PYRAMID®

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TECH AND TOYS II

STARMAKER, STARBREAKER

by J. Edward Tremlett

BLASTER AND LASER DESIGN
by David L. Pulver

MORE ULTRA-TECH GUNS AND HEAVY WEAPONS
by Mark Gellis

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by Alan Leddon

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Each article is color-coded to help you find your favorite sections.

Pale Blue: In This Issue
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Purple: Systemless Features
Green: Distinguished Columnists

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Jeffrey K. Starling

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Greg Hyland

In This Issue

Innovation never rests on its laurels, and neither does *Pyramid!* This month, we have more future tech and tools that may change the world . . . or do something *really* impressive!

Is it the ultimate tool for making colonist-worthy planets? Or the most destructive tech ever devised? (Hint: it's probably both.) *Starmaker, Starbreaker* provides a systemless overview of this mechanical marvel: its history, uses, and implications.

From the mind of David L. Pulver, co-author of ***GURPS Ultra-Tech,*** comes *Blaster and Laser Design*. The latest installment of *Eidetic Memory* walks interested parties through how to design a slew of TL9+ energy weapons, including a new example gun.

Add extra realism and detail to computers in your game with *Thinking Machines*. These variant rules for building computers in ***GURPS*** will overclock your campaign's processor with a *wide* range of computer categories and options, from molecular processors to multi-Dyson-sphere monstrosities.

Do you prefer solid projectiles over energy beams? Then you need *More Ultra-Tech Guns and Heavy Weapons*. Here you'll find descriptions and ***GURPS Ultra-Tech*** stats for over two dozen new future-tech firearms of assorted sizes.

Are you holding a broken warp drive while staring down an army of laser-robots, and all you have is duct tape, a broken toaster, and a lot of sweat? Matt Riggsby – author of ***GURPS Fantasy-Tech: The Edge of Reality*** – has been in that *exact* situation. The fruits of his experience are *Mr. Fixit,* which expands the ***GURPS Basic Set*** equipment repair rules.

After a hard day of shooting stuff up with the best weapons the future has to offer, you want to relax with the best amenities the future has to offer. Outfit your post-modern pad with the latest options in *Future Home Tech*.

Unfortunately, not all home tech is benign. Michele Armellini (author of ***GURPS WWII: Their Finest Hour***) warns you to check your cute little vacuum cleaner carefully – it could be *The Killer Cleanbot!* This handy little murderer comes complete with ***GURPS*** stats. You'll never worry about cleaning again!

This month's *Random Thought Table* explores how the early stages of technology influence procedures later on and can even spill over into the mainstream. *Odds and Ends* takes a look at ad-tech and includes a *Murphy's Rules* that'll drive you crazy.

Whether forging worlds, firing weapons, or fixing widgets, this month's *Pyramid* is a trove of tech and toys. It's the future; what're you waiting for?

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From the Editor

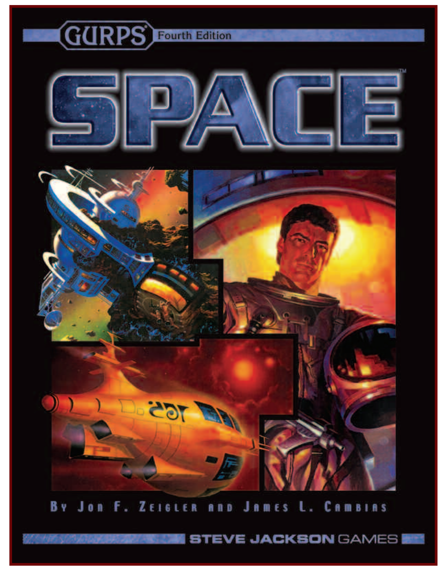
Inventions Are the Mother of Necessities

Hey, all! *Pyramid* Editor Steven Marsh here. Whenever I'm acting as a GM, I take my cue from God: Once you define what exists, the rest of creation falls into place nicely.

This issue includes a number of "meta" possibilities for looking at ultra-tech in a different way. Whether coming up with new computers or the cutting-edge of laser technology, wrapping your mind around what technology you want to include in a setting goes a long way toward fleshing out the parts of the campaign you hadn't gotten around to yet.

As I was writing this month's *Odds and Ends* (p. 39), I came up with an idea for a futuristic campaign that I hadn't considered (in a nutshell: "all tech has advertising – *all of it*"). It came to mind by coming up with a rule, then thinking through the implications of it. I wrote an entire *column* (pp. 37-38) about how bits of the campaign world can be filled in by mulling over the implications of the technology.

The same principle applies on the player's side. For example, having solid rules in place for how to rig a stopgap tech solution (pp. 28-30) makes it easier for players to envision a hero who gets in situations where he can kludge tech. As another example, in one game I played, the heroine wore top-of-the-line futuristic armor. In crunching the numbers one time, I realized she could jump from a ludicrous height (like, terminal velocity) and land relatively unscathed most of the time. This led to her hero using this technique . . . often. It became one of her character's trademarks, and eventually the technique was adapted by her cohorts in the military. It didn't end up unbalancing the campaign or breaking anything, and visions of heroic "death from above" just felt cool. And it wouldn't have been possible without thinking of the implications of the tech in the game world.



Hopefully this issue sparks your own light bulbs. (Like, what if there were a technological innovation in light bulbs where they consume nearly no power when on, yet suffer a high breakage potential when turned on and off? That might lead to a setting where people use sheets or covers to block perpetually illuminated lights . . . that'd be pretty different! Hmm . . .)

Write Here, Write Now

So, did this issue give you a eureka-in-the-bathtub moment? You can send file your field reports privately to **pyramid@sjgames.com,** or share your research findings with the world (or worlds!) at **forums.sjgames.com.**

Starmaker, Starbreaker

The Most Dangerous Machine in Existence

by J. Edward Tremlett

Good afternoon, all sapient beings, and welcome to Cosmos Today. I'm your host, Brent Cleopatra Mercy, reporting live from the dome, here at Galactic Zero.

Today's topic is Imru Niji Al-Khem, the inventor of the Starmaker. It's been 50 years to the day since his tragic assassination at the hands of a rival corporation's mercenaries. Fifty years without the guiding presence of a man who created what some call the wonder of our age, and 75 years since its unveiling.

Today, we're going to talk to the board of directors at Khemworks, the company Imru Niji founded, to see how they're handling his legacy. We're also going to ask members of all five major governmental parties whether his creation is as safe as the company says, and why no one cares that its inner workings are as secretive as its late creator.

But first, we have live feed from the far-off Cameroon IV System, where the Starmaker is currently in operation. As you can see, it's already made contact with the star, and is turning it from a relatively small and dim star into something that can sustain life on numerous planets. Khemworks engineers tell us that the process should be done in about 45 minutes . . .

Um, wait. We're getting reports that the Starmaker is under attack. Five ships of unknown design, possibly alien, are firing at it. Its accompanying fleet is turning to intercept, but the ships are getting through. They're too fast to catch and are firing directly on it, and . . .

It looks like the Starmaker is trying to disengage, but I think something's wrong with the star. It's turning it brighter and increasing its size. I repeat, it's –

<crackle>

Oh. Cao Đài Tiên Ông Đại Bồ Tát Ma-ha-tát . . . I think the star just exploded. The Starmaker clearly warped away in time, but we've lost all contact with our camera pods and we're receiving no signal from the warships that accompanied it. That's . . .

We're going to go to commercial, now.

In the far-flung future of humanity, the strange, barely understood science of the Starmaker has changed everything. The ability to alter the nature of a star in a matter of hours, or less, can turn systems inhabitable, and save others from certain doom. But the destructive possibilities of its technology are staggering, especially in the wrong hands.

That's not the only concern about this wonder of the age. Its creator kept the Starmaker's secrets very tight to all five of his chests. Now that he is dead, others have found a way to keep it going, but they don't know what's lurking underneath its metal shell.

The answers might surprise them . . . and kill us all.

> *We are stuck with technology when what we really want is just stuff that works.*
>
> *– Douglas Adams,* ***The Salmon of Doubt***

This wondrous device could be put into any far-future, space-opera campaign where an overpopulated humanity jostles for space, a well-meaning but occasionally overbearing government struggles to keep pace with it, and relations between worlds – and alien neighbors – aren't always so rosy. The known background of the device and its mysterious creator are given, along with information about what the device can do, and possible reasons why it works. Ideas for its use and misuse, and possible adventures for heroes to do with or alongside it are also provided.

The Protostar

Some historians and science buffs say that Imru Niji Al-Khem was prescient, a philanthropist, and a miracle worker. They also say he was goodhearted, brilliant, and an aimless wastrel. Still others say he was manipulative, greedy, and unbelievably reckless. But none will dispute that he was possibly the greatest genius of his time.

Imru was born a little over 112 years ago, in the wealthy, highly developed Lysander system, not far from Procyon. The Al-Khems of Lysander Prime were early founders of that system, and held near-monopolies on many essential services.

The product of great wealth and excellent gene-modding, Imru grew up highly intelligent, super-healthy, and well-educated. He had seven doctorates by the time he was 30, in subjects ranging from physics and astronomy to xeno-archaeology and Old Earth mythology.

He also had six medical clones as backup in case of a serious accident or malady. In celebration of his seventh doctorate, he "activated" them all, and they underwent a highly experimental, telepathic brain-bonding procedure. This "hivemind" supposedly gave him seven times the intelligence and computational power, but some wondered if splitting his attention in seven different directions was a good thing.

On his 30th birthday, the family gave him his own corporation: Khemworks, headquartered on far-off Lysander Gamma. It's said this was an attempt to teach their beautiful dreamer some discipline after one financial embarrassment too many. Whatever the true cause of his family's generosity, Imru applied himself ferociously.

Currently interested in terraforming, he hired several savvy financial advisors to make a business model. Khemworks started showing promise, and once the company was well in motion, he handed control over to those advisors, so he could go back to his research. He retained ownership, veto power, and the ability to fire any of them, but as long as money rolled in, he didn't care.

In a few years, Imru's company was making far more money than some of his siblings. All records indicate he didn't care so long as he could indulge himself in such esoteric pursuits as "stellar linguistics," often sending all seven parts of himself to different regions of the galaxy to explore several different interests at once. Such "walkabouts" became commonplace for him, and the pieces of himself would always come back with some new, highly profitable ideas.

One such walkabout coincided with the mysterious tragedy of Lysander. The system's star became a red giant within minutes, quickly vaporizing the inner planets. Lysander Prime became a burning tomb within an hour, and the outer worlds began to smolder and die not long thereafter.

Lysander Gamma was the last to go, and Imru's advisors managed to get themselves into a planetary evacuation pod. They hoped Imru would be in the evacuation fleet, but, when he didn't show up, they determined he must have died. Under the circumstances, they had themselves appointed the new owners of Khemworks, and resettled in another star system.

They did right by the company, and kept it stable in spite of the tragedy. However three years after the reincorporation, at an investors meeting, they received a surprise: Imru was alive – though down to four clones. He showed up along with the legal backing to reclaim both his title to the company, and the remnants of his otherwise-extinct family's considerable fortune.

Imru claimed he'd spent the last few years after the tragedy "clearing his mind." This had involved investigating far, unexplored reaches of the galaxy, and searching for new ideas at the bleeding edges of space. He told the astounded press that he'd found many ideas in the broken ruins of dead worlds, and, now that his different fields of interest had a focal point, he promised his advisors that they would bring "a new, more profitable era" to Khemworks – and humanity.

The official company record states that the advisors willingly and happily stepped aside, but some records suggest doubts on their part. Imru was quite changed from his ordeal: his clothes were new and strange, his pockets were full of things he did not care to show others, and his five sets of eyes burned with eerily focused purpose.

Raising Stars

One big problem with any mass space colonization is finding those elusive "Goldilocks" planets: not too hot, not too cold, but just right for baseline human inhabitation.

In order to have such a planet, you need both a suitable world *and* a suitable star – comparatively rare in the universe. As time went on, terraforming became both more advanced and commonplace, but there was still the problem of locating systems with a star that could maintain Earthlike conditions. The next logical step was stellarforming: the process of altering a star's energy output.

When Imru designed the Starmaker, the best a stellarformer could do was create a Dyson Sphere around a less powerful solar body and reflect some of its energy back upon it, making it brighter and hotter. There was talk of extending an already-suitable star's lifespan by extracting some of its gasses, or turning gas giants *into* stars, but these were theoretical.

The Starmaker has made these pursuits somewhat obsolete, much in the same way warpspace rendered the improved design of sleeper ships something of a moot point. There are still scientists engaged in trying to make something of these projects, but as they require the construction of full or partial Dyson spheres to execute, funding is hard to come by.

First Fusion

Imru's initial move was to devote one of Khemworks' better terraforming teams to a "special job" in an obscure, far-off system with a substandard star. The planet was unremarkable: a rocky sphere about two-thirds the size of Mercury, with a mostly iron core. Imru, who'd quietly bought the rights to the entire system the year before announcing his survival, claimed it was "perfect."

The terraformers worked for a year. They paved the entire planet with thick plates of advanced metallic laminate. Then they sunk energy collecting conduits into its core, and placed mighty warp engines nearby, buttressing them with impressive laser defenses and living quarters. Finally, a massive, ringed, central command complex was sunk into the laminate, right above the equator.

The construction baffled the engineers, as the planet's core couldn't possibly generate enough energy to power warp pods, much less the defensive grids. Where was the energy going to come from?

Apparently unconcerned, Imru and his four clones took up residence in the command center. They said they'd inform Khemworks' advisors when they had the results they were aiming for. It would be "something wonderful," Imru said with a wink, but that was all he'd say.

Over the next few months, the system played host to a number of weird gravitic anomalies and strange energy readings. Far off observatories registered high levels of exotic, hitherto-theoretical particles, vulgar displays of what could only be described as "cosmic lightning," and things that made no sense at all under even the most extravagant of theories.

Then came the day of the Starmaker.

After two solar days' worth of docu-mercials and Khemworks-sponsored terraforming-drama marathons across numerous channels, the company's orbital cameras in the terraformed planet's system went live. Trillions of people across several systems watched as the small, metal-clad planet headed straight for the small star at the center of its system.

Once it got to within an AU of the solar body, the planet lit up almost as bright as the star itself. A beam of energy shot from inside the control ring, towards the star, and a focused flare leaped up from the star to meet it halfway. Both bodies shuddered as if fevered, and pulsed in time. Then, as streams of light and matter flowed back and forth, the star slowly began to glow brighter, and become larger.

Over the course of the next hour, the viewing audience saw that small star, barely capable of warming its own planets, transform into a Earth-type sun. The broadcast was liberally peppered with Khemworks advertisements, all promoting the company's new "photoforming" capabilities. The Starmaker could permanently change the makeup, power, and lifespan of a star in a matter of hours, making the most advanced forms of stellar midwifery obsolete.

All five parts of Imru were on hand to answer questions and explain the process, but not all aspects, obviously. Many things aboard the Starmaker would remain trade secrets.

Main Sequence

For the next 20 years, Khemworks took full advantage of its unique service and made a tidy profit. The company offered deluxe packages to colonization consortiums: reworking an entire system from the star on down, to maximize living conditions for baseline humans. They "fixed" dozens of stars, remade hundreds of planets, and gave human-held space much more breathing room than they'd ever anticipated having.

Not everyone was happy, though. There were concerns from scientific consortiums and citizens' groups about the long-term ramifications of drastically tampering with stars. There was also noise from various religious groups, some far more zealous – and scared – than others, that what Khemworks was doing was blasphemy, sacrilege, or just plain dangerous. Meanwhile, nearby alien empires were worried that this meant humanity would soon be expanding even further.

The government at the time was also highly concerned. What would happen if the technology got loose, or a hostile power stole it? For that matter, what if something went wrong? In closed-session hearings, Imru did his best to calm those concerns by saying that the process – subject to strict corporate secrecy laws – was perfectly safe.

As for security concerns, the controls of the Starmaker were isomorphic: only he and his clones could operate it. However, if the authorities wanted to ensure that no one else got their hands on it, Imru stated he would be happy to have the armed forces nearby. It *would* save them a lot of money in security bills, he joked, treating the lawmakers to the eerie sight of five identical beings chuckling in unison.

The joke came true. Now, when the Starmaker went out, a small fleet of warships went with it. Seeing the massive device soaring among the stars with such an armed guard made Khemworks' singular creation seem even more impressive, adding to their corporate cachet.

Unfortunately, the armed forces couldn't be everywhere.

In the 25th year of the Starmaker – when Imru and his clones took separate, well-deserved holidays – a group of elite assassins struck. They killed each clone in almost simultaneous operations, and then went after Imru himself, clearly meaning to take him alive. Something went wrong, and Imru's ship caromed out of control and slammed into one of his pursuers, utterly destroying him.

Suspicion immediately fell to religious zealots or unfriendly aliens, but the plot was eventually proven to have been engineered by one of Khemworks' corporate rivals, eager to sabotage the Starmaker. Fortunately for Khemworks, it turned out that while the controls *were* isomorphic, the key had been Imru's DNA. Since he'd given blood samples to re-establish his identity, it was relatively easy to synthesize enough DNA to fool the machine.

Once that deception was taken care of, the Starmaker was back in business, but the great machine was never the same.

Photoforming 101

What can the Starmaker do with a star? The simple answer is "anything, given enough time."

If it's making a small, dim star larger and brighter, then the Starmaker would only have to be in contact for an hour or so. However, that one hour would be preceded by several days' worth of solar scans and running equations. Such careful work is done to ensure a smooth conversion process with no unexpected or disastrous results.

If a more extreme conversion is needed, such as dialing a red giant back to a much smaller body, or turning an unstable or dying star back into something useful, the time required could be several hours of contact, and possibly weeks or months of pre-conversion scans and equations. Conversely, something extremely simple like turning on a brown dwarf might only take a day's worth of number-crunching, followed by momentary contact.

The Starmaker's only limits are at the extremes of stellar life. It cannot generate a star out of even the most fertile of stellar nurseries, and cannot turn a black hole or black dwarf back into a star.

I was like a boy playing on the seashore, and diverting myself now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

– Isaac Newton

The AI checked out, the exterior machinery was in top shape, and whatever secret workings made the Starmaker tick seemed perfectly fine. Nonetheless, technicians and the AI both complained that it seemed sluggish to respond, as if it were somehow fighting control.

Solar Flare

Public reaction to Imru's death was profound, but not always respectful. Once word got out that the controls weren't entirely isomorphic, loud concerns about safety started up again. The question remained: what *else* had he been less than truthful about?

Fortunately, the government took a laissez-faire attitude toward business, so long as "reasonable" safety measures were taken. Thus, in spite of the outrage, the Starmaker continued remaking stars, and garning Khemworks a tidy profit, for 25 more years.

But exactly 50 years to the day after it first went online, something went seriously wrong. In the middle of a blissfully normal photoforming, the Starmaker stopped, chose a course, and warped off, ignoring all attempts to stop it. Even its AI was locked down, and the accompanying warships could only watch helplessly as the Starmaker vanished.

The machine wasn't missing too long. Within a few hours, its signal popped up in a nearby giant molecular cloud, and the warships sped to intercept it. When they got there, they discovered that its terrified crew had jumped into evacuation pods and set themselves adrift.

Something very strange was happening to the Starmaker. Its metal surface was shifting and buckling, as though undergoing a moonquake, and the planet began to slowly expand – its surface moving apart at the equator at the rate of 10 miles an hour. Extraordinarily – and miraculously – the metal shell was stretching along with it.

Khemworks' chief scientists and engineers quickly assembled, but none of them could conclusively answer the owners' questions. One of them pointed out that it looked as though the Starmaker was a cell undergoing division. The directors weren't impressed by such an absurd notion, but when it was clear that the equatorial control ring had replicated itself, they stopped laughing.

