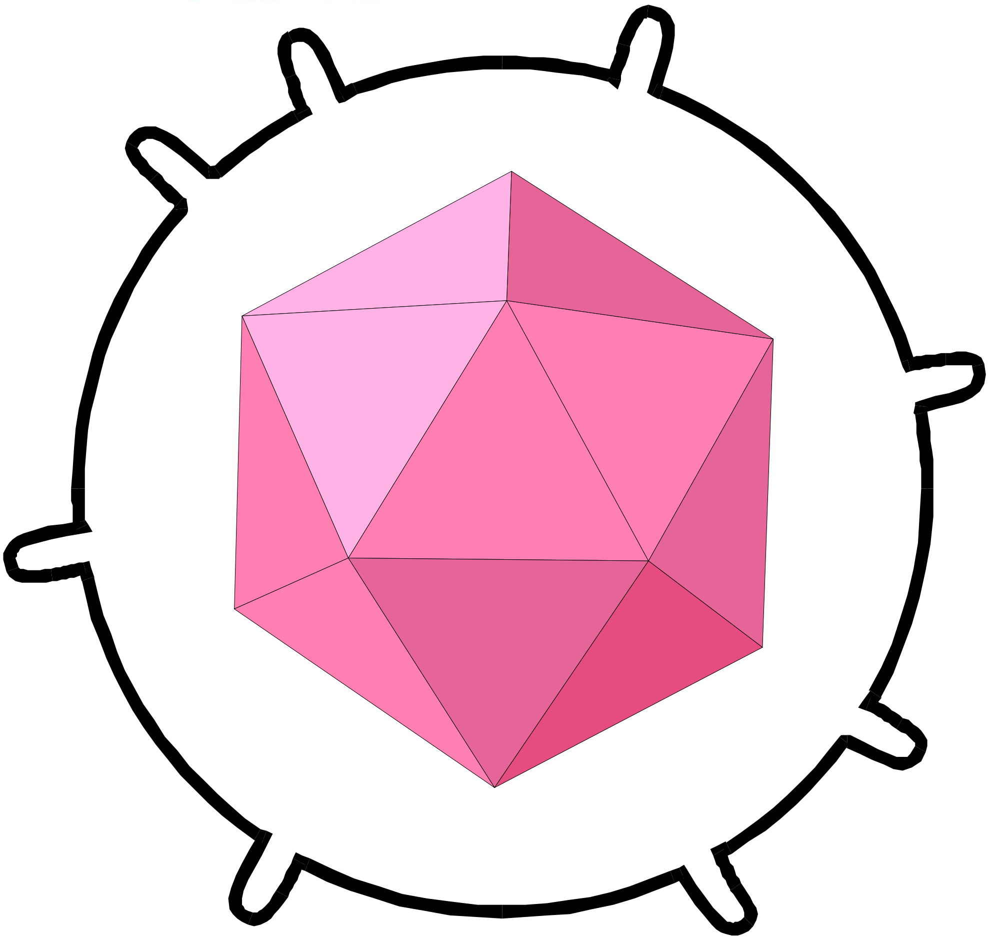
Northern Lights

Issue 2-97 May



Contents:

OFF THE TOP OF MY HEAD

Time flies when one is having fun, I have heard, so I reckon I have lots of fun. Making the AotA deadline is as hard as ever, though this is the second time in a row that I actually manage a contribution. (Actually, I am a few days late. I hope I make it anyway.)

This issue is a little bit thin. There is more RML material. Expect to see more more of it as the project plods along. The project is moving with all the speed of an arthritic sloth, but at least it is moving.

The piece de resistance of this issue isn't the RML update though, it is the nanotech article. GURPS has barely scratched the surface of all the fun that can be had in a nanotech campaign. GURPS also makes the assumption that nanotechnology is far off in the future, and that it will be expensive. In the essay I argue that it nanotech products will be dirt cheap, and no more than twelve years off. If you run a campaign that way, it won't fit with any other science fiction world in GURPS, but it can be fun, realistic, and a bit scary. Nanotech makes atomic bombs seem like party crackers. When we are talking nano, we are talking about stuff that can destroy the world in a week, if we are not very, very careful.

