style system of roads is available.
- Mendelian genetics -- animal and plant breeding become a lot easier once this is known; more food again.
- Alloys -- with small imports of higher tech elements like aluminum and chromium, the "older" structural metals (copper, iron, and tin) can be alloyed and used in a many more ways.

- Paper money -- economic activity will not be stunted by being tied to an arbitrary and limited supply of something like gold.

Putting It All Together

So what is a low-tech world going to be like in the Third Imperium? A culture from Earth's past with the same tech level is a start, but the extra ideas and seemingly anachronistic technologies add up to change things a bit.

The most important change is that life for the average person will not be as nasty, brutish, or short. Food is more available and cheaper, and can be moved and stored more easily; fewer people will work on farms, freeing them up for other specialist activities. Disease is, if not conquered, at least muted somewhat, and the general concept of sanitation will exist; high law-level worlds might have elaborate duties imposed on citizens to deal with food and bodily wastes.

Another big difference will be political: states on these worlds can be larger and more coherent. In the real world, low-tech empires were never able to get much bigger than those of China or Rome because it was impossible to run an empire that took more than a certain amount of time to cross. One can look at non-balkanized low-tech worlds like Keng and retroactively decide that they *must* be using railroads and optical telegraphs, otherwise the planet could not possibly be united.

The planets wil be richer, too. As mentioned before, more people will be freed from farms to work at specialized tasks, which will raise the general standard of life for the world's citizens. Trade goods for off-world are likely to be a big industry too, as a few imports are going to be able to fill the gaps that simply cannot be covered with a low-tech solution. These goods are likely to be anything that requires a Human brain and a lot of spare time, two things that can be supplied as easily at TL3 as at TL12, if not more so. Certain mechanization-resistant activities to produce agricultural luxuries, analogs of coffee-picking and truffle-hunting here on Earth, are likely. The production of art objects is a good bet too -- the reader is directed to, for example, the Portland Vase. A beautiful Roman-era piece of cameo glasswork, the techniques involved were reinvented in the 19th century but have resisted mass production. It is estimated that the original glass-worker took as much as two years to produce this single vase, and about the same amount of time would be needed now, high-tech or no high-tech. An artisan on a low-tech Imperial world could get away with similar work if he knew he could sell it for Imperial credits to some rich off-worlder. A sum that would be relatively trivial to someone from Regina would support him and his family for the entire time it took to do one piece.

Just don't try to rip him off when buying his vase. He may be primitive, but he's not stupid.