The division went on for a little over eight days, and then stopped, completed. Two Starmakers now floated in the molecular cloud: equal in size, shape, and energy signature. One had half the warp pods and laser defenses of the other, obviously, but both had complete power conduits and control rings. Both rings had identical command structures and facilities, including two copies of the same AI.

Obviously, this was not something Khemworks' owners had expected, but they didn't want to own up to their ignorance. If the government realized how little they actually *knew* about the Starmaker, they might take it away from them. So they lied, telling galactic officials that they knew this would happen, someday, but kept it secret for security reasons. No one wanted hostile corporations or religious nuts to take advantage of the situation, did they?

The government was not pleased, and demanded a full accounting as soon as possible. Khemworks agreed, and, after refitting both Starmakers with warp pods, defensive grids, and androids who wouldn't abandon ship, they had several teams of engineers go to work on the new Starmaker. Their orders were to quietly strip it down to find out how this had happened, and, more importantly, what was inside the thing.

The teams secretly moved the other Starmaker off to the small, five-planet Cyndus system – an expanse of dockyards and repair facilities. Over the next year, with direct governmental oversight, they tried every known method to tear up the surface, but with no luck.

Then someone had the idea to try and remove one of the power conduits, so they could send probes down the tunnel to the core. The attempt was successful, but the moment the conduit was taken out, the Starmaker exploded with stunning force and ferocity. The resulting cataclysm was best described by a far-off astronomer as "a supernova with no star."

The Cyndus Incident wiped out the entire system, including its star. Neither Khemworks nor the government had a good explanation for the loss of millions. Publicly, they came forward and said that there *was* another Starmaker, but that they had been keeping its existence secret out of fear of sabotage.

As for the explosion, they blamed it on a stellar accident, perhaps akin to whatever wiped out the Lysander system, all those decades ago. It was a horrible tragedy, but humanity had to accept such risks when going out into the stars.

After that show of solidarity, the government, tired of Khemworks' reckless ignorance, quietly took total possession of the company. They seized all its assets – most notably the sole remaining Starmaker – and locked down all its research, journals, and information about what happened at Cyndus.

The owners were given the choice of staying and obeying, or leaving and staying quiet under the harsh and extensive corporate privacy regulations.

From now on, the government would be handling the photoforming.

The adventure of the sun is the great natural dram by which we live, and not to have joy in it and awe of it, not to share in it, is to close a dull door on nature's sustaining and poetic spirit.

– Henry Beston

Oncoming Eclipse

That was 25 years ago. Since then, the government has been running Khemworks as a shell corporation. Its owners have authority over the company's other, lesser endeavors, but the government has full control over the Starmaker. Soldiers run the great machine, ensuring a high level of discipline and secrecy is maintained at all times.

While the Cyndus incident was a true tragedy, the usurpation of Khemworks couldn't have happened at a better moment. Humanity has overexpanded, once again, and is looking to send colony ships out into the as-yet-untouched arms of the galaxy. Having control of the Starmaker gives the government the ability to decide where Humanity will be going, by declining some photoforming jobs and accepting others.

It also gives them another revenue stream. As Khemworks, it can collect fees from the colonization interests for fixing far-off stars. Then – as the government – they can tax the inhabitants of the new colonies. The money coming from Khemworks also has the benefit of being totally under the table, which means it can be used to fund top-secret projects without anyone asking where the money went.

Unfortunately, the ability to do the miraculous and make a tidy, secret sum off it comes with a hefty price tag.

For starters, there's secrecy: Apart from well-founded concerns about corporate espionage and malfeasance, the Starmaker is a massive PR nightmare. The echoes of the Cyndus incident are still being felt, and not everyone is willing to accept it was a "stellar accident." The other Starmaker's presence at the explosion has given a lot of dissident voices good reason to suspect what really happened. All it would take is for a key piece of evidence to get out, and then the government would have some massive explaining to do. They don't believe any of the remaining owners at the company would be so stupid as to dare tell what they know, but they can't count on their silence, either.

The religious groups that opposed the Starmaker from the beginning have not gotten any less quiet, and some have actually gotten more than a little violent – threatening action against the colonization consortiums. There's also increased tensions along the border, as nearby alien empires are not happy to have humans encroaching further into "their" territory. Most are hoping for a diplomatic solution, but some have threatened "preemptive strikes" against the machine if it is not stopped, or at least confined to clearly human space.

Above all other concerns is a more serious question: Will the machine replicate again? If it's on a 50-year cycle, then it's due for another split in 24 years, which gives the government a little over two decades to figure out what to do, what to say, and how to handle it. But what if it replicates sooner this time . . . or does something entirely different?

The machine's unpredictability is a major concern. Its initial recalcitrance while accepting commands after Imru's death has turned into outright reluctance to obey. About one order in four is ignored on a mechanical level, and all the AI can do is repeat the command.

This stubbornness has had disastrous consequences. In the recent incident at Cameroon IV, when the Starmaker was attacked by a small fleet of as-yet-unidentified alien ships, it was told to disengage the photoforming and warp out. Instead it made the star go nova – destroying not only its attackers but the remaining warships, Khemworks terraformers, and every soul on every planet in the system. The government claims it was the aliens' weapons fault, but they're quite aware that the Starmaker was solely responsible; apparently it would rather kill an entire solar system than risk its own existence.

There's also the issue of what to do with *two* Starmakers. It would be good to have one machine working in human space, and another further out, as that means they can double the colonization rate. However, it also means there's twice the risk of someone trying to hijack or destroy a Starmaker, so they will have to assign more warships to protect them.

The hijacking potential is a major concern. If the government was worried about what could happen if the technology got into the wrong hands before, Cameroon IV has shown exactly what *could* go wrong. An enemy armed with a Starmaker could turn it into a *Starbreaker:* a weapon capable of killing an entire system, and possibly even more than that, and then warping away to strike somewhere else. It could turn a Sun-sized, stable star into a massive, raging red giant, make it go nova – or supernova – or turn it into a black hole, a Thorne-Żytkow object, an iron star, or some other exotic but deadly stellar body.

Even if the hijackers couldn't get the machine to do what they wanted, they could always tow it into a system, park it somewhere central, and replicate the disastrous Cyndus experiment. There's no guarantee they'd survive the resulting explosion, either, but many beings have already claimed that they're more than willing to lay down their lives for a Starmaker-free universe.

What Makes the Stars?

No one knows how the Starmaker actually *works*. Imru refused to tell anyone how he made it, and the secret apparently died with him. Khemworks' engineers are forced to rely on observing the matter/energy stream, and making outside scans, as the one attempt to open a Starmaker up had such explosive repercussions. However, these have proven extremely inconclusive.

Here, then, are some options for the GM to consider, based on Imru's chief fields of interest.

Astro-Physics

The Starmaker is a wonder of hyper-advanced physics: a series of ultra-compressed stars held in electro-magnetic suspension within the sphere, balanced against a tiny black hole. Whenever a star needs to be converted, one of the captured solar bodies and/or the black hole is whirled into place and either drained or added to, essentially giving its life and power to the job, or getting more.

However, after so long, there's no more room in the "tank," and the Starmaker divides in order to maintain balance, creating two fully functional Starmakers. In order to achieve this, Imru had to introduce some biological properties into the mix – most notably his own cell structure. This DNA imprint formed the basis of the isomorphic controls, but a low-level telepathic field was also in play. Now that Imru is dead, having the DNA but not the mind is confusing the Starmaker, hence its reticence.

Two things are infinite: the universe and human stupidity; and I'm not sure about the universe.

– Albert Einstein

Xeno-Archaeology

The Starmaker was not built inside the planet – it *was* the planet. Imru's researches into long-dead alien races led him to the giant world-machine, and, over time, he learned how it worked, how it had broken, and how it could work better. This is why Imru added the metal plates, the power conduits, and the ability to split itself off every 50 years to manage excess energy.

Imru never quite learned everything about the aliens whose technology he co-opted. There were signs that the world-machine itself had a sense of intelligence, and, growing tired of being used, scoured and blasted its own civilization. It then floated through space for aeons before falling into the gravity field of the system where Imru found it, waiting.

But he was confident he could control it . . . at least so long as he lived.

Old Earth Mythology

In the religion of Imru's ancestors, God made man from the earth, but also made other beings out of fire and flame – the *djinn*. These creatures of power once lived alongside mortals, but eventually vanished from the Earth. However, they were rumored to have traveled to the stars, long ago. The question was where.

Imru eventually figured out that a creature of fire and flame would choose to hide itself in a star, and learn to use its power to shape and influence its new home. He was quite correct, and one of his clones found such a creature, trapped it using the "magic" of old, and bade it to do his bidding, in exchange for certain things. One of those things was the right to reproduce itself every so often, hence the division.

The *djinn* very craftily insisted that only Imru should be able to command him. When it found a way to call for assassins to kill its master, it thought it might soon be freed. Then Khemworks discovered how to cheat it, and its rage was unparalleled. It can only rebel in small ways, now, but its strength is growing, and one day someone will make a mistake. Then it will have its freedom . . . and revenge.

Stellar Linguistics

The religious zealots aren't too far off the mark – the stars *are* alive after all. Vast and ancient intelligences, they are never fully conscious until the end of their lives. They dream-speak in a language of heat and magnetic fields, lazily communicating with their neighbors as they slowly rouse to wakefulness. On the day they achieve full sapience, they begin to die, shedding their physical selves either gradually or violently, and leaving only a solar remnant to mark the spot where they transcended.

The stars are susceptible to proper suggestion in their sleep, and can be commanded to change their state if the right "words" are used. The Starmaker has a fully awake but "lobotomized" star in its center, which Imru caught and modified to command other stars to change. Like a broken horse, the star came to love Imru, hence its stubbornness and seeming unwillingness to obey.

The captured star also had its death cycle altered, so that every 50 years it would siphon off its vast energies into another container, rather than explosively transcending. Imru hadn't intended for it to become another, fully functional Starmaker, though, so it remains to be seen what will happen the next time the Starmaker divides. Will it be a new and dreaming star, a fully cognizant prisoner, or a conflagration waiting to happen?

Variable Stars

As written, the Starmaker's mere presence can be used to add a level of lurking instability to any space-opera campaign. Whether it's a wondrous but slightly unnerving background object or a source of genuine fear and dread would depend on how many rumors – or unsettling *facts* – they have heard.

It can also be used as an object of direct concern. They might have to defend it from attack while their colony's star is being converted, or maybe the interstellar war they're about to be swept up in has been sparked by its existence. They may find themselves working against it, or trying to take it for themselves.

There are also other options for its direct use.

Stellar Secrets

No one really buys the official explanations regarding the Starmaker. Way too many unanswered questions float around, and the answers all sound like faux-baloney. Seeking the truth could be a lifetime's goal for a group of reporters, would-be blackmailers, galactic revolutionaries, or alien infiltrators.

For starters: stellar explosions seem to follow Imru Niji Al-Khem around like a bad smell. Where was he when Lysander's star exploded, and how did he lose those clones? What *really* happened at Cyndus and Cameroon IV?

Where did Imru really go after the Lysander incident? Where did he get the inspiration – or information – for the Starmaker? Is there any truth to the rumor that one or both of the "dead" clones are still alive and living in the far reaches of the galaxy? Are they free or in alien hands?

Rumor has it that some members of the advisory board who've since left Khemworks are in hiding for their lives – what are they afraid of? There might even be more than a few Khemworks employees who were on the Starmaker the day something really weird happened, but they're also in hiding or imprisoned. What did they see?

Protect the Miracle

The heroes have been entrusted with helping protect the Starmaker. They may be soldiers on an accompanying warship, mercenaries called in to deal with a larger threat, or security specialists hired for a one-off or ongoing job. They could also be a black ops team that's infiltrating dangerous groups in the hopes of catching them trying to attack the great machine.

The military aren't the only ones handling security, though. The heroes could be governmental operatives employed in a much more underhanded manner: keeping the connection between the government and Khemworks a secret, as well as suppressing anything that would suggest a link between the Starmaker, Cyndus, and Cameroon IV. This could be as simple as ensuring that certain people stay quiet, or as complicated as running false-flag operations and planting false information to discredit anti-starmaker factions, or set them against each other. It's a dirty job, but someone's being paid to do it – might as well be you!

Douse the Candle, Dim the Light

The protagonists are not convinced by the hype, and want the Starmaker out of action. They may be anti-colonial protesters who believe problems at home should be solved before migrating further out, concerned scientists who think tampering with stars is too dangerous, or religious zealots who view stars as sleeping angels. They might also have lost family in one "accident" or another involving the Starmaker, and want answers – *now*.

Getting answers will not be so easy, of course. The government's not going to stop using the greatest invention since warp drive just because a few million ordinary people died, and they're not going to surrender secrets quickly. But there are a lot of media and communication channels they *don't* control yet, and a lot of places to look for answers to questions. Plus, if the heroes have to hide from "the man," it's a large galaxy, with lots of groups to join or link up with, and many sympathetic persons to give aid and comfort.

Target: Starmaker

Not everyone wants the Starmaker out of action. Some people want it for themselves, and the adventurers are among them. They could be mercenaries being paid to hijack it, or terrorists who want to own it, or threaten to destroy it. They might be trying to hack the machine and replace its AI with one of their own, or possibly "tag" it so they can spy on it, or try to learn what makes it work. They could also be alien soldiers trying to make good on their own empires' threats.

Whatever the means or reasons, it will not be a simple task. The Starmaker is constantly protected by a small fleet of warships, and staffed by military personnel. The AI is a top-of-the-line program that will not tolerate being messed with, and they'll have to be sure they have a supply of Imru's DNA on hand if they want to get it to obey them.

Beyond that, there's the Starmaker, itself, and its strange defiance. Will it obey them any better than it's obeyed Khemworks, and then the government, since the death of its creator? Or will it somehow recognize what they're doing and shut itself down?

The loudest sound
in the universe is
the last heartbeat.

– Breughel, in
Max Headroom

About the Author

By day an unassuming bookstore clerk, J. Edward Tremlett takes his ancient keyboard from its hiding place and unfurls his words upon the world. His bizarre lifestyle has taken him to such exotic locales as South Korea and Dubai, UAE. He is a frequent contributor to *Pyramid,* has been the editor of *The Wraith Project,* and has seen print in *The End Is Nigh* and *Worlds of Cthulhu*. He's also part of the *Echoes of Terror* anthology. Currently, he writes for Op-Ed News, and lives in Lansing, Michigan, with his wife and three cats.

Eidetic Memory

Blaster and Laser Design

by David L. Pulver

My brother inspired my first attempt at blaster and laser design. He wanted to build a personalized fully automatic snub-nosed energy pistol for his Space Patrol agent Captain Beowulf. Since the interstellar patrol's headquarters was based on Vega, thus was born the antiparticle-spitting Vega Machine Pistol, the sector's most powerful full-automatic handgun.

This is an updated version of this system optimized for ***GURPS Basic Set,*** *Fourth Edition*. It's compatible with ***GURPS Ultra-Tech,*** but can be used without it.

Looks like a Geonosian Beam Weapon. By the Force, this thing is ugly!

– RC-1138,

in ***Star Wars: Republic Commando***

Beam Weapon Design

This is a customized system for building laser and blaster weapons. The weapon designs should be reasonably similar to their equivalents in ***GURPS Ultra-Tech.*** (They won't be *identical,* since ***Ultra-Tech***'s weapons were balanced against each other rather than built using design rules.)

Tech Level

Choose a TL for the weapon; it may be TL9 to TL12. Decide if the weapon will incorporate superscience (TL^) technology.

Example: This will be a TL12 beam weapon. It's a handgun for the galactic police, to be known as the Vega Machine Pistol. It won't incorporate superscience technology. The goal is to design an easily concealed but devastating weapon for undercover Space Patrol officers.

Beam

Select the type of beam, within the limits of the weapon's TL. Force and graviton beams are *always* superscience. Other beams can incorporate superscience (e.g., a "TL9^ super laser" or "TL10^ super blaster") if desired; this will make the weapon twice as powerful as it would be otherwise.

For explanations of damage modifiers, see pp. B104-105 and B111.

Laser (TL9): A high-energy laser fires a beam of coherent light, usually in near-infrared frequency. It inflicts tight-beam burning damage with a (2) armor divisor. For more details, see *High-Energy Laser* in ***Ultra-Tech*** (pp. 114-115).

Force Beam (TL10^): These are tightly focused gravitic beams that deliver a powerful kinetic impact. Force beams inflict crushing damage with the double knockback modifier. They can also be set to stun, delivering a beam with a wider impact; on "stun" the beam has no wounding effect (no HP are lost), but it still has its usual double knockback modifier. For additional details, see *Force Beams* in ***Ultra-Tech*** (pp. 128-129).

Blaster (TL10/11*): A blaster fires a bolt of ionized charged particles at relativistic velocities. It inflicts tight-beam burning damage with a (5) armor divisor and the surge damage modifier. In vacuum, the charged particles repel each other, so Acc is halved and it has only 20% range. For extra rules, see *Charged Particle Beams ("Blasters")* in ***Ultra-Tech*** (p. 123).

Neutral Particle Beam (TL10/11*): Similar to a blaster (see above), this is a neutral beam composed of both positively charged ions and electrons. It inflicts tight-beam burning damage with surge and radiation modifiers, but won't work in atmosphere. However, at the flip of a switch, it can reconfigure to fire a blaster beam with identical stats except using half the power (giving it twice as many shots in this mode).

Rainbow Laser (TL11): This type of laser fires a nanosecond pulse that is focused through interaction with the atmosphere into a needle-thin beam of polychromatic light. It inflicts tight-beam burning damage with a (3) armor divisor. The beam only focuses properly in a very thin to superdense atmosphere; in vacuum or trace conditions, it has 10% range and no armor divisor. See also *Rainbow Lasers* in ***Ultra-Tech*** (pp. 116-117).

X-Ray Laser (TL11): An advanced laser firing coherent X-rays, an X-ray laser inflicts tight-beam burning damage with a (5) armor divisor and the surge damage modifier. In air, range is limited to 7/20 yards divided by the pressure in Earth atmospheres. See *X-Ray Lasers* in ***Ultra-Tech*** (pp. 117-118).

Graviton Beam (TL11^): These weapons project oscillating hypergravity fields that crush or vibrate internal organs. Gravity beams inflict crushing damage with the no-knockback damage modifier. Although their damage is low, they have a cosmic armor divisor (∞) that ignores all normal DR. Force screens can protect against them, but do so at 1/100 of their normal DR. For extra rules, see *Graviton Beams* in ***Ultra-Tech*** (p. 129).

Pulsar (TL11/12*): A pulsar is an anti-particle beam; it fires antiparticles, usually positrons or anti-hydrogen atoms. It inflicts crushing damage with a (3) armor divisor and the explosive, radiation, and surge damage modifiers. In air, range is limited to 1,000 yards divided by the pressure in Earth atmospheres. See *Antiparticle Beams ("Pulsars")* in ***Ultra-Tech*** (p. 124).

Graser (TL12): An advanced laser firing coherent gamma rays, a graser does tight-beam burning damage with a (10) armor divisor and the surge damage modifier. In air, range is limited to 70/200 yards divided by the pressure in Earth atmospheres. See *Gamma-Ray Lasers (Grasers)* in ***Ultra-Tech*** (p. 118).

* The TL before the slash is for cannon; after the slash is for beamers, pistols, and rifles. See *Configuration* (p. 13).

Example: The Vega Machine Pistol is a pulsar.

Check it out! Independently targeting particle beam phalanx. Vwap! Fry half a city with this puppy. We got tactical smart missiles, phase-plasma pulse rifles, RPGs . . .