I started a new campaign, with nanotech of course, a couple of weeks ago, but you will have to wait untill the next issue for the scenario.

That's about it, I am afraid. I haven't even managed any mailing comments. Sorry, I just couldn't make it in time. I hope what little there is, will provide you with a few moments of diversion from the mundane.

I hope you enjoy this issue.

CU,

Henrik Mårtensson

Northern Lights was produced using FrameMaker 5.1.1, Corel Draw 7.0, Corel PhotoPaint 7.0 and a variety of other software. The computer platform was an XPAND Pentium 120 PC.

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Henrik Mårtensson
Januarigatan 26
S-415 15 Gothenburg
SWEDEN
Phone: +46 31 46 86 57
e-mail: henrik.martensson@swipnet.se
URL: http://www.io.com/user/hmmtek/index.html

Nano, Nano!

Nanotechnology in GURPS

By Henrik Mårtensson

GURPS provides a pretty thorough coverage of the Science-Fiction genre, from near-future Cyberpunk to far future super-science. However, there is one technological field that GURPS covers only very, very briefly, and only by providing a few high-tech gadgets. This is despite, or perhaps because, a break-through in this field would transform our world more profoundly than anything since the discovery of fire. It is the field of nanotechnology. This article is about designing game worlds and scenarios against the background of a nanotechnological revolution.

Except for a few referenses, GURPS deals with nanotechnology in two books, ***GURPS Ultra-Tech***, and ***GURPS Robots***.

GURPS Ultra-Tech deals with nanotechnology only indirectly. There are devices described, for instance living metal, chameleon suits, monowire blades, and chrysalis machines, that can be considered applications of nanotechnology.

GURPS Robots is a bit braver, devoting an entire chapter to nanotechnology.

Both books make two assumptions:

1. Nanotechnology will be very expensive.
2. There are technological complications that take hundreds of years to solve, before nanotechnology becomes an important factor in our society.

Both of these assumptions are made for one reason, and one reason only: game balance.

In the light of current nanotech research[1,2], it is far more likely that:

1. Nanotechnology will lower production costs of almost any device to a negligible amount.
2. The nanotechnological revolution will be upon us within the next fifteen years. Once the ball is rolling, technology will advance very fast. In GURPS terms, the world will go from early TL 8 to TL 14 in less than forty years.

In this article, I will examine both of these assertions, and discuss their technological and sociological implications, of course with an eye to campaign world and scenario design.

Let us begin with the basics of nanotech.

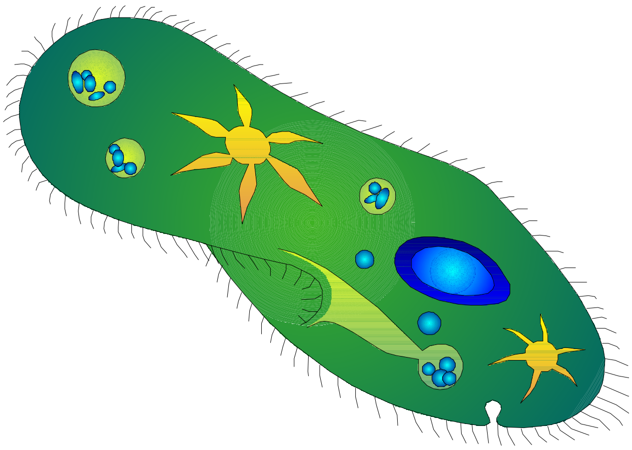
Nano, the basics

Simply put, nanotechnology is about designing and building robots that are small enough to work with individual molecules, or even atoms, of matter. Using such robots, called *assemblers*, it would be possible to build anything we can imagine, provided that the basic elements are available, and that the thing built conforms to the laws of nature. In theory, assemblers could build anything from a beefsteak to a starship. Plans for building a general purpose assembler capable of building a copy of itself, were developed at Xerox PARC in 1996[5].