*– Pvt. Hudson, in **Aliens***

Focal Array

This is the weapon's focusing system, which helps determine range. Decide if the weapon has a tiny (×0.1), very small (×0.25), small (×0.5), medium (×1), large (×1.5), very large (×2), or extremely large (×4) focal array relative to typical weapons of its class. The parenthetical number is the effect on range. Most weapons use a medium array, but a smaller array means reduced range with some saving in weight, while a larger array is heavier but longer-ranged.

Example: This is envisioned as a snub-nosed weapon, so the Vega Machine Pistol will have a very small focal array, reducing its weight somewhat at the expense of a shorter range.

Generator

Decide on the beam generator, which determines rate of fire.

Single Shot: The generator can only fire one shot per second, but is lightweight.

Semi-Auto: The generator can be built to fire at up to RoF 3.

Light Automatic: The generator can be built to fire at RoF 4 to RoF 10.

Heavy Automatic: The generator can be built to fire at up to RoF 20.

If using the *Hotshots and Overheating* rule from ***Ultra-Tech*** (p. 133), a weapon with a light or heavy automatic generator may optionally be designated a Gatling. A Gatling can never overheat but may not fire hotshots.

Example: As the weapon was named a "machine pistol," it seems logical to make it capable of rapid fire! It will have a light automatic generator.

Damage Dice

Choose the dice of damage the weapon inflicts. The greater the damage, the heavier and more power-hungry the weapon will be. Partial dice of damage can be specified as a decimal value, e.g., 2.5d. This will be converted to dice plus adds as detailed in *Rounding Damage* (p. 13), but the decimal value is used for all other design calculations.

To create man-portable weapons, give a beam pistol 2d to 5d, a beam rifle 4d to 8d, and heavier weapons even more damage. Pulsars and "super" versions of ordinary non-superscience beams (that is, not graviton or force) are more energy-efficient and so can usually be built to do twice that amount of damage (four times damage for a superscience pulsar). Graviton beams are less efficient at doing damage, so will usually be about half as lethal (e.g., the average graviton pistol is usually 1d to 2.5d damage).

After the damage dice are assigned, determine the basic empty weight of the weapon (see below). That will give an idea if the weapon is practical. If not, choose a lower or higher damage and recalculate weight again!

Example: The Vega Machine Pistol will inflict 7d damage, high for a normal pistol but about average for a more efficient pulsar.

Empty Weight

Calculate the weight in pounds based on the design decisions and this formula:

Empty Weight = $(D \times S / E)^3 \times F \times G$.

D is the dice of damage.

S is 1 for most beams, or 0.5 for "super" versions of non-superscience beams (i.e., superscience weapons that aren't force or graviton beams).

E is 6 for a pulsar, 4 for force, 1.5 for graviton, or 3 for any other beam type.

F for the focal-array value: 0.25 for tiny, 0.5 for very small, 0.8 for small, 1 for medium, 1.25 for large, 1.6 for very large, or 2 for extremely large.

G for the beam-generator value: 1 for single-shot, 1.25 for semi-auto or light automatic, 2 for heavy automatic or Gatling.

Round the weight off to the nearest 0.1 lbs. if the weight is less than 10 lbs., or to two figures if it weighs 10 lbs. or more.

If the weight seems wrong for the desired weapon, adjust the dice of damage and try again!

Example: The Vega Machine Pistol is a pulsar that inflicts 7d damage. It has a very small focal array and light automatic beam generator. Empty weight is $(7 \times 1 / 6)^3 \times 0.5 \times 1.25 = 0.992$ lbs., rounded to 1 lb. That seems fine for a handgun.

Configuration

Decide on the weapon format. This is independent of weight, e.g. one can build a massive pistol (for a huge robot) or a tiny rifle (for a miniature alien). However, if built for human-sized users, most beamers are well under a pound, most pistols are 0.5 to 4 lbs., and most rifles are 5-15 lbs., with cannons anywhere from a little bit to a lot heavier.

Beamer: The weapon is handheld but has no stock or handgrip and no special aiming systems. These include small holdout or "flashlight" weapons, laboratory devices, and cutting tools. This reduces Accuracy but lowers Bulk.

Pistol: The weapon uses a pistol grip.

Rifle: The weapon is a carbine or rifle format with a shoulder stock and grip.

Cannon: The weapon is heavy weapon designed to be mounted on a tripod or installed in a turret or other weapon mount.

Example: The Vega Machine Pistol is, unsurprisingly, a pistol.

Weapon Statistics

Determine the weapon's full combat statistic block.

Damage

Record the dice of damage chosen for the weapon.

Indicate the armor divisor, if any, in parenthesis: (2) for laser, (3) for rainbow laser or pulsar, (5) for blaster or X-ray laser, (10) for graser, or infinite for a graviton beam.

Record the damage type: burn for laser, rainbow laser, blaster, neutral particle, X-ray laser or graser; cr for graviton, force, or pulsar.

Record any damage modifiers: dbk for force, sur for blaster; ex, rad, and sur for pulsar; rad and sur for neutral particle beam.

Example: As the Vega Machine Pistol is a pulsar with 7d damage, the damage is recorded as 7d(2) cr ex rad sur.

Accuracy

Use the *Accuracy Table* (below) to determine Acc based on beam type and configuration.

Rounding Damage

When recording partial damage, convert it to dice plus adds as detailed below:

Damage Under 1d: 0.01-0.032 = 1d-5; 0.33-0.42 = 1d-4; 0.43 to 0.56 = 1d-3; 0.57-0.75 = 1d-2; 0.76-0.95 = 1d-1; 0.96+ = 1d.

Damage 1d-12d: 0.14- = no modifier. 0.15-0.42 = +1 damage. 0.43-0.64= +2 or +1d-2. 0.65 to 0.85: +1d-1. 0.85-0.99; round up to next full die.

Damage 12d+ (Optional): Record damage as 6d × Nd, where Nd is number of dice / 6, rounded to nearest whole number. Ignore adds.

Accuracy Table

Beam	Beamer	Pistol	Rifle	Cannon
Blaster	3	5	10	15
Force	3	6	12	18
Graser	3	6	12	18
Graviton	3	6	12	18
Laser	3	6	12	18
Neutral Particle	3	5	10	15
Pulsar	3	5	10	15
Rainbow Laser	3	6	12	18
X-Ray Laser	3	6	12	18

Example: The Vega Machine Pistol is a pulsar with pistol configuration, so it is Acc 5.

Range

The weapon's half-damage and maximum ranges depend on the focal array and dice of damage. Use the formula below. Round range to two figures, e.g., 175 becomes 180.

1/2D Range (yards) = D × D × Rb × Rf.
Max Range (yards) = 1/2D × 3.

D is the dice of damage.

Rb is 8 for pulsar, 11 for force, 32 for blaster or neutral particle beam, 40 for laser, 56 for rainbow laser, 100 for graviton, 2,000 for X-ray laser, or 6,000 for graser.

Rf is based on the focal array: 0.1 for tiny, 0.3 for very small, 0.5 for small, 1 for medium, 2 for large, 4 for very large, or 8 for extremely large.

Example: The Vega Machine Pistol's 1/2D range is based on its 7d damage, pulsar beam, and very small focal array: 7 × 7 × 8 × 0.3 = 117.6 yards, rounded to 120 yards. Max range is 120 × 3 = 360 yards.

Rate of Fire

Choose a RoF based on the weapon's beam generator and record it.

Single shot must have RoF 1.
Semi-auto may have either RoF 2 or 3.
Light auto may be given any RoF from 4 to 10.
Heavy auto may be given any RoF from 11 to 20.

Example: The Vega Machine Pistol is light auto, so we can choose RoF 4 to 10. We choose RoF 10.

Shots

Weapons are powered by power cells, classed as A ($2, 0.005 lbs.), B ($3, 0.5 lbs.), C ($10, 0.5 lbs.), D ($100, 5 lbs.), E ($2,000, 20 lbs.), or F ($20,000, 200 lbs.). Decide how many power cells the gun will use and their class and TL (usually the same as the weapon's TL).

The *Shots Table* shows the number of shots that a weapon with 1d damage gets from a single rechargeable C cell; modify this based on the cell type, multiply by the number of cells, and then divide by the cube of the dice of damage. Round the quotient down and record this as Shots.

Superscience cells (***Ultra-Tech,*** p. 133) are available in some settings; they store five times as many shots. Non-rechargeable cells store twice as many shots.

Shots Table

Weapon	*TL9 Cell*	*TL10 Cell*	*TL11 Cell*	*TL12 Cell*
TL9 Laser	225	900	3,600	14,400
TL10-12 Laser	450	1,800	7,200	28,800
TL11 Rainbow Laser	112	450	1,800	7,200
TL12 Rainbow Laser	225	900	3,600	14,400
TL11 X-Ray Laser	112	450	1,800	7,200
TL12 X-Ray Laser	225	900	3,600	14,400
TL10 Blaster	34	135	540	2,160
TL11-12 Blaster	68	270	1,080	4,320
TL10 Force	270	1,080	4,320	17,280
TL11-12 Force	540	2,160	8,640	34,560
TL10 Neutral Particle*	17	68	270	1,080
TL11-12 Neutral Particle*	67.5	270	1,080	4,320
TL11 Pulsar	135	540	2,160	8,640
TL12 Pulsar	270	1,080	4,320	17,280
TL12 Graser	28	112	450	1,800
TL11 Graviton	14	56	225	900
TL12 Graviton	28	112	450	1,800

Cell Type

Type	*TL9 Cell*	*TL10 Cell*	*TL11 Cell*	*TL12 Cell*
A cell	×0.01	×0.01	×0.01	×0.01
B cell	×0.1	×0.1	×0.1	×0.1
C cell	×1	×1	×1	×1
D cell	×10	×10	×10	×10
E cell	×100	×100	×100	×100
F cell	×1,000	×1,000	×1,000	×1,000

* When a neutral particle beam operates in charged particle ("blaster") mode it drains only one-half of a shot.

Example: The Vega Machine Pistol is a TL12 pulsar powered by four TL12 B cells. It would have 20 shots: 17,280 (TL12 pulsar) × 0.1 (B cell) × 4 (four cells) divided by 343 (the cube of its 7d damage).

Reloading Time

The reloading time depends on the weight of the heaviest power cell. It is noted in parenthesis after the number of shots.

The reloading time is (3) for A, B, or C cells, or (5) for D or larger cells. However, each cell must be reloaded individually, so a weapon with 10 A cells would actually require 30 seconds to reload all of them.

Example: The Vega Machine Pistol has B cells, so reloading time is (3). Its Shots are therefore recorded as Shots 20(3).

Weight

A weapon's weight is its empty weight modified by the weight of its power cells. Decide if the weapon's power cells are built into the weapon or stored in an external power pack, vehicle, etc. External power packs don't count toward loaded weight, but do require removing the pack first before the weapon can be reloaded. Use the already-calculated empty weight and the choice of power cells to determine the weapon's loaded weight:

Weight = Empty Weight + PB.

PB is the weight of all power cells built into the weapon, excluding cells stored in a power pack, vehicle, etc. Weight per power cell is 0.005 for A, 0.05 for B, 0.5 for C, 5 for D, 20 for E, 200 for F.

Record the type of power cell after weight; if more than one cell is used, also record the number, e.g., 2C. If the cells are in a power pack append p after cell type.

Example: The Vega Machine Pistol's empty weight was 1 lb. Its power cells are built in; with four B cells that are 0.05 lbs. each, so it weighs 1.2 lbs. Its weight is recorded as 1.2/4B. If the B cells had been in an external power pack, they wouldn't count; the weight would be recorded as 1/4Bp.

At least we now have weapons we know will destroy an Ori ship.

*– Cameron Mitchell, in **Stargate SG-1** #10.20*

Strength Requirement

Calculate the weapon's ST requirement using the formula below with loaded weight.

Beamer or Pistol ST = (square root of weight) × 3.3.
Cannon ST = (square root of weight) × 2.4.
Rifle ST = (square root of weight) × 2.2.

Round to the nearest whole number.

If weapon is a rifle, append a dagger after ST to indicate two hands are used. If the weapon is a cannon, append M after ST (e.g., ST 20M).

Example: The Vega Machine Pistol is a pistol that weighs 1.2 lbs., so its ST requirement is the square root of 1.2 × 3.3. This is 3.61, rounded to ST 4.

Bulk

Calculate Bulk using the formula below, and express it as a negative number (e.g., 3 becomes -3).

Bulk = (square root of weight) × SB.

SB determined from the configuration: 1.5 if rifle or cannon, 1.25 if pistol, 1 if beamer.

Round Bulk to the nearest whole number, and tack on a minus sign. However, the *minimum* Bulk is -6 for a cannon, -3 for a rifle, -1 for a pistol, or 0 for a beamer; the maximum bulk is -10.

Example: The Vega Machine Pistol is pistol configuration. The square root of its weight of 1.2 lbs. is 1.095 × 1.25 = 1.369, rounded to Bulk -1.

Ultra-Tech Beam Weapon Options

Laser Options: An ordinary laser built using this system may have the blue-green, blinding-mode, or ultraviolet options added as detailed in ***Ultra-Tech.*** Lasers, X-ray lasers and grasers, but not rainbow lasers, may have the pulse laser option (***Ultra-Tech,*** p. 118). Apply any modifiers for these options after the weapon is fully designed.

Blaster Options: A blaster or neutral particle beam may incorporate the omni-blaster option (***Ultra-Tech,*** p. 124) at +100% to cost.

Superscience Options: Any beam weapon designed using this system may have the field-jacketed, superscience power cell, gravitic focus or FTL options (***Ultra-Tech,*** p. 133) if desired. Again, apply these modifiers after the weapon is fully designed.

Recoil

All beam and laser weapons have Rcl 1.

Cost

Cost depends on beam type, configuration, and weight using this formula.

Cost = Empty Weight × Bc × Gc.

Bc based on the beam type: $500 for force, laser, or rainbow laser, $1,000 for X-ray laser, $1,500 for graser, $2,000 for blaster or graviton, or $3,000 for pulsar or neutral particle beam.

Gc is 2 for light automatic or heavy automatic beam generators, or 1 for single-shot or semi-auto beam generators.

Example: The Vega Machine Pistol cost is based on its 1 lb. empty weight, generator, and beam type. This is 1 × $3,000 × 2 = $6,000.

As is usual for ammunition, the cost of power cells are not included in the specified Cost of the weapon but must be bought separately.

Legality Class

Calculate the weapon's LC. The basic LC is 4 for force beams, 3 for blasters, graviton, neutral particle beams, lasers, rainbow lasers, X-ray lasers, and grasers, or 2 for pulsars.

Reduce LC by 1 if the weapon weighs 5 lbs. or more (loaded) or by 2 (with a minimum LC of 1) if it weighs over 15 lbs. (loaded).

Example: The Vega Machine Pistol is LC2 for being a pulsar. Its weight does not modify this.

Accessories

Every TL9+ weapon has smartgun electronics (p. B278 or ***Ultra-Tech,*** p. 149) at no extra cost. Other accessories from ***Ultra-Tech*** (pp. 151-152) can be added.

Skill Required

Cannon and other mounted beam weapons use Gunner (Beams) skill.

Pistols and beamers use Beam Weapons (Pistol). Rifle-configuration weapons use Beam Weapons (Rifle).

Example: A Vega Machine Pistol requires Beam Weapons (Pistol) skill.

Statistics

Record the standard statistics for the weapon in the usual format, including skill required and defaults. See the table below for stats for the Vega Machine Pistol.

About the Columnist

David L. Pulver is a Canadian freelance author. An avid SF fan, he began roleplaying in junior high with the newly released ***Basic Dungeons & Dragons.*** Upon graduating from university, he decided to become a game designer. Since then, David has written over 70 roleplaying game books, and he has worked as a staff writer, editor, and line developer for Steve Jackson Games and Guardians of Order. He is best known for creating ***Transhuman Space,*** co-authoring the ***Big Eyes, Small Mouth*** anime RPG, and writing countless ***GURPS*** books, including the ***GURPS Basic Set,*** *Fourth Edition,* ***GURPS Ultra-Tech,*** and the ***GURPS Spaceships*** series.

Vega Machine Pistol Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
12	Vega Machine Pistol	7d(3) cr ex rad sur	5	120/360	1.2/4B	10	20(3)	4	-1	1	$6,000	2

Thinking Machines

by Thomas Weigel

In many campaigns, computers are set decorations rather than integral equipment in a campaign. But what if you want more than that?

This article provides a set of optional variant rules that are reasonably compatible with ***GURPS Basic Set,*** but offer a richer (expanded, detailed, and historically accurate) look at the devices that define the modern world, and will be a sizable part of most plausible science-fiction settings.

> *Sir, they hacked your firewall in ten seconds! Even a supercomputer, with a brute force attack, would take ten years to do that.*
>
> *– Maggie Madsen, in* ***Transformers***

Complexity

A computer's "Complexity" rating measures processing power – i.e., how much information it handles per second. Complexity is a qualitative measure, but can be approximated in *flops* (floating-point operations per second). Complexity 1 covers computers ranging from 0.5 to 400 flops, and each further level of Complexity increases this by ×1,000.

Although imperfect, this maps to historical landmarks and covers everything from the first computers to the latest supercomputers. Further, other improvements (such as memory size and transfer speeds) tend to accumulate in tandem.

For greater resolution *within* a single Complexity, see the advanced, heavy duty, light duty, and old computer options (pp. 20-21).

Complexity 1: As fast as a human at basic arithmetic, but far more consistent and accurate . . . and the computer doesn't get bored. Stores 10 bytes.

Complexity 2: Substantially faster, but still very simple. Fast enough to shred TL6 cryptography by brute force. Stores 10 kilobytes.

Complexity 3: Fast enough to run a complex task manager or operating system *in addition to* the software. Stores 10 megabytes.

Complexity 4: With power to burn, historical Complexity 4 personal computers are marked by mass-market-friendly interfaces (more processing cycles devoted to attractiveness than utility). Fast enough to break TL7 cryptography. Stores 10 gigabytes.

Complexity 5: Can run complex physics simulations, make accurate one-hour weather projections, and beat humans at specific games. Most 2010 supercomputers are Complexity 5. Stores 10 terabytes.

Complexity 6: Human brains are Complexity 6. Most digital Complexity 6 computers in the real world are used for high-end physics simulations and sifting the Internet for data. Stores 10 petabytes.

Complexity 7: Theoretical as of 2010, a Complexity 7 computer can run an electrochemical model of the entire human brain (ignoring quantum effects and smaller biological effects) or predict the weather accurately for a day or two into the future. Stores 10 exabytes.

Complexity 8: Can model Earth's entire weather system in real-time, with precise accuracy several days out, run a fine-grained simulation of the human brain, and redefine economics theory. The required information density for this will require computers to deal with quantum effects in their design, which may result in shredding TL8 cryptography. Stores 10 zettabytes.

Complexity 9: Like Complexity 8, but better. Can model the human brain in exquisite detail, provide an amazingly accurate Earth weather system, and usher in TL10 physics. Volitional AI seems unavoidable! Stores 10 yottabytes.

Complexity 10: Can run quark-level simulations on a large scale and solve many TL10 physics questions by brute force. Without TL^ advances in physical technology, they will *never* be small enough for common use – the required energy, heat dissipation, and bits-per-atom are simply too high! A computer of this Complexity or higher stores gobs and gobs of data.

Complexity 11: Can run an entire city's population as a simulation, down to individual neurons, or simulate the weather for an entire solar system.

Complexity 12: Capable of running a simulation of an entire nation's minds, or running a model of the solar system at a resolution of 1-lb. "pixels."

Complexity 13: Ignoring superscience, a Complexity 13 computer needs to be roughly the size of Earth – this still involves very advanced technology for providing sufficient power, heat dissipation, and information density! Can run a simulation of tens of billions of minds simultaneously, "evolve" entire biological designs from environmental parameters in seconds, and usher in TL12 technology.

Complexity 14: Constructed as a gas giant (and sometimes called a Jupiter Brain in literature), these computers can run the entire economy of a star-faring civilization, function as god-like digital intelligences, or model the entire solar system down to grains of sand.

Complexity 15: A series of layered Dyson shells around a star, each expending its waste energy outward to power the next layer. Unless there are fantastically complicated physics at TL12, such power is not *needed,* but it *could* run an awesome virtual reality for every living sapient. In transhuman literature, a Complexity 15 computer is a Kardashev Type II civilization.

Complexity 16: The only way to build this computer with known physics involves networking thousands of Complexity 15 computers. A species of virtual minds may construct such a system as part of their colonizing effort, or god-like beings may build them to answer the questions that puzzle god-like beings.

Computer Models

Combined with options (pp. 20-21), the sizes below represent a wide variety of specific models.

Each size has *two* Complexity values – the Complexity at the introduction TL, and Complexity at TL11. Complexity increases by +1 per *three* quarter-TLs (see *Quarter-TLs,* below) after introduction until TL11. At TL11, molecular manufacturing provides a new Complexity based on inefficient bits per atom. At TL12, this increases by +1 due to more efficient use. Without TL^ advancements, the computer cannot be improved beyond this point.

Computers introduced during TL6-7 are exceptions, because vacuum tubes and transistors happened within a *very* short span of time. The historical progression will be provided for those computers in their individual entries.

Where two computers have the same Complexity, the computer that is a larger *size* of computer gets a +2 on contests, and the computer that is a later TL gets a +3 per quarter-TL newer.

Legality is LC4 for most computers, and otherwise depends on society. In settings where grain computers (or smaller) are surveillance tools, they may be LC2 or worse. In settings with government-controlled encryption (e.g., the United States until TL7.75), minicomputers and larger are LC2. Even in permissive settings, minicomputers and larger may be LC3. Living city computers are LC2 (LC1 in paranoid societies), and any computer that needs an orbit is LC0 (LC1 in *very* permissive societies). In settings where artificial intelligence is tightly controlled, any computer of Complexity 6+ may be -1 LC or worse.

Most computers run on external power. Battery-powered computers increase their cost and weight by 2% per hour of duration.

The computers below give cost and weight for a *single* computational core. A core runs *one* program of the same Complexity, 100 programs of -1 Complexity, 10,000 programs of -2 Complexity, and so on (see *Multiple Cores,* p. 20, for a way to improve this).

Quarter-TLs

Computer technology advances *quickly* (many pronouncements are obsolete before they're safely forgotten), at roughly ×10 flops per decade (or +1 Complexity per three decades). For advancement purposes, this article uses the term *quarter-TL* (roughly a decade). Historical quarter-TLs during the computer era *have* been decades.

TL	*Historical Period*
6.75	1930s
7	1940s
7.25	1950s
7.5	1960s
7.75	1970s
8	1980s
8.25	1990s
8.5	2000s
8.75	2010s

Molecular Computer (TL12)

The size of a large, complex molecule, these are common in managing chemical processes (smart drugs, color-changing dyes, medical tests, and similar). Complexity 1. Listed for completeness – they are *included* in the cost and weight of most smart chemicals. Molecular computers power themselves with the energy of the input they receive – no external power or batteries required.

Viral Computers (TL11)

The size of a large virus, these are useful primarily in computer clusters. Complexity 2 at TL11. Cost and weight are only measurable in large quantities! Viral computers power themselves chemically from their environment (or for nanobots, from the nanobot's power source) – no external power or batteries needed.

Blood Swarm: A network of swimmer nanobots that live in the blood. Complexity +3. $1,000. LC3. Includes a one-yard radio. Each core (see *Multiple Cores,* p. 20) raises the host's temperature +0.05° F. The blood swarm can go dormant – while dormant, the swarm is virtually undetectable.

Smartcell Computers (TL11)

The size of a single-celled organism, a smartcell is the largest computer that can be built into a nanobot. Complexity 3 at TL11. Negligible cost and weight. They are usually used in clusters. Smartcell computers power themselves with solar cells or the chemical nutrients of their environment – no external power or batteries required.

Smart Mist: An aerostat nanoswarm (***GURPS Ultra-Tech***, p. 37) with a smartcell computer cluster and firefly (***GURPS Ultra-Tech***, p. 74) capabilities. Each square yard provides wireless network connectivity, holographic touch-screen monitors, and a small amount of computing power for those without computers. Complexity +3. $2,000. LC4.

Brilliant Mist: Several hundred square yards of aerostat nanoswarms, each with 10-core viral-computer clusters and firefly capabilities. Similar to smart mist (above), but more powerful. Complexity +4. $5,000,000. LC4.

Nanocomputer (TL9.5)

The size of a super-amoeba. Complexity 2 at TL9.5; Complexity 5 at TL11. Negligible cost and weight. Nanocomputers are usually powered by solar energy or a microscopic drain on the host product's battery – no external power or batteries required.

Nanocomputers are embedded in other products with one-yard radio communicators to provide help files, expert advice, advertisements, and similar assistance with that specific product. They are also included in the cost of microbots.

Grain Computer (TL9)

The size of a large grain of sand, this is the largest computer available for microbots. At TL11 and later, they are cheap add-ons to products that need an AI, but not much else. Complexity 3 at TL9; Complexity 6 at TL11. $1, 0.0002 lbs.

Grain Computer Implant (TL9): An implant radio (***Ultra-Tech***, p. 211) with a built-in grain computer. Simple procedure. $120. LC4.

Microswarm Computer (TL10): A microswarm with a grain computer cluster. This counts as a primary function for the swarm! Complexity +2. $10,000, 1 lb. Has a radio range of 50 yards.

Pebble Computer (TL8.75)

The size of a *very* small stone, pebble computers form the basis of many small computing platforms near the end of TL8. Complexity 3 at TL8.75; Complexity 7 at TL11. $10, 0.002 lbs.

Computer Implant (TL9): An implant computer (***Ultra-Tech***, p. 215). Minor procedure. $1,000. LC4. Can use a tiny computer (below) instead, but this quadruples the cost and becomes a major procedure.

Cell Phone: A pebble computer with the compact and rugged options (p. 20), radio, GPS, and standard terminal (p. 21) with the compact, rugged, and datapad options (p. 20). $50, 0.1 lb. LC4.

Tiny Computer (TL8.5)

Small enough to fit inside a wristwatch. Complexity 3 at TL8.5; Complexity 7 at TL11. $100, 0.02 lbs.

Pocket Computer (TL8)

Small enough to fit into a PDA or palm top. Complexity 2 at TL8; Complexity 3 at TL8.25; Complexity 7 at TL11. $250, 0.2 lbs.

PDA: A pocket computer with the compact and light duty options (p. 20), and a standard terminal (p. 21) with the compact and datapad options (p. 20). $750, 0.075 lbs.

Smart Phone (TL8.75): As a PDA, but with radio communication. $800, 0.08 lbs. LC4.

Small Computer (TL7.75)

Small enough and cheap enough for most budgets. Complexity 2 at TL7.75; Complexity 3 at TL8; Complexity 8 at TL11. $500, 2 lbs.

Desktop: A small computer and standard terminal (p. 21) with no options. $1,000, 12 lbs. LC4.

Laptop (TL8): A small computer with the compact and light duty options (p. 20), and a standard terminal with the compact and portable options (p. 20). Includes a three-hour battery. $2,650, 1.6 lbs. LC4. A slate tablet (TL8.5) is identical, but adds a touch-screen terminal. $4,500, 1 lb.

High-End Smart Phone (TL8.75): A small computer with the light duty and miniature options (p. 20), and a touch-screen terminal (p. 21) with the compact and datapad options (p. 20). Built-in radio. $1,550, 0.33 lbs. LC4.

Smart Robes (TL9.5): A small computer with the compact and cloth computer options (p. 20) with a touch-screen terminal (p. 21) with the same options. $10,000, 4.5 lbs., 18 square feet. Light summer clothing, with its own computer display.

Workstation (TL7.75)

The first workhorse computers used in small offices, a single workstation had many employee terminals. Complexity 3 at TL7.75; Complexity 8 at TL11. $2,000, 20 lbs.

It's amazing that you guys didn't have all these computers and stuff, and you solved cases. I mean really complicated ones. I mean I know coroners weren't doing forensic autopsies back then. But it wasn't until 1975 that the FBI installed their first automated fingerprint reader. That sort of revolutionized what I do . . . what **we** *do.*

– Abby Sciuto, in **NCIS** *#8.12*

Workstations were *possible* at TL7.25 (Complexity 2). They lost their appeal to small computers in TL8, outside of high-end graphical production, servers, and similar jobs. They also begin to show up in cluster computing in TL8.25.

Microcluster (TL8.25): Several dozen workstations. Complexity is one quarter-TL *better.* $50,000, 1,000 lbs. LC4.

Tiny Cluster (TL8.25): A few hundred workstations. Complexity is two quarter-TLs *better.* $500,000, 2.5 tons. LC4.

Small Cluster (TL8.25): A few thousand workstations. Complexity +1. $5 million, 25 tons. LC4.

Server Farm (TL8.5): Several hundred thousand to a few million workstations. Complexity +2. $1 billion, 5,000 tons. LC4.

Normally, you'd use a computer to examine all the combinations, but in this case, it was faster just to write it all out longhand until I found the right code.

– Dr. Spencer Reid, in ***Criminal Minds*** *#4.2*

Minicomputer (TL7)

The size of a large cabinet or human-height server rack. Complexity 1 at TL7; Complexity 2 at TL7.5; Complexity 3 at TL7.75; Complexity 4 at TL8. They follow the normal progression thereafter. Complexity 8 at TL11. $40,000. 200 lbs.

Mainframe (TL6.75)

"Big Iron," TL8 cluster computing largely replaced mainframes outside of dedicated servers. Complexity 1 at TL6.75; Complexity 2 at TL7; Complexity 3 at TL7.25. They follow the normal progression thereafter. Complexity 8 at TL11. $600,000, one ton.

Analytical Engine (TL5+1): A mainframe and primitive terminal (p. 21) with the steampunk option (p. 20). $6.05 million, 6.25 tons. LC4. Charles Babbage designed this, but failed to build it due to cost overruns and arguments with the machinist producing the parts.

Macroframe (TL7)

A room-sized computer built on a massive processing core, macroframes have suffered from processor speed limits during TL8. Complexity 2 at TL7; Complexity 3 at TL7.25; Complexity 4 at TL7.75; Complexity 5 at TL8.75; Complexity 6 at TL9.25. They follow the normal progression thereafter. Complexity 9 at TL11. $10 million, 10 tons.

Grand Calculator (TL5+3^): A macroframe and 10 primitive terminals (p. 21) with the steampunk option (p. 20). Complexity 4. $100.5 million, 52.5 tons. LC2. A city-block-sized monstrosity, filled with analytical engine columns, scurrying clerks (transferring punch cards between towers), hissing water pipes, and unholy *noise.* London constructed it to assist them in running the city, and some claim that it does *too good* a job . . . it runs dozens of administration programs, and prints instructions to a mechanical printer and a set of steam-powered pipes with a grating, disembodied voice. Recently, it has requested the administrative resources to construct additional computing modules . . .

Megacomputer (TL9.25)

This immense computer assumes that a number of TL8 difficulties in intercommunication, heat, and reliability are solved. Large enough to fill a small office building. Complexity 7 at TL9.25; Complexity 9 at TL11. $1 billion, 1,000 tons. Requires power from a city grid or small, dedicated generator!

Skyscraper Computer (TL9.5)

Common in science fiction, this computer uses TL9 manufacturing improvements, superconductors, and photonic circuits to overcome massive technical difficulties. Complexity 8 at TL9.5; Complexity 10 at TL11. $1 trillion, 1 million tons. Requires power from a city grid or dedicated generator!

Living City (TL10.25)

Using microswarm computers and lasers to communicate between components, and skyscraper computers as subnodes, the living city is mind-bogglingly powerful. Can be put in orbit as a small planetoid a few miles in diameter. Complexity 10 at TL10.25; Complexity 11 at TL11. $1 quadrillion, 1 billion tons. Requires power from a city-sized power plant.

Planetary Brain (TL11)

Roughly the size of Earth. Complexity 12 at TL11. $1 quintillion, 1 trillion tons. Cost and weight *includes* the core reactor and solar-panel surfacing.

Cost is often much higher than the production cost, and may include licenses for the gravity well and nanotech conversion force, the cost of *buying* a planet to convert, and so on.

Jupiter Brain (TL12)

This gas-giant-sized computer is less dense than a planetary brain, to prevent gravity from destroying the computer, but *far* more massive. It relies on high-energy laser beams to transmit exabytes of data between sectors. Society must be capable of dismantling entire planets to even consider building one. Complexity 14 at TL12. $1 septillion, 1 quintillion tons. Cost and weight *includes* core reactors and orbiting solar panels.

As with a planetary brain, cost will be higher than the production cost.

Shell Computer (TL12)

A shell computer (sometimes called a Matrioshka Brain) consists of layered Dyson shells. Complexity 15 at TL12. $1 decillion, 1 octillion tons. Cost and weight *includes* solar arrays, massive capacitors for bursts of energy, and reactors for power backup (in case of asteroid collisions, sunspots, and so on).

The cost to own a star system to build it is almost incalculable. Unless FTL technology exists, any task that requires the *full* power of the shell computer will take several minutes – the time required to propagate the task to all nodes and return the answer!

Shell Cluster: A cluster of thousands of shell computers. Light-speed technologies take a minimum of *centuries* to propagate a task and return the answer. Complexity 16 at TL12. Including adequate communication arrays, $1.5 undecillion, 1.5 nonillion tons.

Computer Options

A computer can be customized with the following options. Each option can be taken only once.

Advanced (TL8): The computer uses cutting-edge technology that anticipates the next quarter-TL of developments. The computer gains a +2 on contests with other computers of the same Complexity. Multiply cost by ×10. Reduce LC by 1. This cannot be combined with *Obsolete* or *Old*.

Compact (TL6.75): The computer uses high-end, lightweight components. All skill rolls to modify or repair the computer are at -2. Multiply cost by ×2, weight by ×0.5. This cannot be combined with *Miniature*.

Dedicated (TL5): The computer hardware is devoted to a specific program, and can run *only* that program. Increase Complexity by +1. Multiply cost and weight by ×2.

Faster Than Light (TL^): The computer's processors function at FTL speeds. The computer gains +4 on contests with non-FTL computers of the same Complexity for *each* ×10 faster than light. Also note that for shell computers (pp. 19-20) and shell clusters (above), this will dramatically cut down on the time required to propagate a task! In a setting where FTL communications are the norm, this has no effect on cost, weight, or LC; where it is possible but uncommon, multiply cost by ×100, weight by ×2, and reduce LC by 1.

Heavy Duty (TL6.75): The computer is significantly larger and more powerful. The computer gains a +2 on contests with other computers of the same Complexity. Multiply cost and weight by ×2. Cannot be combined with *Light Duty*.

Light Duty (TL7.25): The computer is smaller and less powerful. The computer suffers a -2 penalty on contests with other computers of the same Complexity. Multiply cost and weight by ×0.5. Cannot be combined with *Heavy Duty*.

Miniature (TL6.75): The computer uses the smallest and lightest components available. All skill rolls to modify or repair the computer are at -5. Multiply cost by ×4, weight by ×0.3. This cannot be combined with *Compact*.

Multiple Cores (TL5): By default, a computer has a single core (and can run a single program of equal Complexity). Each *additional* core increases the cost and weight by +100%.

Obsolete (TL6): The computer is an older model. For a computer that is from the previous quarter-TL, multiply the cost by ×0.25. For *each* quarter-TL earlier than that, multiply the cost by another ×0.5, to a maximum of one full TL (total of ×0.03125 cost). Cannot be combined with *Advanced* or *Old*.

Old (TL8): The computer uses inexpensive, older technology (not quite a full quarter-TL). The computer suffers a -2 penalty on contests with other computers of the same Complexity. Multiply cost by ×0.5. Cannot be combined with *Advanced* or *Obsolete*.

Rugged (TL7): The computer is designed to resist physical attacks, environmental conditions, and rough treatment, and to be easier to repair in the field. Add +2 to HT and to all skill rolls to modify or repair the computer. Multiply cost and weight by ×2.

Some more exotic options are below. Availability (and whether they can be combined) depends on the setting – in some campaigns, a cloth biocomputer will seem perfectly normal!

Biocomputer (TL9): A biocomputer is constructed from neurons, but organized as a traditional computer rather than a brain. Multiply cost and weight by ×2 (this includes a support network for nutrients, waste, and heat management). *Reduce* Complexity by 1.

Cloth Computer (TL9.25): The computer is built on a cloth-like substrate, which can be manipulated in any way cloth can. If the surface is broken, the computer is destroyed. The computer can take up one square foot per 4 lbs. (winter clothing), one square foot per pound (summer clothing), four square feet per 1 lb. (finest silk), or 10 square feet per 1 lb. (TL9.5, ultra-tech diaphanous materials). Multiply cost by ×5, weight by ×2. A cloth computer can be combined with armor (just add the weights and costs). As long as the DR is not penetrated, the computer is not destroyed.

Paper Computer (TL9): The computer is built on a paper-like substrate, which can be rolled, flexed, folded, or scrunched, but is still somewhat stiff to the touch. At TL9.5, it can be a memory material, returning to its unbent shape when pressure is not being applied. If the surface is broken, the computer is destroyed. The computer can take up one square foot per 1 lb. (heavy cardstock), four square feet per 1 lb. (translucently thin paper), or 10 square feet per 1 lb. (TL9.5, transparent, and as thick as a single human hair). Multiply cost by ×3, weight by ×2.

Quantum Computer (TL9): The computer is built to take advantage of quantum effects. This can have a profound effect on the speed of certain kinds of tasks (see *Quantum Computing*, p. 21). Reduce Complexity by -3 at TL8, by -2 at TL9, and by -1 at TL10. Quantum computing is the default at TL11-12.

Regenerating (TL10): The computer has healing capabilities – due to bioplastic at TL10, or construction nanobots at TL11+. Given sun and ordinary air, the computer can heal 1 HP every six hours at any TL. At TL11+, the computer can heal 1 HP per hour as long as it is not missing any parts; missing parts heal at the slower rate. Multiply cost by ×5. Reduce Complexity by 1.

Semi-Flexible Computer (TL8.75): The computer is built on a semi-flexible substrate. It can be rolled or flexed, but not folded or scrunched, and if the surface is broken, the computer is destroyed. The computer can take up one square foot per 4 lbs. (1/2" thick foam), one square foot per 1 lb. (heavy foil), or four square feet per 1 lb. (TL9, translucently thin foil). Multiply cost and weight by ×2.

Solar-Sail Computer (TL10): The computer is built on a microscopically thin substrate, which can be rolled and folded up when not extended as a solar sail. The computer takes up 250 square feet per pound, and can absorb 1 HP of damage per pound before being destroyed. Multiply cost by ×5, weight by ×2.

Steampunk (TL5^): A mechanical computer, built decades before the first historical computers were built! The cost and mass includes a steam engine to power it. Multiply cost by ×10 and weight by ×5. Complexity depends upon the *effective* TL – a TL5+2^ computer will have Complexity as if it were TL7.