There are still engineering problems to be solved, but according to the proponents of nanotechnology the first replicators are no more than ten to fifteen years away. Eric Drexler, the

first scientist to work out an engineering approach to building nanotechnological components[3], said as much before the Senate Commitee on Commerce, Science and Transportation, Subcommitte on Science, Technology, and Space, in June 1992[1]. The committee, headed by Al Gore, believed him. (This was a short time before Al Gore became vice president.)

Actually, we already have a few early nanomachines in the form of enginered bacteria, and even viruses.



E-coli bacteria were genetically reengineered to produce insulin as early as 1978[1]. While they are not general purpose nanorobots, and thus do not fulfill all of the criteria of general purpose assemblers, they are in fact self-replicating insulin factories.

Even more astounding, viruses have been reengineered so that they can invade cells in the human body, and actually repair damage at the genetic level.

This is where nanotechnology is today, in real life. The ball is rolling, and there does not seem to be much that can stop it.

Nanotechnological research has received increased funding in the U.S. In Japan, some of the major corporations are doing nanotechnological research. While the holy grail of the nanotechnological general purpose, self-replicating assembler has not yet been reached, both scientists and engineers are optimistic.

The nanotechnological revolution has already begun.

More than just a few new gadgets

Let us have a look at that first assertation I made about nanotechnology:

Nanotechnology will lower production costs of almost any device to a negligible amount.

How is that possible? The answer can be summed up in a single sentence, and it holds both the greatest promise, and the greatest threat of nanotechnology:

A nanotechnological assembler can build other assemblers.

Think it over! When the first assembler is built, the first real task it will get, after testing, is to build another assembler. The two assemblers will then build two more. Then there will be four assemblers to build four more. If assemblers are built, and immediately set to build more assemblers, they will multiply according to the formula

$$n = 2^{\frac{t_1}{t_0}}$$

where
n = The number of assemblers
t_0 = The time required to build an assembler
t_1 = The total time used to build assemblers

This means that assemblers can multiply fast. Assuming it takes an assembler 100 minutes to build a replica of itself, in 24 hours you will have 21,618 assemblers. In a week, the assemblers could devour the Earth. (To be more exact, starting with a single assembler, we would have $2.207107888183 \times 10^{30}$ assemblers after a week. Assuming that a nanorobot has a volume of $1{,}000{,}000\ \mathrm{Nm}^3$, large enough to have onboard computers, they would take up a volume of

$2{,}207{,}107{,}888\ m^3$. Give them another week, and they could eat the Earth.

Are you starting to get a little bit scared? You should be! Fifteen years from now, we may be sitting on a technology that can destroy the entire planet in a few days, if something goes wrong. Talk about having grabbed a tiger by the tail.

However, for our purposes we will consider other applications of nanotechnology, besides destroying the world. What if nanotechnology works the way it is supposed to? It can be scary enough.

One thing nanotechnology will do, is to flush the present global economy down the toilet. The formula on page 4 shows us that we can always build enough assemblers to meet any demand, as long as the basic elements are available. Feed the assemblers some iron ore, and some organic materials, like grass, and they can build more assemblers, a car, or an airplane, or a starship. Programming the assemblers may be a chore, but once that is done, all we have to do is to step back and watch. Some estimates predict that the cost of producing an ordinary car will fall to about $3.75[1].

Sounds great, until you realize that nanotechnology will not only be a cornucopia that provides us with everything we want, for almost no cost, it will also make jobs disappear. Practically every manufacturing job on the planet could be gone in a few years. With a large portion of the former tax payers unemployed and on well-fare, the economic system will collapse. In the west, unemployment could easily rise to over 90% in less than ten years.

To a scenario designer trying to create a believable world based on nanotechnology, this poses problems. A nanotechnological revolution is pretty much like the singularity of a black hole. We can trace the paths leading to it, and make reasonable predictions about when we will get there, but once we do, the old laws do not apply, and all bets are off.