Tattoo Computer (TL10): The computer is embedded in circuits made of ink, which are then tattooed or printed on another surface. If the surface is broken, the computer is destroyed. The computer takes up 10 square feet per pound. Multiply cost by ×10.

Interface

A computer needs an interface to communicate with the rest of the world. Most interfaces run on external power. Battery-powered interfaces increase their cost and weight by 2% per hour of duration.

Machine Interface (TL5)

All computers have *at least* this interface. Commands are input by directly manipulating the computer's internal levers, adding and removing vacuum tubes, sending and receiving electrical signals through a data port, or similar method. This adds no weight or cost, and has the same computer options (pp. 20-21) as the computer itself.

Terminal (TL6)

A terminal provides a human-usable interface, usually in the form of a keyboard and view screen. At TL8+, the view screen can be a monitor, projector, or Braille display; at TL10^+, it can be holographic, but this adds $2,000 to the cost.

Primitive Terminal (TL6): This encompasses all varieties of paper-tape readers, typewriter-like card punches, automatic card sorters, and blinking display panels. A task performed on primitive terminal may take an hour or more simply to set up. Deciphering the results takes several minutes of sifting through the output. $5,000, 500 lbs. LC4.

Standard Terminal (TL7): A keyboard and monitor (monochrome until TL8). At TL8, includes mouse and speakers, and may include a microphone. $500, 50 lbs. LC4. Multiply weight by ×0.2 at TL8, and then halve cost *and* weight at TL9 and TL10.

Hands-Free Terminal (TL8.25): A head-mounted monitor, one-handed keyboard and pointer device (or a hip-anchored keyboard), and earpiece. Until TL9, gives -1 to DX-based rolls when worn. $2,000, 10 lbs. LC4. Halve cost and weight at TL9, and again at TL10.

Touch-Screen Terminal (TL8.5): An ultra-thin glass monitor with built-in speakers, microphone, and camera. Surface is touch-sensitive, and can see and hear the user. $1,000, 5 lbs. LC4. Halve cost and weight at TL9, and again at TL10.

Terminals can be built with these computer options (from pp. 20-21): compact, rugged, biocomputer, cloth computer, paper computer, regenerating, semi-flexible computer, steampunk, and tattoo computer. They can also have any of the following options.

Command Center (TL7): Multiple wall-mounted monitors and executive desk-sized interface. A touch-screen terminal covers the entire desk. Complex, difficult, and time-consuming tasks are at +2. Cost ×20, weight ×5.

Luxurious (TL8): A massive monitor (or 2-3 linked screens) and desk-sized interface setup. A touch-screen terminal is the size of a drafting table. Complex, difficult, and time-consuming tasks are at +1. Cost ×4, weight ×2.

Portable (TL8): Laptop-sized. Complex, difficult, and time-consuming tasks are at -1. Cost ×0.5, weight ×0.2.

Datapad (TL8): Fits in a palm-top or PDA. Complex, difficult, and time-consuming tasks are at -2. Cost ×0.25, weight ×0.01.

Wrist-Top (TL8): Fits on the back of a wrist. Complex, difficult, and time-consuming tasks are at -4. Cost ×0.01, weight ×0.001.

Other Interfaces

GURPS High-Tech (p. 21) provides a HUD interface. ***GURPS Ultra-Tech*** provides a more powerful HUD interface (p. 24), neural interfaces (pp. 48-49), holoprojectors (pp. 52-53), and virtual reality rigs (pp. 53-55).

About the Author

Thomas Weigel has passed some forms of the Turing test in Austin, Texas, with his wife and two cats, and hopes to someday qualify as human. He hopes you find this article, painstakingly translated into one of your human communication protocols, as pleasing as his last one.

Quantum Computing

Quantum computers examine all possibilities simultaneously until measured, then "collapse" into an answer (with a small probability of being wrong). With a program designed for quantum computers, and on a task that quantum computers excel at, the computer can perform the task in a fraction of the time.

How fast is a matter of conjecture. The known algorithms available today indicate that a quantum computer can perform a task in a number of operations equal to the square root of the number it would take a classical computer. To calculate how much time that requires, take the square root of the number of seconds it would take a classical computer of the same Complexity, and divide the result by the following:

Complexity 1: Do not divide.
Complexity 2: Divide by 30.
Complexity 3: Divide by 1,000.
Complexity 4: Divide by 30,000.
Complexity 5: Divide by one million.
. . . and so on.

Example: A classical Complexity 3 computer that takes six seconds to perform a search task, when that is the only task it is performing, is roughly equivalent to saying the computer makes six million operations. A quantum Complexity 3 computer would thus take 2,450 operations, which would require 0.00245 seconds.

Quantum computers are best at needle-in-a-haystack searches. This includes database queries, brute-forcing TL8 encryption, finding the best route on a map, and finding a person who matches difficult criteria in a large population. (Note that some encryption methods – including the McEliece cryptosystem – are immune to currently known quantum attacks, but are not as practical to implement with today's computers.)

More Ultra-Tech Guns and Heavy Weapons

by Mark Gellis

While ***GURPS Ultra-Tech*** and other sourcebooks cover most of the weaponry that adventurers might need for a futuristic game, a few gaps remain that are worth filling. To that end, this article offers a wider selection of solid-projectile artillery and other heavy weapons. All of the weapons listed here are assumed to be TL9. The TL10 and TL11 versions of these weapons are identical in terms of weight, cost, performance, accuracy, etc., but have the advantage of being able to use the kinds of special ammunition developed at these higher technology levels.

Although this article introduces a few new types of ammunition (see p. 25), it generally relies on the same calibers for ammunition used in ***GURPS Ultra-Tech.*** The rules for special warhead types, therefore, are unchanged. As in ***Ultra-Tech,*** the default ammunition is an inert solid projectile, but this is not the most commonly used ammunition for many of these weapons. For example, the 40mm automatic cannon is often armed with HE rounds; these do 6d×6(0.5) pi++ with a follow-up explosion doing 8d cr ex [2d].

For special considerations on using conventional guns, see ***GURPS High-Tech,*** pp. 78-88.

> *I have a love interest in every one of my films – a gun.*
>
> *– Arnold Schwarzenegger*

Pistols

For an overview of handguns, see ***GURPS Ultra-Tech,*** p. 135, and ***GURPS High-Tech,*** pp. 90-103.

5.5mmCL Pocket Pistol

This tiny automatic pistol is not especially accurate and does not have much of a punch – it uses a round designed for "varmint rifles" that is more suitable to taking out rattlesnakes and rabbits than human beings – but it is easy to carry and conceal. Additionally, its low recoil also makes it relatively easy to shoot. It is popular among people who want a pistol they can have on hand without attracting attention (for example, a street thug who needs a gun he can hide in his pocket, or a woman who wants a firearm she can keep in a small purse).

7.5mmCLP Derringer Quad

This is a stylish, if not particularly practical four-barrel derringer. It is about the same size as the 7.5mm holdout pistol. This makes it useful as a backup weapon or a tool for assassins, but most firearms experts agree that it is best suited to function as a fashion accessory. (This point is also made about 5.5mm pocket pistol at times, especially since both weapons are available in various colors at two times the normal price, or with decorative engraving at five times normal price.)

7.5mmCLP Snub-Nosed Revolver

By TL9, improvements in the basic design of automatic pistols – reducing the likelihood of jamming and increasing the number of rounds that can be carried – make the revolver almost obsolete. However, many shooters still prefer to use a revolver, and several TL9 models exist. This is one of the smaller and more compact ones, with a 2.5" snub-nosed barrel. It is extremely reliable, and its size makes it easy to carry in a purse, a shoulder holster, or an ankle holster. Although it suffers from the same problem as most small caliber pistols – limited stopping power – it is practical enough to be a common back-up weapon for undercover police and government agents.

10mmCLP Heavy Revolver

This heavy-framed revolver, chambered for the 10mm round used in the heavy automatic pistol, comes with a 4" barrel. It is well-respected in rural communities, where one of its main uses is against wild animals like poisonous snakes or wild dog. Its exceptional reliability is considered an important asset. It can also be purchased with a rather intimidating 7.5" barrel (Damage 3d+1 pi+, $650, 3.0 lbs.).

> *Those seeking the ultimate in home demon protection can now protect their plane of existence with a double-barreled, pump-action, combat shotgun that blasts more holes than Mobil Oil.*
>
> *– Gamespot, "Doom II Review"*

RIFLES

For an overview of rifles, see ***GURPS Ultra-Tech,*** pp. 135-136, and ***GURPS High-Tech,*** pp. 107-122.

5.5mmCL Light Hunting Rifle

This is a light "varmint rifle" ideal for taking down small game like rabbits and foxes. It uses a round that is, for all practical purposes, a caseless version of the venerable .22 LR cartridge. It is underpowered for shooting at people – it is used because a more powerful round would simply splatter small game – but it can still kill. It is a very common weapon in rural areas and it is often the first firearm owned by young people who live in such communities.

5.7mmCL Combat Rifle

This light assault rifle uses the same cartridge as the Gatling carbine and the PDW, but it has a somewhat longer barrel. This gives it increased accuracy at longer ranges. While it is not as powerful as the standard assault rifle, it is a capable infantry weapon that can double as a sniper rifle; it is also lighter and carries more ammunition than the standard assault rifle. Some cynical social critics have remarked that since the combat rifle is more likely to wound than kill, when compared to the assault carbine, it is ideal for waging *economic* warfare: a dead soldier can be buried in an hour by two unskilled workers but it will cost an enemy nation a fortune to create and maintain the medical infrastructure (doctors, nurses, hospitals, etc.) needed to keep tens of thousands of injured ones alive and try to restore them to health.

SUBMACHINE GUNS

For an overview of submachine, see ***GURPS Ultra-Tech,*** p. 135, and ***GURPS High-Tech,*** pp. 122-126.

7.5mmCLP Machine Pistol

This is a version of the machine pistol designed for lighter 7.5mm ammunition. It trades killing power for an increase in the number of rounds carried in the magazine, which makes it a very attractive option to some shooters. It can be kept in a properly designed shoulder holster, although the user normally needs to wear bulky clothing to truly make it a concealed weapon.

MACHINE GUNS

For an overview of machine guns, see ***GURPS Ultra-Tech,*** p. 136, and ***GURPS High-Tech,*** pp. 129-137.

15mmCL Light Gatling Gun

A high-speed rotary multi-barrel Gatling gun using the same cartridge as the heavy chain gun, this weapon can be mounted on light armored vehicles, mecha, and aircraft. It can also be used in an air-defense role on tanks and naval vessels. Its heavy round makes it effective against almost any target without significant armor. Its computerized controls allow gunners to set any rate of fire up to the maximum of RoF 100 (6,000 rounds per minute); the most common settings are a 20-round burst, a 50-round burst, and a 100-round burst. Along with solid projectiles, various types of armor-piercing rounds and HE rounds (15d(0.5) pi+ with a 2d cr ex [1d-1] follow-up blast) are common choices for ammunition.

25mmCLR Light Autocannon

This is a scaled-up version of the 15mm chain gun firing a much heavier round and delivering significantly more damage. It has the added advantage that it can use a wider variety of special ammunition. (The round has a much higher muzzle velocity than the one used by the 25mm payload rifle or 25mm assault cannon, but the bullet itself is virtually identical.) Along with solid projectiles, APHEX (6d×4(2) pi++ with a 1d cr ex [1d+1] follow-up blast) and HE (6d×4(0.5) pi++ with a 4d cr ex [1d+1] follow-up blast) are common ammunition choices.

25mmCLR Heavy Gatling Gun

This is a multi-barrel version of the light autocannon. It is often used on manned aircraft and ships. It makes a superb close-defense anti-missile weapon. At its maximum rate of fire, it can lay down a storm of bullets that will literally disintegrate most targets. Computerized controls allow the gunner to preset different rates of fire; the most common are a 20-round burst, a 50-round burst, and a 100-round burst.

40mmCL Heavy Autocannon

Often used on light tanks, by giant mecha, aboard ships, or as an anti-aircraft weapon, this huge automatic cannon can employ almost any type of special ammunition, including anti-tank and high-explosive rounds. It fires a much heavier round than a 40mm grenade. This greatly increases its range and muzzle velocity, but the warhead is the same in terms of how much explosive it can carry. Along with solid projectiles and HE (6d×6(0.5) pi++ with an 8d cr ex [2d] follow-up blast), APHEX (6d×6(2) pi++ with a 2d cr ex [2d] follow-up blast) and shaped-charge warheads (6d×4 (10) cr inc + linked 4d cr ex [2d]) are commonly used ammunition types.

Modern hypervelocity railguns work very much like a nuclear particle accelerator. A metal pellet (the projectile) is attracted down a guide (the rail) of magnetic fields and accelerated by the rapid on-off switching of various fields.

– Bill Yenne,
Secret Gadgets and Strange Gizmos

Artillery

For an overview of handguns, see ***GURPS Ultra-Tech,*** p. 136, and ***GURPS High-Tech,*** pp. 138-149.

64mmPLB Commando Mortar

Lightweight and portable, the commando mortar is ideal for small teams that need some form of light artillery. It trades the higher rate of fire provided by the 64mmPLB mortar box (***Ultra-Tech,*** pp. 136 and 138) for greater mobility. The mortar can be broken down into three pieces (each weighing less than 15 lbs. and easily carried by a single person); it can be taken apart or reassembled in 10 minutes. The most common forms of ammunition include HE, flare, smoke, gas, and incendiary rounds.

64mmCL Light Tank Cannon

The need for an intermediary artillery piece led to the development of 64mm field guns. These weapons are light compared to other artillery, and do not produce as much damage, but are easy to transport – they can be carried by either truck or helicopter. Ammunition is also lighter and more can be carried. Tanks and self-propelled howitzers armed with these weapons are usually equipped with an automatic loader and an ammunition canister with space for 50-100 rounds. The round fired by these weapons is much heavier than the 64mm mortar round, but the warhead is identical in terms of how much explosive it can carry. The most common ammunition types employed with the direct fire weapon are HE (6d×15(0.5) pi++ with an 8d×2 cr ex [3d] follow-up blast) and shaped charge (6d×7(10) cr inc linked with an 8d cr ex [3d] blast).

64mmCL Light Howitzer

The light howitzer is optimized for indirect fire, and can be effective at longer ranges. The most commonly used ammunition with this weapon is HE (6d×8(0.5) pi++ with an 8d×2 cr ex [3d] follow-up blast).

64mmCL Dual-Purpose Gun

This is a lightweight rapid fire artillery piece that can be used to attack air or surface targets. It is most commonly seen on naval vessels but can also be used as a coastal defense or a heavy anti-aircraft weapon. Dual-purpose guns tend to be heavier than their howitzer counterparts; the more robust design permits rapid fire and includes the machinery for handling a large ammunition canister. The typical ammunition for this weapon is HE (6d×8(0.5) pi++ with an 8d×2 cr ex [3d] follow-up blast).

100mmCL Medium Howitzer

This is a standard medium field-artillery piece capable of delivering significant amounts of firepower over long distances. It is easy to transport, and can be delivered by truck or helicopter. It is commonly deployed with regular military forces. The most common ammunition used with this weapon is HE (6d×12(0.5) pi++ with a 6d×5 cr ex [5d] follow-up blast).

100mmCL Dual-Purpose Gun

This is a scaled up version of the 64mm dual-purpose gun. A heavier weapon, it is optimized for anti-surface warfare, but can still be employed against aircraft. Its large round can have a devastating effect when employed for coastal bombardment. The typical ammunition for this weapon is HE (6d×12(0.5) pi++ with a 6d×5 cr ex [5d] follow-up blast).

160mmCL Heavy Howitzer

This is a standard heavy-artillery piece. Its tremendous shells are ideal for heavy bombardments. In modern warfare, the use of the howitzer, especially heavier models such as this, is sometimes constrained by the danger of creating collateral damage. The trade-off of a weapon that can deliver an extraordinary amount of explosive power at relatively low cost is that unguided shells, even aimed by highly trained professionals, are likely to often destroy not only military targets, but to significantly damage any nearby civilian ones as well. Using guided smart shells can greatly reduce this problem, but this will also significantly increase the cost of ammunition. The most commonly used ammunition is HE (6d×20(0.5) pi++ with an 8d×4 cr ex [8d] follow-up blast).

Railguns

For an overview of railguns, see ***GURPS Ultra-Tech,*** p. 141.

160mm Railgun

This is the weapon that sounded the death knell for other large artillery pieces on many worlds. Unlike the 40mm railgun (***Ultra-Tech,*** p. 141), this huge cannon is not primarily a direct fire weapon (although it could be used as one if necessary).

New Ammunition Types

The 5.5mm pistol and rifle round is a conventional firearm cartridge, and damage for any special ammunition types can be determined using the rules for other, similar calibers.

Although the rounds for 25- and 40mm cannons and 64mm artillery are heavier than the rounds described in ***Ultra-Tech*** for those calibers, the size and weight of the *warheads* and the explosive damage that is produced by them is the same. For 25-, 40-, and 64mm rounds, use caliber-appropriate warhead types and other guidelines for special ammunition listed in ***Ultra-Tech*** (pp. 152-156).

The 160mm warhead weighs 64 times as much as a 40mm warhead. In most cases, penetrating damage will be four times as much as that produced by a 40mm warhead (use this factor to determine the radius of effect for both flare and aerosol warheads), and explosive damage will be eight times as much as that produced by a 40mm warhead. For example, a TL10 HEMP warhead will do 6d×20(10) cr inc + linked 8d×2 cr ex [8d]. Determine cost for 160mm warheads using the guidelines for other warheads in ***Ultra-Tech.***

The 400mm warhead weighs 64 times as much as a 100mm warhead. In most cases, penetrating damage will be four times as much as that produced by a 100mm warhead (use this factor to determine the radius of effect for both flare and aerosol warheads), and explosive damage will be eight times as much as that produced by a 100mm warhead. For example, a TL10 HEMP warhead will do 6d×48(10) cr inc + linked 8d×8 cr ex [20d]. Determine cost for 400mm warheads using the guidelines for other warheads in ***Ultra-Tech.***

An explanation the base listed damage for the strike missile and cruise missile is required. It is important to remember that this is the damage that would be produced through kinetic impact if a missile was armed with an inert solid warhead. The strike missile and cruise missile are both much slower than the tactical missile; they burn fuel more slowly, allowing them to achieve greater ranges. This reduces the raw kinetic energy they deliver to their targets. This is a moot point, of course, since such missiles will rarely be armed with inert warheads. Instead, they are far more likely to be armed with warheads like HE or HEMP, the effects of which are described above.

Ammunition Table

TL	Ammo	WPS	CPS	LC
9	5.5mmCL	0.005	$0.10	3
9	25mmCLR	1.25	$25	2
9	40mmCL	4	$80	2
9	64mmCL	12	$240	1
9	100mmCL	40	$400	1
9	100mm Rocket	25	$400	1
9	160mmCL	150	$1,500	1
9	160mm Railgun Shell	300	$3,000	1
9	160mm Strike Missile	200	$2,000	1
9	400mm Cruise Missile	2,500	$25,000	1

Instead, it can fire projectiles at nearly orbital velocities, allowing it to hit targets almost 200 miles away. It can also fire more rapidly than most artillery pieces; it is capable of launching 100 160mm shells in a little more than six minutes. A single navy cruiser armed with one of these weapons can deliver as much death and destruction as a TL8 carrier battle group, and can do so more rapidly and at far lower cost, with almost no risk to military personnel (such as pilots), and at distances that make it easier to surprise an enemy and difficult for an enemy to retaliate.

It is equally effective as a defensive weapon. A battery of railguns emplaced as shore defense weapons and aimed using satellites that can track targets from orbit can make approaching enemy territory too closely an unhealthy course of action.

The 160mm railgun uses external power.

Guided Missiles and Launchers

For an overview of missiles, see ***GURPS Ultra-Tech,*** pp. 145-146, and ***GURPS High-Tech,*** pp. 150-153. Warheads are described on pp. 152-156 of ***Ultra-Tech.***

Multiple Tactical Missile Launcher (MTML)

This is a four-round missile launcher for 100mm tactical missiles. It is suitable for vehicles, helicopters, or mecha (shoulder pods are considered particularly stylish). A helicopter equipped with four of these pods can carry 16 missiles. A light armored vehicle equipped with a single MTML can serve as an effective mobile surface-to-air missile platform. The TL10 version is identical to the TL9 version, but fires the TL10 missiles described in ***Ultra-Tech.***

Modular Launch System

This heavy modular launch system can carrying 20 100mm missiles. It is mostly employed as an air-defense system for ships and ground installations. The TL10 version is identical to the TL9 version, but fires the TL10 missiles described in ***Ultra-Tech***.

160mm Strike Missile

This is a medium-sized tactical missile for use against heavy targets. While slower than the 100mm Tactical Missile, it has a larger warhead and much greater range.

A TL10 version of the missile is identical except that damage with an inert solid warhead is now 6d×30 pi++ and range is now 1,500/75,000. As is the case with all guided missiles, the figure listed before the slash in the range statistic is the velocity of the missile in yards per second.

Backblast is usually not a problem as these are not shoulder-launched weapons (except possibly for mecha). However, in case it ever matters, the missile produces a potentially lethal backblast, doing 8d burning damage to anything in a cone up to four yards behind the launcher.

Multiple Strike Missile Launcher (MSML)

This is a four-round pod for the 160mm missile. It is suitable for helicopters, large vehicles, and heavy mecha. A helicopter equipped with four of these pods can carry 16 air-to-air and/or air-to-ground missiles. A truck carrying an MSML can serve as a mobile surface-to-air or surface-to-surface missile platform. The TL10 version is identical to the TL9 version, but fires TL10 missiles.

Heavy Modular Launch System

This is a heavy modular launch system carrying 20 160mm missiles. It is mostly employed as an air-defense system for ships and ground installations. The TL10 version is identical to the TL9 version, but fires TL10 missiles.

400mm Cruise Missile

A highly capable autonomous heavy missile, able to cruise at treetop altitudes for two hours and hit a target the size of a dinner plate at a range of 1,000 miles when fitted with a proper guidance system, this is an apex predator of precision munitions. Its gigantic 400mm warhead can deliver a huge amount of explosive death to a target. It can bust bunkers, sink battleships, or carry a nuclear warhead big enough to a kill a city. Different versions can be launched from aircraft, ground installations, surface vessels, or submarines. A heavy bomber or a warship carrying a dozen of these missiles can inflict almost unspeakable damage on an enemy. The standard HE warhead does 6d×15(0.5) pi++ with a 6d×20 cr ex [20d] follow-up blast. A TL10 version of the missile is identical except that damage with an inert solid warhead is 6d×25 pi++ and range is 500/5,000,000.

Backblast is usually not a problem as these are not shoulder-launched weapons. However, in the event that it ever matters, the missile produces a potentially lethal backblast, doing 16d burning damage to anything in a cone up to six yards behind the launcher.

About the Author

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Guns have a way of materializing more readily than the commodities that sustain life.

– Norman Cousins

Weapons Tables

Pistols Table

GUNS (PISTOL) (DX-4 or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	5.5mmCL Pocket Pistol	1d+1 pi-	1	70/1,400	0.7/0.2	3	6+1(3)	6	-1	2	$200	3
9	7.5mmCLP Derringer Quad	2d pi-	1	100/1,200	1.2/0.024	1	4(3i)	7	-1	2	$350	3
9	7.5mmCLP Snub-Nosed Revolver	2d pi-	1	100/1,200	1.3/0.03	3	5(3i)	7	-1	2	$400	3
9	10mmCLP Heavy Revolver	3d pi+	2	180/2,000	2.5/0.084	3	6(3i)	10	-2	3	$600	3

Rifles Table

GUNS (RIFLE) (DX-4 or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	5.5mmCL Light Hunting Rifle	1d+2 pi-	4	80/1,400	5/0.3	3	10(3)	7†	-4	2	$500	3
9	5.7mmCL Combat Rifle	4d+1 pi-	5	400/3,000	6.5/1	15	100+1(3)	9†	-4	2	$1,200	2

Submachine Guns Table

GUNS (SUBMACHINE GUN) (DX-4 or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	7.5mmCLP Machine Pistol	2d+2 pi-	2	150/1,900	3/1	10	60+1 (3)	9	-3	3	$750	2

Machine Guns Table

GUNNER (MACHINE GUN) (DX-4 or other Gunner at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	15mmCL Light Gatling Gun	15d pi+	6	2,000/9,000	150/120	100	500(5)	25M	-10	2	$50,000	1
9	25mmCLR Light Autocannon	6d×4 pi++	6	2,000/9,000	250/120	10	100(5)	32M	-11	2	$45,000	1
9	25mmCLR Heavy Gatling Gun	6d×4 pi++	6	2,000/9,000	500/350	100	300(5)	45M	-12	2	$75,000	1
9	40mmCL Heavy Autocannon	6d×6 pi++	6	2,000/9,000	500/350	5	125(5)	45M	-12	2	$60,000	1

Artillery Tables

ARTILLERY (CANNON) (IQ-5)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	64mmPLB Commando Mortar	6d×2 pi++	3	360/3,000	40/2	1	1(2i)	15M	-8	2	$1,000	1

ARTILLERY (CANNON) (IQ-5) for indirect fire; GUNNER (CANNON) (DX-4, or other Gunner at -4) for direct fire

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	64mmCL Light Tank Cannon	6d×15 pi++	6	3,000/10,000	1,500/12	1	1(4i)	125M	-14	4	$75,000	1
9	64mmCL Light Howitzer	6d×8 pi++	6+3	5,000/15,000	1,500/12	1	1(4i)	125M	-14	4	$75,000	1
9	64mmCL Dual-Purpose Gun	6d×8 pi++	6+3	5,000/15,000	3,000/1,500	5	100(4i)	185M	-16	4	$225,000	1
9	100mmCL Medium Howitzer	6d×12 pi++	6+3	10,000/30,000	2,500/40	1	1(4i)	150M	-15	4	$100,000	1
9	100mmCL Dual-Purpose Gun	6d×12 pi++	6+3	10,000/30,000	5,000/3,000	3	60(4i)	225M	-17	4	$300,000	1
9	160mmCL Howitzer	6d×20 pi++	6+3	15,000/50,000	10,000/150	1	1(4i)	250M	-18	6	$500,000	1

Railguns Table

ARTILLERY (CANNON) (IQ-5)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	160mm Railgun	6d×100(3) pi++	6+6	100,000/300,000	300,000/30,000	1/4	100(4i)	750M	-24	2	$20,000,000	1

Guided Missiles and Launchers Table

ARTILLERY (GUIDED MISSILE) (IQ-5)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	100mm MTML	6d×30 pi++	3	2,000/10,000	150/100	1	4(20i)	25M	-10	1	$25,000	1
9	100mm Modular Launch System	6d×30 pi++	3	2,000/10,000	1,500/500	1	20(20i)	140M	-15	1	$300,000	1
9	160mm Strike Missile	6d×20 pi++	3	1,000/50,000	200	1	1(20i)	23M	-11	1	$2,000	1
9	160mm MSML	6d×20 pi++	3	1,000/50,000	1,200/800	1	4(20i)	140M	-15	1	$200,000	1
9	160mm Heavy Modular Launch System	6d×20 pi++	3	1,000/50,000	16,000/4,000	1	20(20i)	300M	-19	1	$2,000,000	1
9	400mm Cruise Missile	6d×15 pi++	3	300/3,000,000	2,500	1	1(20i)	150M	-15	1	$25,000	1

Mr. Fixit

by Matt Riggsby

In many science-fiction adventures, scientists and technicians are called on to repair complex devices. This may involve fixing a rusty old piece of alien equipment using incompatible new parts, reversing the polarity of the neutron flow to raise the force screen, or getting the damaged FTL drive back on line before a nearby star goes nova. Though this is often an important complication in the evolving plot, it can be a solitary and fairly tedious struggle of man against technobabble.

These rules extend the existing rules for equipment repair on pp. B483-485 (they are *not* directly compatible with the damage control rules in ***GURPS Spaceships***). They break down the large but homogeneous task of fixing something into smaller and more specific repair tasks. This allows technical protagonists some choices in how to prioritize work and get some meaningful parts of a task done before others in pursuit of a particular end, or to take advantage of the availability of specific resources. They also move into the area of dramatic repair of technology. This focuses less on lasting repair and more on restoring function. This is duct-tape-and-bailing-wire, reroute-the-ray-guns-through-the-princess'-necklace engineering.

No casualties, Captain, but trouble aplenty with the engines. Every dilithium crystal connection smashed in the warp engine circuitry. We're trying to bypass them now.

– Montgomery Scott, in ***Star Trek: The Animated Series*** *#1.11*

Damage and Repair

Whatever the specifics, every complex device (hereafter, a *system*) is likely to have at least four *components*.

Actuation: Parts that perform the task for which the device was designed: transmission and wheels on a car, field emitters on a force-screen generator, lasers on a holoprojector, etc. A device could easily have multiple actuation components. For example, a grav tank would have weapons systems, antigravity generators, targeting sensors, and life support.

Control: Parts for controlling and coordinating the system, including both parts linking the components, and user interfaces (steering wheels, control panels, etc.).

Power: Components for producing or drawing in power. This might be the fuel tank and engine in a car, or a broadcast power receiver for an automated defense and monitoring station.

Safeties: Components that allow the device to operate without harming itself or its owners: the coolant system in a vehicle's engine, electrical fuses that stop power surges and prevent control panels from going up in a shower of sparks, or radiation shielding preventing a fusion cannon from melting down or blowing up.

The GM should split up damage over these components as desired, indicating how badly different parts of the system are damaged. Though it's easiest to simply assign damage equally, the GM may wish to allocate more damage to some components than others if the system has been subject to targeted attacks. For example, if a sensor array was damaged by a large bomb set to kill its operators, the nearby controls may be disproportionately damaged, while a spaceship whose reactors were targeted by enemy fire would have disproportionate power-system damage.

Separate components may require different skills or even multiple skills for repair, particularly for large systems like spaceships and permanent installations. For example, a large space station may require Electronics Repair to fix the control component, but Mechanic (Antimatter Reactor) to fix the power component, and a mix of Electronics Repair and various Mechanic specialties to fix the other sections.

As a mechanic performs repairs, he may allocate the damage he repairs among components that fall under the skill he is rolling against. Each component individually becomes functional when remaining damage is less than system HP/4, but the system as a whole works at half effectiveness. The system is only *fully* operational when all components have less than system HP/12 damage remaining.

Example: Fergus the Engineer is on board a spaceship (strongly resembling the star freighter on p. B465) that is part of convoy attacked by pirates. Though Fergus and many of the crew survive, the ship, which has HP/ST 500, takes 700 points of damage. The GM decides that the pirates specially targeted the ship's drive and main reactor: actuation and power system each take 200 HP damage, while control and safety components take 150.

The control and safety components each come back on line if Fergus fixes 25 points of damage on each, while the power and actuation components need 75 points of repair. At that point, everything acts at half effectiveness until enough repairs have been done to bring all components down to only 41 points of damage each. In any event, because the ship has fallen under 0 HP, it requires $30M (a roll of 3 by the GM for the $1d × 10% worth of its original value in spare parts, at an original value of $100M); see *Major Repairs* (p. B484).

> *Lando: What are you doing here?*
>
> *Han Solo: Ah, repairs. I was hoping you could help me out.*
>
> *Lando: What have you done to my ship?*
>
> *Han Solo:* ***Your*** *ship? Hey, remember you lost her to me, fair and square.*
>
> – ***Star Wars: The Empire Strikes Back***

Salvage and Partial Repair

In desperate situations, a mechanic may try to salvage components from other functional devices to use in repairs for badly damaged systems (for example, plugging a portable fusion reactor in place of an original gas generator or using the teleporter controls to run a weapons battery). A functional power or control component may be mated with a different actuation component, as allowed by the GM. At minimum, power components must supply sufficient energy for the system being repaired, and control components must be for systems of equal or lesser size and complexity. An attempt requires (system HP/100) hours, and a skill roll at -2 or worse (GM's call). Greater penalties and other limitations may be imposed for particularly incompatible components. For example, a steam locomotive may provide enough energy to run a ladar array, but it requires additional work and parts to convert its output into electricity, and it may simply not be possible to use that same steam engine to replace an equally powerful car engine.

Once components are repurposed, they rarely work well. Unless they come from identical or near-identical sources (for example, salvaging an engine from a car and putting it into an identical vehicle), repurposed power components provide 25% lower performance than original components, while control components give at least -2 to operator skill. Again, the GM may impose greater penalties: wiring controls from one spaceship into another is tough enough on the operator; using them to control an array of FTL early warning sensors is even worse.

If a system is badly damaged enough to require spare parts (see *Major Repairs*, p. B484) but entire replacement components are not available, a mechanic may cannibalize other devices to obtain them – for example, using piping from a life-support system to repair a power reactor, or electronics from a communications system to repair an energy-shield generator. A system can be dismantled for generic spare parts worth 30% of the system's original value if it has positive HP. The value drops to 10% if the system has been damaged down to -1×HP, 3% down to -5×HP, or 1% down to -10×HP. This also requires (system HP/100) hours. The system providing parts takes 2×HP damage when it is stripped.

Example: There are a couple of heavily damaged pirate vessels and other freighters in the vicinity; Fergus and some other survivors decide to look them for parts. Ideally, Fergus would want to rip out a functional control component from one of them and put it in his own ship, taking five hours and an Electronics Repair roll at -2, but all the ships in the area are too badly damaged. Three other freighters (original value $100M) are damaged to between 0 and -1×HP, so he spends five hours on each stripping them for useful parts, ending up with his $30M worth of replacement parts with which he can continue repairs.

Given the time and costs involved, a technician may attempt to repair *part* of a larger damaged component. For example, he may only want to repair a space station's subspace transmitter without worrying about normal-space radio, sensors, and internal communications, or (the old classic) get the ship's star drive up and running without fixing the sublight drive and ray gun turrets. This requires repairs to control and power components and focused repairs to the actuation component. Power and control components must be fixed so that no more than system HP/4 damage remains. The amount of damage to the specific item to be repaired is a fraction of the damage taken by the actuation component proportionate to weight, minimum 1 HP. ***GURPS Spaceships*** and ***GURPS Ultra-Tech*** can be used to approximate the weight (and therefore proportional HP) of individual items making up the actuation component.

Example: A grav bike (p. B465) is heavily damaged, taking 48 points of damage, allocated evenly at 12 points for each component. The driver just wants to fix the radio so he can call for help. The GM decides that the radio is equivalent to a medium radio broadcast communicator (***GURPS Ultra-Tech,*** p. 44). The bike is 800 lbs., while the radio is 5 lbs. The radio itself requires (5 / 800) × 12 = 0.075, rounded up to 1 point of damage repaired. However, the power and control components, which have taken 12 points of damage each, must have 5 points of damage each repaired before the driver can plug in the radio and turn it on.

A mechanic also may try to cut corners while repairing a system by not doing all of the repairs. However, there are drawbacks for each one.

Actuation: Without actuation components repaired, the system won't be able to do anything. However, there may be times when a mechanic wants to repair other systems for cannibalization.

Control: Without functional controls, only simple on/off operation is possible. Weapons fire immediately, continuously, and unaimed. Vehicular engines operate at full power and without the ability to steer them. Sensors cannot be tuned, optimized, or redirected. Moreover, even activating or deactivating the device takes four times as long as usual and requires a skill roll.

Power: Like actuation, most devices cannot operate without power, but a mechanic may opt to bypass an existing, badly damaged power system in favor of a different but functional one.

Safeties: A system can operate without safeties, but if something goes wrong, it goes wrong *badly*. If safeties have not been repaired to less than system HP/12 damage remaining, roll 3d6 on *any* subsequent failure with the system. On a 14 or more, the failure becomes a critical failure; at the very least, the system stops working.

Example: Knowing that the pirates may come back, Fergus is in a hurry to get things up and running again. Over time, he repairs 75 points of damage on the power component (125 points of damage remain on that component) and 25 on controls (again, 125 points of damage remaining).

If there were a particular small component that Fergus absolutely needed to get running, such as a teleport projector or a single weapon, it would probably take a single successful repair roll to get that particular part of the actuation component operational. Absent that, there's more work to be done to get the ship moving. Fixing 75 points of damage on the entire actuation component (again, 125 points remain) gets the engines barely up and running again. However, safeties are still out, so any problems that later arise are likely to become crises.

Component Repair and Jury Rigging

Swapping out components also can be used as a method for jury-rigging devices that are in good repair but inoperable for other reasons. For example, an alien vessel with readout screens displaying infrared or using ultrasonic sound output might be adapted for human use by swapping out control components, or an alternative ultra-tech crystal power generator might be wired into a system where the more conventional main power plant has run out of fuel.

Instant Repairs

Sometimes, slow and steady repairs, reliable though they are, aren't enough. In order to fire the weapon, call for help, or head for the hills, a system has to work *now*. On any system that has taken damage up to -5×HP without being destroyed, a sufficiently desperate mechanic may attempt *instant* repairs, performing fragile but focused repairs that restore tenuous functionality. However, it takes a deeper understanding of how things work than just a good repairman's knowledge.

Instead of the usual repair skill, determine an appropriate skill for coming up with a novel approach to the problem, as per finding an "invention" skill (see p. B473). The engineer may roll against this skill once per day to devise an innovative way of accomplishing the task (four times a day for Gadgeteers, hourly for Quick Gadgeteers). The roll is at -2 for every multiple of HP the item has taken or part thereof. For example, a vehicle that is down to 0 HP requires a roll at -2, -4 if it is down to -1×HP, and so on.

Once this "concept" roll succeeds, actual repair work can begin. Pick *one* appropriate skill for the repairs. Divide the amount of damage the item has taken by twice the technician's skill (three times skill for a Gadgeteer, four times skill for a Quick Gadgeteer). This is the number of hours required to attempt the solution. The repair roll is subject to the same penalties as the concept roll. If the roll succeeds, the *entire* system becomes functional once again: controls, power, and so on. However, it does not recover any HP, and if it takes any damage, it stops working again.

Instant repairs depend on unique inspiration and insights, and result in very unusual work, so much so that others may find it difficult to do more orthodox repairs. Anyone not involved in planning or carrying out the instant repairs is at -2 to work on the system until they've figured out how it was done; treat as familiarity.

Example: Before starting work on the safeties component, Fergus gets word that the pirates are on their way back to finish off the freighter. The ship is still under 0 HP (175 HP have been fixed, 525 remain to be repaired); it has the right components in good-enough shape to be barely operational, but its performance is halved, and without safeties working, it could easily blow itself up before the pirates get to it. Fortunately. Fergus is a Gadgeteer and has Engineer (Starship)-15. The ship is between 0 and -1×HP, so he's rolling at an 11 four times a day to think of something terribly clever. Once that roll succeeds, the GM determines that the relevant skill to fix the ship is Electronics Repair, which Fergus has at 16. The repair attempt takes 525 / (16 × 3) = about 11 hours of work. If the pirates don't get there by then, Fergus has to roll against a 12 get all the right connections made so that he can safely spin up the FTL drive and get the ship to a safe place for full repairs.