Before delving into the sociological consequences, we will take a peek at some of the technological possibilities of using nanorobots.

Part 2: Nano Devices

Let's have a look at some of the most spectacular devices that nanotechnology will bring us. These are the things that will change the world around us, and the way we perceive it. All of the devices in this section are theorethically possible, most are described in the book *Nanotechnology*[2].

Let us start with the machine that will cause the most profound changes of all, the Replicator.

The Replicator

Available around 2010 A.D. The replicator is perhaps the most important nanotechnological gadget. It is a machine that uses a myriad of assemblers to build practically anything, including new assemblers. A small replicator might be the size of a microwave oven, and would be able to produce about a kilogram (a little over two ponds) of product per hour. This product can be anything that the replicator is programmed to build.

An industrial replicator is a scaled up version of the basic replicator. It can produce up to several tons of finished product per hour.

The replicator has a built in complexity 12 computer that controls the assemplers. Without orders from the central computer, the assemblers will not work. The assemblers will not be able to receive orders from the replicator if they are outside the replicator. This prevents assemblers from running amok building new assemblers.

The replicator requires no external energy source. Excess energy is a byproduct of the replication process.

The manufacturing cost of a replicator is less than $1. The retail cost is determined by the specific game world. (In "Utopia" on page 11, every citizen has a free replicator. In the world of "The Rising Dragon" on page 12, all replicators are industrial models owned by the state.)

Products built by the replicator

Products manufactured by a replicator are built atom by atom, each atom placed precisely at the right place (within the limits posed by quantum mechanics). This means that even very complex machinery can be built of a single piece of material, with no hidden structural weaknesses. For instance, except for parts that have to rotate freely, like the wheels, and some interior parts of the engine, transmission, and steering system, a car could be built in a single piece. There would be no rivets, bolts, or any other weak points. The material could just as easily be non-corrosive composite materials as it could be iron. The engine block could be a single giant crystal, molecularly bonded to the rest of the car.

In GURPS terms, all items produced by a replicator are of Very Fine quality (unless deliberately degraded). The materials used are the best that are theorethically possible. The cost of manufacturing an object equals the cost of the raw materials, plus the cost of transporting them to the replicator. In most cases, this cost is negligible.

Phased Array Optics

Available around 2012. Phased Array Optics (PAO) is a 3D display system with resolution equal to that of the human eye. A PAO display looks like nothing less than a window onto a scene, provided that there is enough data for the required resolution. A PAO display is flat, and may be transparent. This means that PAO displays could be built into glasses, or even contact lenses. They would be able to superimpose computer generated imagery on real scenery seen through the lenses.

PAO displays can produce images of anything appearing behind them, but they can also project images in front of them. This is much like the holodeck in *Star Trek: The Next Generation*, but

without the tactile capabilities. (For tactile response, Utility Fog is needed. See “Utility Fog” on page 8.)

PAO displays are typically included in other equpment, like computers and communication devices, so there is no separate cost for them. A PAO equipped data processing and communication system (audio, video, data) would cost \$1-\$3 depending on size and capabilities.

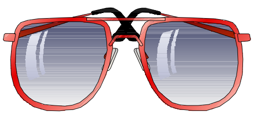
One interesting capability of PAO displays is the design of invisibility suits. *Passive* invisibility suits generate a still display exactly like the background. *Active* invisibility suits require a lot more computing power, but are able to generate contiguous scenery in real time. Such a PAO system would cover the whole body, and be 2-4 millimeters thick The system is able to scan and reproduce scenery from all angles at the same time. Invisibility suits are quite complicated.

Passive invisibility suits will be available from 2040 A.D. (Treat as *Chameleon Suits*, UT p. 85.)

Active invisibility suits will be available from 2050 A.D. Spotting an active invisibility suit requires a roll vs. Vision-6 when the user is moving 1 yard per second or less, and vs. Vision-3 if the wearer is moving faster. In close combat, all attacks at a person in an invisibility suit are at -3.

If they were freely available, invisibility suits would cost \$10, but legal restrictions raise black market prices to the listed levels in ***GURPS Ultra-Tech***.

The Companion



Available around 20012 A.D. The companion is a communications device and a personal supercomputer rolled into one. The standard companion looks like a pair of eyeglasses. There is also an implant version available. (The implant version is hooked up directly to audio and visual nerves, and is powered by blood sugar. It lacks the audio and visual amplification capabilities of the standard model.) The Companion has an onboard Complexity 10 computer with 1×10^{18} bytes of non-volatile RAM memory. (For those interested, such a computer would occupy about a cubic millimeter of space. The rest of the available volume is devoted to accumulators and peripherals.) It runs by solar power. Built in accumulators can power it for up to 30 hours of continuous use, without recharging. (Provided the radio communication system is not used.) The companion contains the following subsystems:

- Visual. The lenses are transparent Phased Array Optic (PAO) systems, capable of producing high resolution 3D images indistinguishable from reality. See “Phased Array Optics” on page 6. Mounted above the lenses are two video cameras for recording 3D images. The cameras can pick up infrared and ultraviolet light as well as normal, visible light. They can also provide light amplification under low light conditions. (Treat as *Multi-View Goggles*, UT p. 33.)
- Audio. Earpieces similar to present day hearing aids provide high quality audio feedback. The system can also function as a sound amplification system. (Gives +3 to all Hearing rolls.)
- Data storage. 1×10^{18} bytes of non-volatile RAM in the form of coded polymer chains. (The storage density is roughly equal to that of DNA.) Table 1 on page 7 shows how the memory is used. The figures are from the book *Nanotechnology*[2].

Table 1: Companion Data Storage

Use	Memory size
Free for personal use	10.0×10^{17} bytes
10,000 hours of movie and video	108×10^{12} bytes
10,000 hours of music	2.7×10^{12} bytes
10,000,000 books	100×10^{12} bytes
10,000 maps	13×10^{9} bytes

Table 1: (Continued) Companion Data

Use	Memory size
Courseware and knowledge bases	1×10^{12} bytes

- Communications. Optical infrared links and radio channel communication. The optical link can transmit more than 3×10^9 bits per second. Radio channels are limited to 500 kilobits per second. The communication system can scan up to one thousand communication channels simultaneously, and record and process the broadcasts. This is done without putting any extra load on the main computer.
- Power. Computer and memory draw less than 1 mW. Display, earphones and optical transmission use 100 mW each. Radio transmission use up to 5 W. Battery capacity is 10 Watt-hours.
- Interface. The main input interface works through speech recognition. Eye-motion tracking sensors allow control through eye movement. The PAO visual system can also project an image of a keyboard. The built in cameras can register hand movements, and register when a key is pressed on the virtual keyboard. Output is through the PAO lenses and the audio earphones.

The base cost of the companion itself is $1. This cost is often subsidized to $0 by various service providers, much like cellular phones are today. The real cost to the user is determined by the services subscribed to, like voice and data communication, radio and TV channels, databases, etc.

Utility Fog

Available around 2050. Utility fog is the most advanced application of nanotechnology described in this article. Utility fog is built from foglets, robots about the size of a human cell with arms sticking out in all directions. When foglets link up, holding on to each other, what you get is a sort of robot crystal. This is utility fog. To use utility fog, you fill a room with it, from floor to ceiling. To the naked eye, the room looks slightly foggy. Though the robots are linked to each other, there is plenty of space for air in the room. (Foglets take up only 5 percent of the total volume they occupy.)

The foglets can be programmed to exert force in any direction on any object in the room. They can make an object float, hold it to a wall, or keep it riveted to a wall. Foglets can also contract, and link up to make objects, cups, plates, PAO displays, a telephone, a chair… Foglets can link up to form just about any physical object.