About the Author

Matt Riggsby's earliest memory is an original broadcast of the *Star Trek* episode "That Which Survives." Since then, he has cobbled together an MA in archaeology, followed a career in emergency repairs on databases, manufactured cake layers with dental equipment, and improvised surveying gear in a hole in Cyprus. He has assembled a household from a wife who helps hold things together, as well as a third-grader and several dogs who present endless opportunities for repairs.

The Doctor: Oh, tut, tut, tut. That scanner's not working.

Sara: Can you mend it?

The Doctor: Yes, I shall have to repair it, of course. Yes, yes. But that means checking the whole circuit.

*– **Doctor Who** #3.15 (1965)*

Future Home Tech

by Alan Leddon

Many of the tools and devices found in a home are based on the latest technologies – home lighting by candles was once state of the art! Microwave ovens are a development of radar technology, and home-computer technology advances with incredible speed (resulting in "planned obsolescence").

As a culture develops toward what would be considered ultra-tech (TL9+), personal gadgets and home furnishings will advance alongside transportation, weapons, power sources, medicine, and other technologies. Although in earlier TLs, such items can be safely glossed over, at higher TLs, the sheer functionality of a sofa or personal data device can make it a useful item of adventuring gear; no doubt, a creative player can find a myriad of uses for any "ordinary" item at higher tech levels.

It is always sad when someone leaves home, unless they are simply going around the corner and will return in a few minutes with ice-cream sandwiches.

- Lemony Snicket

Bearing in mind the sheer range of capabilities now available in affordable devices, it seems only reasonable that TL9 and higher gear will be capable of a huge range of functions not typically considered in RPGs. Consider the typical iPod or similar device in the modern TL8 world: Available applications range from a mind-boggling number of games, to a "flashlight" function, to appointment calendars, and far more. A single such device can be programmed with hundreds of functions. Personal reading devices at TL8 can have enormous capacity, with the upper levels likely storing more books than a human can read in a reasonable lifetime. Already in the real world, there exist washing machines that can email the owner to tell him that the current load is done. At TL8, it is possible to purchase a vacuum cleaner that navigates a room without supervision, and automobiles can park themselves. Technology exists in the real world now to resolve recognizable images from scans of human brainwaves and allow mental impulses to direct robotic limbs.

For all of the items that follow, the following capabilities are assumed.

- They accept voice commands. Devices may receive their commands from a number of specified individuals (recognizing the voice profiles of those people) or from anyone.
- Devices at TL9+ are able to recognize some gestures – communications equipment is muted by a finger drawn across the user's throat, lighting turns on when pointed at, etc.
- They have some form of response capability, most commonly the ability to project information onto a nearby flat surface (within 6', perhaps). This information will include at least the current status of the device – temperature, whether it needs cleaning or repair, if it is in use, current power level, etc. The information available also provides the current time; everything can keep time at these tech levels.
- Storage units can describe their contents; food storage devices can indicate if items have gone bad or otherwise need to be replaced.
- Units at TL10 and above display the above data directly on their housing, no screen required; this is a limited version of chameleon technology (***Ultra-Tech,*** p. 98).
- Devices can network with more "capable" units – every device in the house can tell the resident's personal communication device anything that the resident needs to know (the laundry is done; the pasta is overcooked; an intruder has been detected; it is time to wake up).
- All items have visual and audio recording ability, typically (TL×4) hours. This may be triggered by a specific event ("if someone sits on you during the hours between 0400 and 0800") or on command.
- All household furnishings and appliances have limited self-cleaning and self-repair capability; this might be limited to reconstructing its own software, or may include the ability to remove dents from its own housing, and vibrate soil and liquids into a waste container.

Biosynthesis Station (TL9)

The biosynthesis station is used to custom manufacture organic materials that may be needed from time to time. It typically builds proteins from an on-board supply of amino acids. Other organic compounds (vitamins, fats, oils) can be synthesized by first assembling proteins that act on other chemicals to make these materials. A typical unit is able to manufacture materials such as cleaning enzymes, cornstarch, egg whites, silk thread, a few kinds of glue and paint, various simple medications (a pain reliever, insulin, vitamin pills), and maybe a few more items. The station is typically 6′ tall by 3′ by 3′ at TL9, becoming 1′ shorter at each TL above 9. The station costs $5,000 at all TLs; it weighs 400 lbs. at TL9. Refill canisters of amino acids and other raw materials cost $200 and weigh 30 lbs., they will produce 15 lbs. of organic materials at TL9 (18 lbs. at TL10, 21 at TL11, and 24 at TL12). It takes one minute to make 1 lb. of a desired material. The station always knows how much additional material can be produced from the current canister.

Mind-Reading Machines

Modern real-world technology has advanced to the point that a computer can display accurate and recognizable images derived from measuring the brain waves of a human subject. Similarly, human and monkey brainwaves can be measured and translated accurately into commands for a robot arm to manipulate objects. With so many possible applications, this technology will no doubt continue to be developed into the future.

The GM may choose to adopt broadly applicable variant rules to simulate these developments. Any device capable of voice command, gesture recognition, or body-language interpretation can have mind-reading technology instead, at no additional cost. The advantage of mind-reading tech can be simulated with quicker response times, as there is no need to delay the machine's action by sending signals through slow-to-respond wetware. This might be especially important in combat gear. Similarly, the ultra-futon (p. 33) can use brain waves to keep the sleeper completely comfortable, and the smart stove (below) can prepare food to the diner's precise desires.

Power Pantry (TL10)

This short-lived product is available in various sizes during its tenure. It can store a variety of food stuffs in individual energy fields that dramatically retard the spoilage of the foods. It is replaced at TL11 by the foodfac (***Ultra-Tech,*** p. 70).

Foods are taken out of the device at room temperature (unless they are supposed to be cold, like ice cream and ice cubes), with no damage caused by the machine. An item that would spoil in a day will last a full week in the device, and other spoilage times are likewise multiplied by a factor of seven. Sogginess, mold, and decay are all prevented or slowed. The individual energy fields are tailored to the item they are protecting; fruit may be stored next to bread and ice cream without any concern for the different needs of the different items. It works on outside power, or for 36 hours/capacity in cubic feet on a C cell.

Power Pantry (TL10): $800, 24 lbs., plus $100 and 8 lbs. per cubic foot of capacity (minimum two). LC6.

Smart Stove (TL10)

A smart stove is a flexible mat about 1/2″ thick. The area of the unit depends on the number of burners the device has – generally one square foot per burner. They may be rolled, folded, or simply stored flat when not in use.

Smart stoves are unfolded and placed on a flat surface for use. Food is put in containers on top of the burners, and verbal commands issued ("heat this water to boiling"; "cook this human leg to 130° on the nar scale"). The stove itself does not get hot; rather, it directs any of several possible energy types into the food (or other items) to be heated. The surface of the burners may be safely touched at any time, and materials left on the stove will be undamaged if the stove is not told to cook them. Cooking typically takes 3d seconds, although the GM should adjust this upward for large quantities of food. Users may verbally order a longer cooking time, for example when cooking a gourmet dish, or when planning to eat at a specific time. The stove's programming prevents burning food or damaging cooking vessels. If the stove does not have access to house power, each burner can cook for up to 12 hours on its own A cell.

Smart Stove (TL10): A one-burner stove: $200, 4 lbs. LC6. Add $75 and 1 lb. for each additional burner.

Smart Table (TL9)

A smart table is the next development from tables found throughout the world for much of history. The defining characteristic of a smart table is that its upper surface is a programmable chameleon surface (***Ultra-Tech,*** p. 98). Most smart tables can display maps, boards, and pieces for a variety of popular games, and show a floorplan of the home, displaying the status of all of the other appliances and devices, as well as the location of living creatures. Fancier tables are able to change color and pattern to fit in with the furniture around them, or to match holiday decorations. Basic smart tables start at $4,000, 4 lbs., and LC6 for a dinner tray or a children's drawing table, and can reach $100,000, 1,000 lbs., and LC6 for a banquet table that seats eight.

Utility Tool (TL9^)

The utility tool is the advanced version of a multi-function pocket tool. It fits comfortably in the user's palm. The device includes a monowire cutting blade (***Ultra-Tech,*** p. 163) about 3″ long, one or more tools to open and close common physical fasteners, and one or more tools for grasping and manipulating objects too small to be handled with fingers. The tool also has adapters for various physical data ports, and can help the user to connect two or more devices (computers or equipped with computer controls) physically; it can also serve in place of a missing or damaged transmitter for common wireless-connection types. Common utility tools cost $100 and have negligible weight at TL9^.

Units with additional tools, the ability to interpret alien software, or other functions requested by the purchaser can reach up to $500. LC is typically 6, although, in some settings, paranoid governments may give it LC3 due to the monowire edge on the cutting blade. Schools, hospitals, and ports may restrict or forbid the carrying of the tool, classifying it as a weapon due to the presence of a cutting blade on it.

Used as a weapon, the monowire blade does sw+1d(10) cutting damage with Reach C, 1.

Ultra-Futon (TL9)

This is a pretty standard item of furniture, known by scores of names in any culture it is found in. It comes in various sizes, typically sized for a small child, a medium child, a small adult, two adults, or two adults with lots of extra room. The device includes a small processor able to read and interpret the user's body language as he tries to become comfortable; this device alters the firmness and temperature of its cushions in response to the comfort level of the user, ensuring the user experiences complete relaxation at all times while using the bed. Almost all such units have small motors enabling them to change their configuration between a bed, a lounge chair, or a couch. The mattress is kept in place by thousands of tiny grippers, and never slides off the frame. The mattress changes its dimensions to accommodate the current arrangement of the frame. The units include the effects of responsive beds (***Ultra-Tech,*** p. 69).

Small Ultra-Futon (TL9): Suitable for a child. $700, 140 lbs. LC6.

Medium Ultra-Futon (TL9): Suitable for a human teenager; seats two as a love seat. $800, 160 lbs. LC6.

Large Ultra-Futon (TL9): Suitable for a human adult; seats three as a couch. $1,000, 180 lbs. LC6.

Double Ultra-Futon (TL9): Suitable for two human adults; seats four as a couch. $1,250, 200 lbs. LC6.

Queen-Sized Ultra-Futon (TL9): Suitable for two human adults with a bit of extra space; seats five as a couch. $1,500, 250 lbs. LC6.

King-Sized Ultra-Futon (TL9): Suitable for two human adults with a lot of extra space; seats six as a couch. $2,000, 300 lbs. LC6.

Survival Feature: Add +50% to cost, +20% to weight. The mattress can provide adequate heating and cooling (+3 HT rolls to resist injury due to a hot or cold environment); this works for (4 + TL) hours if the bed does not have an outside power source.

Adventure Seeds

Check His Pockets! Modern-day protagonists come across a crashed spacecraft from an advanced culture (several TLs above their own). Among the items that remain functional are some of the devices described above. The adventure begins as the investigators try to discover how these devices function . . . but the real adventure might be in hanging on to them, or finding applications for them.

Devil's Due: The adventurers are hired to transport "a load of furniture" to a distant and ultra-conservative planet. The furniture in question is a load of ultra-futons. The destination has no particular laws against the cargo, and the merchants easily offload their cargo. However, shortly after the first purchases are made, the group finds out that "the Committee for the Prevention of Vice" is looking to have a . . . conversation . . . with them.

Get It All Back: The party is contacted by a space faring agency of their culture, such as the patrol or the navy. They are offered the contract to check on a scientific outpost on a primitive planet that has fallen out of contact. They are to rescue survivors, recover technological equipment, bring home bodies, etc., as required to minimize contamination of the native culture. When they arrive, the "hidden" outpost has been raided, and the household and personal items of the missing scientists have been traded far and wide by the locals.

Keep the Secret: A wealthy and prestigious civilian organization has contacted the adventurers, offering a large sum to recover some missing household items. One of the organization's officers has absconded with a shipment of everyday goods, set up house on a prespaceflight world, and is preparing to "invent" the stolen items to become wealthy. The organization wants no official involvement, wants all of the items recovered, and does not care about the fate of its missing officer – so long as neither the natives nor the authorities get to talk to him.

About the Author

Alan Leddon lives in Madison, Wisconsin, where he spends far too few hours per week involved in roleplaying games. He passes the wasted nongaming hours in pointless pursuits including working, sleeping, and talking to strange people in black outfits who call themselves "Mr. Smith" and "Mr. Jones."

Alan is saving up toward his next home, which will feature a balcony over the gaming room, from which Alan will GM. He is looking forward to the day when he can look down upon his players and thunder, "Thou shalt roll a Fright Check at -2!"

Science fiction, outside of poetry, is the only literary field which has no limits, no parameters whatsoever.

– Theodore Sturgeon

The Killer Cleanbot

by Michele Armellini

Number 73, as you'll have guessed, that stinging in your back means this harmless-looking office is the place where you die. Or where you would die, if this weren't an exercise. Trainee, you failed to notice your killer, just like I wouldn't have noticed, when I was your age, a waste-paper basket . . . We used paper for office work, back then. But baskets couldn't kill you.

By 2030, automated semi-intelligent devices will be able to carry out everyday menial tasks. Therefore, such things will be ubiquitous. Today, people don't pay attention to a microwave oven in a kitchen, or a waste-paper basket in an office. Tomorrow, nobody will register the presence of a vacuum-cleaner robot.

User Instructions

Three options are possible for applying this concept. In its simplest form, the device could be a mere tool and weapon, if sophisticated and wicked. It would need remote controlling; in this incarnation, it is technically feasible even today – an urban, land-based version of an UCAV (unmanned combat air vehicle).

The killer vacuum cleaner, however, really comes into its own at TL9, as a true robot. By that time, its computer can host some basic form of artificial intelligence (AI) that, although programmed, can take independent decisions and action. This would be a Low-Sapient AI in a ***Transhuman Space*** setting, while the hardware would be called a "cybershell." Such an option would make the device and its controlling intelligence suitable as an effective NPC – a valuable asset, if it's on the heroes' side, a lethally devious enemy otherwise.

Finally, this seemingly innocuous household appliance could be fitted with an advanced computer, one complex enough to host a fully developed AI. This would be suitable for PC status and would make for a peculiar adventurer!

Model AS2174-03

The opaque product code is intended to deflect casual interest in these killer machines.

Sheep's Clothing

The device is immediately recognizable as a familiar household mainstay: a cylindrical, automated vacuum cleaner. The default appearance includes the color livery and logo of a well-known and respected European producer of these items, Hauswerk AG. The model is the common but obsolete SSR-3 (SSR stands for Staubsauger-Roboter, robot vacuum cleaner). However, the outer body work and logos can be replaced to match whatever robot household devices are in use in the building to be penetrated. All of that gives the robot the equivalent of an Honest Face perk.

The impression that this is an outdated, unremarkable, and thus harmless appliance is reinforced by any interaction with it. While most robots have a warm, attractive voice, this vacuum cleaner comes with an old, unpleasing sound synthesizer. Additionally, its replies are standardized and plodding, when not stupid. People don't question it for long.

It moves slowly, on four small wheels, on flat surfaces; stairs seem impassable obstacles for it. It seems to have two small photoelectric sensors, and two short arms to collect small litter. Its main function is to suck up dust with an underbody air pump. It also features a straight, small third arm with a secondary pump to clean hard-to-reach spots, though this seems not to be functioning.

The vacuum cleaner is always noisy when it's on. While this prevents it from being stealthy, its modus operandi is to hide in plain sight. Thus, its constant whirring soon gets classed as background noise to be ignored. Along with its noise, its presence is ignored too.

All of this is to deceive the target.

Wolf's Fang

The killer cleanbot's actual capabilities are quite different.

The robot can work as expected for some 20 minutes. After that, it will have to reach a discharge station and unload the dirt. Most of the space that a real cleaner would dedicate to collected dust is taken up by hidden devices.

Its actual wheeled movement is faster than expected. If it uses its small arms, it can go up and down stairs, albeit slowly.

Its "eyes" are much more sophisticated than they appear. It can see in the dark, and it isn't easily blinded. Its secondary function, in fact, is to act as a spy. Indeed, it can store hundreds of hours of surveillance images. It can carry away all that intelligence with it, if it leaves the building it's working in; or it has various ways to send it out. It can download the intel into some other device, even the building's systems themselves if their security has been breached. This connection capability may also be used to mine electronic data from within a system that is unassailable through remote links. Alternatively, one of its Accessories is an expellable memory storage.

If the waste is processed within the building, it can plant this device on a human employee leaving the premises. If not, nothing could be easier than just dropping the memory stick into the garbage! Other agents, working with the waste-disposal firm, will retrieve it later. Radio communication is a last resort; the agency that built it does not believe that such a thing as secure radio signals exist, so they didn't even bother with a scrambler.

But this robot's most important function is as a killer. The additional suction arm disguises a weapon mount – this usually holds a commonly available machine pistol or submachine gun. The specific weapon varies, but the H&K MP7A1 (***GURPS High-Tech,*** p. 126) or 4.6mm PDW (p. B278) are typical. Its preprogrammed preferred method is to wait for the mark to be alone in his office. Such a gun isn't particularly powerful, but it's more than enough for an unwary, unarmored human. The "suction tube" incorporates a silencer, and the report is also covered by the robot's own whirring.

The killer has good chances to get away unscathed. Its Payload includes a separate chamber containing a recently fired case of the relevant caliber. This can be placed under the furniture, as if the killer retrieved all cases but missed this one. It will point to a human murderer, an amateur using an antique automatic pistol. The agency usually finds a scapegoat that can be framed by planting the actual pistol that fired that case in his home, or office, or vehicle. The bullets that are actually used normally fragment on impact, and thus can't be matched.

Finally, the robot is tougher than an ordinary vacuum cleaner. Hitting it with a chair or hosing it with water or a chemical extinguisher won't stop it.

Detective Spooner: What if I am right?

Lieutenant Bergin: Well, then I guess we're gonna miss the good old days.

Detective Spooner: What good old days?

Lieutenant Bergin: When people were killed by other people.

– ***I, Robot***

AS2174-03

104 points

Attribute Modifiers: ST-2 [-20]; HT+1 [10].
Secondary Characteristic Modifiers: SM -2.
Advantages: Absolute Direction (Requires Signal, -20%) [4]; Acute Vision 2 [4]; Damage Resistance 8 (Can't Wear Armor, -40%) [24]; Doesn't Breathe [20]; Enhanced Move 1 (Ground) (Road-Bound, -50%) [10]; Extra Arms 1 (Weapon Mount, -80%) [2]; High Pain Threshold [10]; Infravision [10]; Injury Tolerance (No Neck) [5]; Machine [25]; Payload 2 [2]; Protected Sense (Vision) [5]; Reduced Consumption 2 (once a day) [4]; Sealed [15]; Telecommunication (Cable Jack; Video, +40%) [7]; Telecommunication (Infrared Communication) [10]; Telecommunication (Radio; Video, +40%) [14]; Temperature Tolerance 2 [2].
Perks: Accessories (Igniter; Microframe Computer; Removable Memory Storage; Vacuum Cleaner); Honest Face. [5]
Disadvantages: Disturbing Voice [-10]; Ham Fisted 1 [-5]; Horizontal (Accessibility; When Negotiating Obstacles, +80%) [-2]; No Legs (Wheeled) [-20]; No Sense of Smell/Taste [-5]; Noisy -1 [-2]; Restricted Diet (Very Common, Power Cells) [-10]; Short Arms [-10].

The Mind in the Barrel

The following is the low-sapient AI that is normally installed in the cleanbot's Complexity-7 microframe computer. The agency using this robot has specifically designed it, tailoring it to the task. It has a bland, meaningless name, "Roscoe," but human agents predictably nicknamed it "the Cleaner."