The closest equvalent to a room full of utility fog is the holochamber in *Star Trek: The Next Generation*. Of course, utility fog could be used for many other things than recreation. In a sense, utility fog is the technological equivalent of mana. You can bend it to your will, use it to create invisible servants that do your bidding, levitate, create objects or illusions… Only the imagination of the user sets the limits.

In GURPS terms, each foglet is a robot with an onboard Complexity 2 computer. However, linked foglets function as a neural network, providing vast computing power.

Here are some of the things that utility fog can do:

- Provide a personal shield against any form of intrusion. The PD and DR would depend on the radius of the shield. Assume PD 5 and DR 100 for a personal shield with a 1 yard radius. A house full of utility fog, protecting its inhabitants from an external explosion, would have a DR of 1000+.
- Lift just about anything. Utility fog can excert a force of $6{,}89 \times 10^6$ N/m^2 (1,000 pound force per square inch) in any direction. (This is about 68 atmospheres of pressure.) Assume a ST of 50 if the area where force is applied is about palm sized. (Note that effective ST increases with the area on which force is applied. An area of utility fog large enough to form a contour chair, for instance, would have an effective ST of well over 1,000.)

Utility fog is free. A program that tells a replicator how to create foglets cost $50.

Nanomedicine

One area where nanotechnology, in the form of genetic engineering, is already used today is medicine. In the future, it might be possible to use nanorobots to rebuild humans, from changing the skin texture to rebuilding the bone structure.

Nanorobots could even be set to clean up arteries, and fix damaged cells, in effect halting, or even reversing the effects of aging and disease. Most super advanced medical technology is however pretty well covered in GURPS Ultra-Tech and GURPS Robots, so I will not delve into it here. Suffice it to say that the medical TL will be 13+, and costs of medical equipment will be divided by 4,000, compared to the GURPS standard price. The factor restricting availability of medical equipment will be legality, not price. For instance, the Osiris treatment (***GURPS Robots***) would be cheap if available, but may be illegal in some societies.

Oh, very well, I'll give one example of a medical application that has been seriously suggested[7].

Artificial Blood Cells

Available around 20015. Large carbon molecules called Buckyballs can carry oxygen far more efficiently than red blood cells. Up to one litre of human blood can be replaced by Buckyballs. This will increase the oxygen carrying capacity of the blood enough to keep a 36 hour supply of oxygen. It does have medical applications. Buckyballs can transport oxygen to tissues that for some reason do not get the oxygen they need from red blodd cells. The ability to hold ones breath for a long time is an incidental by-product.

Buckyball blood cells cost $10 per litre, but installing them requires an operation that can be much, much more expensive. How expensive depends on the game world. (For instance, in Sweden, such an operation, performed for medical reasons, would be free, or cost very little.)

Nanotechnology and the final frontier

With the arrival of self-replicating general purpose assemblers, the real diaspora into space may finally begin. The major problem with space exploration, and more specifically, building settlements on other planets, is the hideous expense. Nanotechnology will not only cut the costs substantially, it will also alter the way we explore space.

In 1980, NASA made a study of using self-replicating machines to build colonies on other planets[8]. The idea was to send a robot that could build a factory, that could turn out more robots that could build a permanent base on another planet. According to the study, that was firmly based in conventional technology, a seed factory would mass about a hundred tons. Crating a hundred tons of machinery to Mars would be feasible, and though expensive, much less so than any other solution proposed at that time.

The plans for the proposed factory would have required 1×10^{12} bits to describe. That is, you could put complete plans for about one million such factories in the 1 mm^3 computer chip used for the Companion. See “The Companion” on page 7. Actually, the complexity of a nanotech seed could be significantly reduced. All construction would be managed by assemblers, that are comparatively simple devices. They would not have to bother with all the macroscopic activities that make building things difficult, like mining, hauling, casting, etc. They just pick up atoms laying about, move them, and put them down again.

This means that using nanotechnology, it would be possible to use a smaller seed, let's say an ounce (28.3 g), a little bit more than a post

card or an ordinary letter. (A seed this large would of course have a lot of excess capacity. In a pinch, even smaller seeds could be used.)

Starbase seed

Available in 2020. A starbase seed is a package consisting of general purpose assemblers with onboard Complexity 2 computers, and a Complexity 10 central computer. The central computer has complete plans for building about 100,000 different types of permanent bases and settlements, adapted to different purposes and environments. A starbase seed planted on the moon would build a lunar colony. Planted in an Earth ocean, it would build an underwater base. Only about 10% of the seed's memory capacity is used for construction plans. The rest is used to store plans for research and manufacturing equipment, necessary, and luxury, personal items, educational and entertainment books, music, video, etc.

When a starbase seed touches the surface of a planet and is activated, it starts by building an army of assemblers. The assemblers then start building whatever type of station that fits the environment and the purpose of the installation.

A completed station may be as large as a large city, completely ready for inhabitants to move in. Everything will work, electrical power will be on, toilets will flush, etc.

Typical construction times will be 6-8 days, depending on the size of the installation.

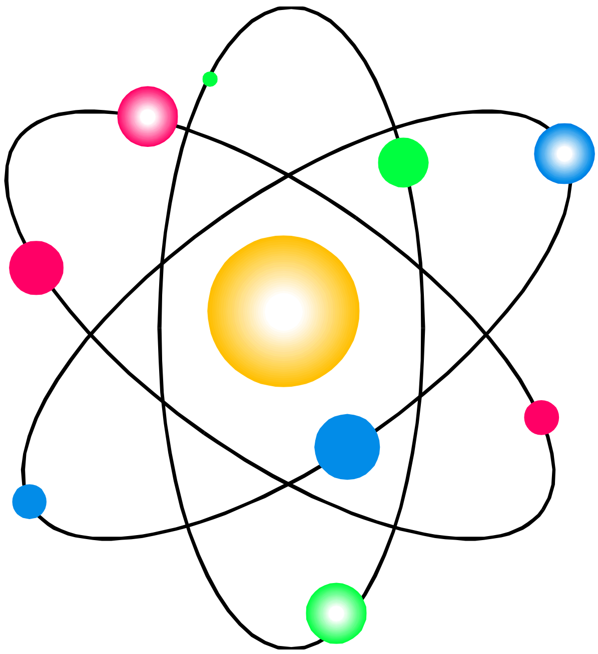
The manufacturing cost of a starbase seed is neglible, but there are a lot of investments in programming. Cost may vary from about $10,000,000 to $1,000, depending on the campaign. Usually, legal restrictions are the limiting factors. It would be a very unusual society that let private citizens own and use starbase seeds. (Activating a seed in an existing city could be disastrous.)

Trivial applications

In addition to the major applications made possible by nanotechnology, there will be thousands of lesser applications, where nanotechnology will serve to improve existing products. Some of the things that might be found in just about everywhere in a nanotech world are:

- T-shirts with animated pictures
- A universal tool, capable of reconfiguring into almost anything
- Full-wall flat videoscreens
- Programmable paint that can change both color and texture
- Reprogrammable books with pages that can change their content
- Variable transparency windows and walls
- Retractable walls and ceilings
- Walk-through walls
- Programmable rooms with configurable walls

These are just a few examples to get you going. Most post nanorevolution societies will be steeped in nanotechnology. Everything, from lipstick to cars to books will contain nanomachinery.



Part 3: Modelling A Nanotech Society

What will a post-nanotech revolution society look like? Let us sketch a few mini-scenarios. The basic assumption is that virtually any material object, from a spoon to an aircraft, can be produced for a negligible cost using a replicator. In GURPS terms, you can take the cost of any available mass produced item, and divide the cost by 7,000. Development costs for producing one off items, like a starship, might not fall quite so dramatically, because of the cost of programming the assemblers doing the construction work. On the other hand, building a fleet of a thousand ships, would cost only a little bit more than building a single one, so in a society where spacefaring is common, serial production would lower starship costs too.