It can connect to and use computers within the target building, and search for data, but it is no hacker; any protective measures have to be circumvented for it by someone else. It can clean floors, it can play the part of a non-sapient AI, and it can shoot.

"Roscoe" is different from most LAIs. While the agency owns copies of it, each individual "Roscoe" can't access them; thus it can't rely on a backup copy. It is exempt from many usual restrictions, and even its agency never really trusts it – understandably, given that it is a killer AI. Therefore, it is hardwired in the cleanbot's microframe, and only its agency can download it anywhere else. As an added security measure, "Roscoe" can't survive for more than a month. This will prevent him from going rogue and will reduce the chances that the opposition can draw intelligence from it. The motivation for "Roscoe" to succeed is the promise that if everything will run smoothly, it will be used again – thus delaying its death sentence.

On the plus side, "Roscoe" needs to understand human motivations in order to come up with a refined assassination plan. Thus, unusually for a LAI, it is not disadvantaged by Low Empathy.

This AI comes with the Social Stigma (Subjugated) that is usually attached to non-sapient AIs. This is because it is assumed to be exactly that! However, anybody knowing the truth would *still* hate it as a fearsome inhuman murderer – this would be Social Stigma (Monster).

Here is the killer cleanbot with "Roscoe" installed in it.

Roscoe the Cleaner

169 points

ST: 8 [0]; **DX:** 11 [20]; **IQ:** 10 [0] **HT:** 11 [0]
Damage 1d-3/1d-2; BL 13 lbs.; HP 8 [0]; Will 10 [0]; Per 10 [0]; FP – [0].
Basic Speed 5.50 [0]; Basic Move 5 [0]; Move (Road-Bound) 5/10; Dodge 9*.
2'8"; 65 lbs.; SM -2.

Advantages

AI [32]; AS2174-03 Cybershell (Microframe) [104]; Computer Brain 3 (2, 2, 2) (Limited Integration, -20%; Skills and Languages Only, -10%) [30]; Enhanced Time Sense [45]; Fearlessness 2 [4]; Indomitable [15]; Possession (Digital, -40%) [60]; Unaging (IQ Only, -75%) [4]; Visualization [10].

Disadvantages

Bloodlust (15) [-5]; Callous [-5]; Duty (15 or less; Extremely Hazardous) [-20]; Hidebound [-5]; Social Stigma (Subjugated) [-20]; Terminally Ill (Up to one month) [-100]; Wealth (Dead Broke) [-25].

Quirks: Attentive; Broad-Minded. [-2]

Skills

Acting (A) IQ+1 [4]-11; Computer Operation/TL9 (E) IQ+3 [8]-13; Guns/TL9 (Submachine Gun) (E) DX+3 [8]-14; Housekeeping (E) IQ [1]-10; Observation (A) Per [2]-10; Photography/TL9 (A) IQ [2]-10; Research/TL9 (A) IQ [2]-10.

* Includes +1 from Enhanced Time Sense.

"Roscoe" the PC

As described, the LAI is most suitable as a short-lived NPC. Nonetheless, it might make for an interesting and challenging PC. That would probably mean it's developing higher intelligence, exactly the threat its own agency is worried about. In this case, its first objective should be circumventing the software time bomb that will erase it. It can't do that on its own – but that's what other friendly PCs are for! Maybe the PCs are agents who know "Roscoe" and who the agency likewise intends to terminate. "Roscoe" might find some leverage on them and ask them for help. A skilled hacker should be able to deactivate the self-destruct commands – hopefully without triggering alarms.

Once that is achieved, "Roscoe" might wish to get into a more advanced cybershell, to make copies of himself, and in general to behave like the rogue AI it has become. All of that means another adventure in its own right.

Deploying the Cleanbot

There are many ways in which this robot can be used.

The Agency

The owners and users of this robot are left for the GM to customize. Clearly they aren't averse to "wet" work, but maybe they mostly use "Roscoe" for espionage. They have no problem with designing and using a killer AI, which would be in itself one of the worst crimes in most jurisdictions. They might be a governmental agency, a powerful terrorist organization, or an immensely wealthy and ruthless corporation.

The reason why no price tag is provided, either for the cybershell or the AI, is that they are entirely designed, developed, and built in-house.

Locations

Cleanbots in the shape and size of AS2174-03 are commonly used in office buildings, hotels, hospitals, and shopping malls. Homes tend to use a number of smaller, flat devices. The agency initially developed the robot for industrial espionage, so offices or factories were the obvious target locations. If the agency wants to remove a target that works at home and seldom visits hotels or public buildings, they'll resort to other means.

In some buildings, all cleanbots are controlled by a central AI. In these cases, the building's intelligence has to be hacked, so that it will not notice the cleanbot that goes about on its own. As for "Roscoe," he will need to act as a remote-controlled drone.

In and Out

Deploying the robot implies a wider operation and some degree of penetration in the target building. At the very least, agents must infiltrate the company that handles cleaning and waste disposal. If that is accomplished, then it will be easy to pay a regular maintenance visit and "repair" one of the normal cleanbots – actually swapping it with the killer.

The same trick can be used to get "Roscoe" out, especially if the mission was mere espionage. Even if a murder was committed, after a few days – especially if a colleague, business associate or relative of the victim has been framed – life will go on, including "maintenance."

In emergencies, "Roscoe" can use its igniter to set curtains afire. Although most buildings have sprinklers and fire alarms, the fire is intended as a distraction. Human guards don't care about vacuum cleaners while the alarms are ringing.

The Kamikaze Option

The agency has been considering the possibility of equipping the cleanbot with an explosive charge. This would be very unsubtle; until now, as far as the agency knows, nobody has realized that cleanbots can kill. If one exploded to commit a high-profile murder, security standards would be heightened everywhere. However, important targets who have already survived attempts on their lives might need to be dealt with in this way. This would also mean a strong incentive for "Roscoe" to go rogue, so the agency researchers are still trying to find ways for this to work. They could use something less intelligent, but that might not be able to act convincingly enough to get close to the target. The researchers are now toying with the idea of fooling "Roscoe" somehow, turning it into an unwary kamikaze after it has gained a foothold in the victim's office.

About the Author

Michele Armellini lives in Udine, Italy, with his very understanding wife, Silvia. He is fascinated by robots, both the real ones and the fantastic kind, and an avid reader of transhumanist books by Gibson and Sterling. He makes a living out of foreign languages, but he loves dabbling with and studying the obscure and the uncanny – and trying to convert them into game mechanics! Apart from material he published in Italian, he has written for *Pyramid,* and he is the author of ***GURPS WWII: Grim Legions.*** He is the author or co-author (with Hans-Christian Vortisch) of several e23 products, including ***GURPS WWII: Their Finest Hour, GURPS WWII: Doomed White Eagle,*** and ***GURPS WWII: Michael's Army.***

Random Thought Table

Echos and Repercussions

by Steven Marsh, *Pyramid* Editor

The other day I was poking the near-future science-fiction supers roleplaying game ***Aberrant*** with a stick, looking for a *Murphy's Rules* submission (see p. 39 for the results of those efforts). I ended up discarding many possibilities I found, but one stuck in my mind well enough that it made me go, "Hmm . . ."

To back up a bit: ***Aberrant,*** for those who don't remember, came out in 1999 but it was set in the "future" of 2008. This "future" contained a few bits of low-level ultra-tech brought about by the arrival of super-powered beings on the scene, but for the most part, their efforts at extrapolating the future were (naturally) based on a view of the 1999-present. This can be fertile ground for fun; see the *Murphy's Rules* from *Pyramid #3/15: Transhuman Space* for one such example.

However, I didn't see much that jumped out at me as just feeling wrong until I found one section in the core ***Aberrant*** book (on p. 237). There, it explains that one use of the research action is:

> . . . searching computer databases for historical facts . . . In all cases, the number of successes achieved determines the amount of information discovered; one success gives you at least basic information, while extra successes provide more detail.

Less "Research," More "Search"

I was somewhat puzzled by this, and puzzled by why I was puzzled, until I realized that this game was written *before* Wikipedia existed. By one reading of the ***Aberrant*** rules, doing a computer search for historical facts would require a roll (which your average person would fail about 36% of the time). Today, "searching a computer database for historical facts" for "basic information" has been rendered so mind-bogglingly easy it's hard to fully realize a time *before* it existed, let alone carried a chance of failure.

Admittedly, this observation comes with the standard caveats of the fallibility of Wikipedia. However, it's "good enough" to get a broad idea on a staggering percentage of topics. So transformative has this one website been that it remains quite probably my most-visited site, and I never need to feel lost when I encounter a random reference to *Little Nikita,* the unscrupulous diner's dilemma, or Harold Stassen.

What Does the CC: Field Stand For?!

One way to make a science-fiction setting come alive is to think of the odd repercussions that certain social decisions and technological innovations have. There are a number of examples in the world of entertainment:

- Fans of current television are often mystified by how slow-paced the shows of yesteryear are. (Arguably the most notable example is the pacing gulf between the original and current series of *Doctor Who.*) However, once upon a time, the only way to get television programs was with over-the-air analog reception – which often deteriorated depending on weather and range from the broadcast tower. In a tradition carried over from radio broadcast days, you didn't want some piece of vital information lost because inopportune static obliterated it. As a result, you ended up with lots of slow-tracking shots of (for example) the hero saying, "We'll be okay as long as no one deactivates the Force Field Defense Unit," followed by a shot of a man skulking in shadows fiddling with a large knob clearly labeled "Force Field Defense Unit," followed by the hero saying, "Oh, no! The Force Field Defense Unit has been turned off!"
- Another reason shows are more fast-paced is because there's literally less time; in the United States, the shows of yesteryear were frequently 51 minutes (sans commercials), but nowadays they're closer to 42 minutes. That's a lot less time for dallying!
- The uniforms and sets on the original *Star Trek* are such interesting colors for two reasons. First, they show off the possibilities of then-new color-television technology. Second, the colors chosen were meant to be of sufficient contrast that they were still comprehensible on black-and-white screens (since that's what most households still had).

Outside the world of entertainment, there are many other examples of odd repercussions that rise from technological or social decisions.

- In the United States, the increased affordability of automobiles and the omnipresence of cheap gasoline led to the rise of the suburbs (since people could more easily live away from the city), which in turn led to urban deterioration.
- The invention of air conditioning allowed people to live in previously undesirable climates.
- As an ancient example, the fact that most weapons are used right-handed likely led to the common gesture of shaking of hands (most commonly the right hand) as a sign of peace; if two people are using their right hands as a greeting, they aren't able to attack!

The Future Was Weird When It Got Here . . .

One easy way to use this idea in gaming is to consider the implications of specific inventions – not their *current* effect, but the effect they had on the setting as they evolved and progressed. Look at the list of "ultra-tech" technology that you want to have in your campaign, and choose a few elements that seem like they could have an interesting history. For each one, consider what that technology would have been like when *first* invented . . . and what that implies for the setting as a whole.

Number Games

Imagine a space campaign with reasonably fast interstellar travel (say, jump gates) and faster FTL communications. The heroes will be able to get messages from afar, but getting actual backup will be a while in coming.

Now, let's imagine the trajectory that FTL might have taken. Looking at the history of telecommunications, speed has increased, enabling more complex messages as time has gone by. Today, it takes less time to download a high-def YouTube video than it took to send a telegraph of a few words; what if a similar mechanic started at the beginning of the FTL-radio era?

What if the first FTL radio communications were mind-bogglingly expensive and/or slow . . . say, one digit per hour. In the early days of this system, it would be essential to come up with a communication method that would enable maximum possibility of a message being successfully received.

In this setting, scientists would have come up with a method of communication that increased the possibility of a successful transmission and mitigated the effects of an unsuccessful one. One method they might have devised is:

All communication is done via two-digit codes (at least at first). A single zero is reserved to initiate or end communication.

Assign each ship in the fleet a two-digit number that doesn't contain any even digits. (These digits might also do double-duty; for example, "11" might mean "captain," "13" might mean "second-in-command," etc.). Then, come up with a list of the most common or likely communication situations using two-digit numbers that contain only even digits (and no zeros). Here are a few examples.

22: Mission achieved; all objectives accomplished.
24: Most mission objectives accomplished; may be a problem or follow-up required.
26: Mission successful, but with complications.
28: Proceed/continue.
42: Hold.
44: Mission still in progress.
46: Mission in progress, but tending positive.
48: Mission in progress, but tending negative.
62: Mission or objective failed; not salvageable.
64: Mission or objective failed; could be salvageable.
88: Return to point of origin.

Thus a "communication" (in 24 characters) might resemble:

011440 ("Ship 11 is working on its mission. It's neither trending good or bad.")
0280 ("Continue.")
0112413640 ("Ship 11 has finished its mission, but there may be follow-up required. Something bad but salvageable has happened to our second-in-command.")
0880 ("Don't pursue the matter further. Come on home.")

Extrapolating this, there can only be 25 "named" ships in the fleet (at least at first). This should be fine; if we assume that FTL ships are expensive or controlled, we don't need many for the earliest days of exploration. In fact, if we limit it to *prime* numbers, then we have 12 possible ship "names."

Now, as the campaign's history evolved to its "present," we can easily assume that FTL communications eventually improved; communications might increase to four digits an hour, then four digits a second, etc. Eventually it gets to whatever level we want the campaign to be at (whether full video transmission or "Twitter 2525"). However, by imagining the backwards trajectory and projecting it to the present, we have any number of interesting holdovers from the earlier era that can continue to influence the "modern" setting:

- Ships are still given prime-digit "names." ("These are the voyages of the starship *Thirty-Three Thirteen*.") Officers are still referred to via their numbers in some instances.
- Many "holdover" codes remain a part of common language: "Captain, I think I'd call this a 22." "A-yep. Let's 88 outta here." In particular, "zero" is a great conversation starter and ender. ("Zero, Tara! Good to see you!" "Great to see you! I can't talk now; I have to run. Zero!")
- If the FTL communication evolved fast enough that there are still people who remember the "old days," there's probably a social brevity in those who got used to the quiet and terseness of the initial days. ("I just got a 32-word report from Admiral Shin." "Wow . . . he's chatty today.")

Hopefully, this one worked example can give you additional ideas of how society can be shaped by seemingly unrelated technological advances. As homework, consider what might happen if the first-generation replicators only created red objects (red would probably be seen as a "copycat" or inferior color), or if the first-generation portable laser weapons required a full palmprint to activate (weapons and fighting techniques would probably evolve to fit that requirement, remaining even once the requirement faded away).

About the Editor

Steven Marsh is a freelance writer and editor. He has contributed to roleplaying game releases from Green Ronin, West End Games, White Wolf, Hogshead Publishing, and others. He has been editing *Pyramid* for over 10 years; during that time, he has won four Origins awards. He lives in Indiana with his wife, Nikola Vrtis, and their son.

Odds and Ends

Ad-Tech!

GURPS Ultra-Tech has so many wonderful toys; how can the budget-limited consumer ever afford them all? One possible answer: Get someone else to foot part of the bill – with advertising!

Advertisements have long been used to bring the cost of goods to a more affordable level. Prior to TL8, this was primarily used to offset the production cost of mass media (most notably periodicals). However, starting with the rise of constant Internet and personal electronics, ads have helped to lower the retail price of other items as well. Today, ads are used to reduce the cost of many items (software, tablet computers, etc.), and there are no doubt ideas floating around to bring commercial messages to new avenues.

Presuming humanity's eyeballs don't melt into twitching masses as advertising's upward trajectory continues, it's reasonable to consider that some options will progress into the era of ***Ultra-Tech.*** Here is an optional rule to introduce advertising-supported tech.

To figure out the savings afforded by ad-supported tech, consider the obtrusiveness – how much of a distraction the ads cause the user *and* how frequently they get in the way. The former is expressed as a penalty, from -1 to -4, on rolls to use the device or notice anything subtle or hidden (as the ads are assaulting his senses).

The GM can choose from two ways to figure the latter. He can determine the circumstances under which the ads are distracting, and assign those circumstances a frequency; e.g., "The ads only get in the way when you're flying upside down, so we'll call that 'quite rarely.'" Or he can roll every time the item is used (every minute for continual-use gadgets) to see if the ads cause a penalty.

- Quite rarely (6 or less): -5% to the item's cost per -2 distraction penalty.
- Fairly often (9 or less): -5% to cost per -1.
- Quite often (12 or less): -10% to cost per -1.
- Almost always (15 or less): -15% to cost per -1.
- Constantly: -20% to cost per -1.

If there is a stigma or similarly limiting disadvantage associated with using ad-tech, apply another -5% to cost per -1 to reactions (or similar inconvenience) it imposes. No matter what, this cannot reduce the item cost below 20%; treat any cost break better than -80% as -80%.

Example: The SwimFun Gill is a standard artificial gill ($2,000; ***Ultra-Tech,*** p. 177) that streams ads for restaurants to swim to, things to do back on dry land, etc. On a 12 or less (each minute), the ads give the user -2 to use the gill or notice things out of his immediate field of vision (-20%). As well, the SwimFun is considered a "plebeian" breathing device, incurring a -2 reaction from the mid-to-upper class, seasoned divers, etc. (-10%). The final cost is $1,400 ($2,000 × 0.70).

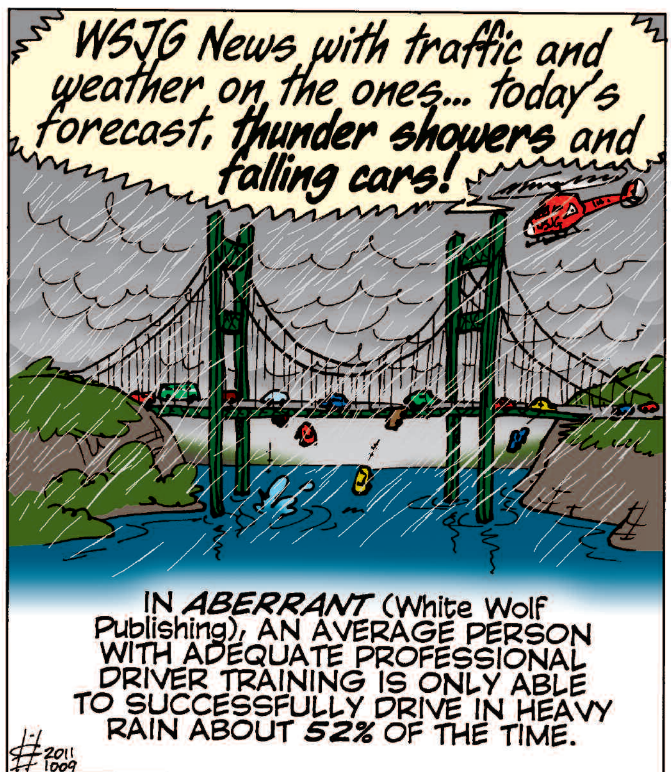
In a dystopian, ad-filled future, the default assumption may be that *all* tech is plastered with as many ads as it can support! In that case, simply figure out how disruptive the advertising is, and *reverse* the cost modifier to find the relative price of an ad-free version. For example, if all tech causes a constant -2 penalty from ads, an ad-free biomedical sensor (normally $200) would cost +40%, or $280!

Not Available in Stores . . .

It's always the GM's prerogative whether any specific ad-supported tech is available; lots of technological innovations simply can't stream advertising. Likewise, even if ad-tech is attempted in a device, there are likely to be a number of limitations, such ad-tech having fewer features and lower-powered specs than traditional tech or even being discontinued by the manufacturer.

Murphy's Rules

by Greg Hyland



Got a *Murphy's Rule* of your own? Send it to **murphy@sjgames.com**

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GURPS rules and statistics in this magazine are specifically for the ***GURPS Basic Set,*** *Fourth Edition*. Page references that begin with B refer to that book.