Modelling a nanotechnological society is a little bit more difficult than just dividing all costs to a fraction of the standard GURPS value.

The nanotechnological revolution is pretty much an overnight leap from TL 8 to TL 13-14, with some technology as high as TL 15, or even TL 16.

Practically everything we have, use, wear, or do, will be affected by nanotechnology. Computers will become so advanced that they are completely off the scale. (At least the hardware will be. Programming them is another matter.) The equivalent of a Complexity 10 computer in GURPS will be about the size of a pinhead, and require less than 1 mW of power. Every field of science and engineering will take similarly spectacular leaps. Practically everything that it is theoretically possible to build, can be built, and very, very cheaply too.

The problem is that we will not have time to adapt, to find new things to do when manual labour is no longer required, when everyone can have practically everything for free.

It is impossible to predict exactly what will happen. Indeed, most scenarios seem to lead either to a total collapse of our civilization, or the emergence of a totalitarian world government.

I have outlined two possible ways for nanotechnological societies to develop. One is utopian, the other is dystopic, but none of them is a worst case scenario. (The worst case scenario is that assemblers run amok, either by accident or design, and eat the world, turning it into a grey goo, consisting of nothing but assemblers. Seen in that light, even the “The Rising Dragon” scenario is pretty upbeat.)

Utopia

Supposing that we manage to adapt our present civilization to manage the impact of nanotechnology, what will have to be done?

At first, nanotechnological products will be very expensive, but this will quickly change as replicators become more common.

Competition from the booming nanoindustry will quickly eliminate traditional manufacturing methods, with rising unemployement as a consequence. The welfare system is quickly overloaded. As an emergency measure, the state dispenses free personal replicators to all citizens. It is the only way to keep them from starving.

With the economic system in chaos, and people’s basic needs handled by replicators, there is no longer a strong economic incentive to work. More than 90% of the worlds population will engage full time in art, entertainment, and other recreational activities.

As nanotechnological medicine develops, blood sports are legalized, and quickly become popular. On the other hand, wars disappear.

Necessary community work, like research, engineering, teaching, government work, and health care becomes unsalaried volonteer activi-

ties. Starbase seeds are used to colonize the planetary system.

The world is peaceful and prosperous. Humanity prepares for the leap to the stars.

The Rising Dragon

Another possibility is a total economic collapse of all Western civilisation. It is actually possible that totalitarian communist regimes would fare better than a capitalist society, because the means of production is owned by the state, prices are set by the state, and people don't complicate things by getting bright ideas and setting up private enterprises. (No privately owned replicators.) Since China is the largest remaining communist dictatorship, it is not unreasonable that it would emerge as the new, and perhaps only, world leader in such a scenario.

Nanotechnology would put its mark on Chinese society, however. With virtually limitless production capacity, inefficiencies in planning would not matter much, there would still be enough of everything for everyone, though perhaps not an abundance.

With the collapse of Western civilization, there would be a power vacuum that the Chinese could not resist filling even if they wanted to. They would have to expand, trying to spread their influence over the world, and to create a global, communistic super state.

With expanding borders, and subjugated peoples, would come new ideas, new influences, and of course wars. While there are no other nations able to fight back, there are plenty of weapons available, and plenty of people willing to use them. At first, China strikes back hard, but continuing unrest in the conquered territories, and rising expectations of material standards among the indigenous population force reform. After a turbulent decade or two, the world settles down under a Chinese communist dictatorship that is somewhat more benevolent than it is today.

Eventually, with global world order restored, there will be demands of local autonomy, leading to a new period of unrest. By controlling the use of nanotechnology, China manages to maintain its position for a time, but eventually, the technology is stolen.

It is only a matter of time until terrorists try to use assemblers as a weapon, threathening to destroy the world if their demands (whatever they may be) are not met.

Under the threat of terrorism, the world government creates a monitoring system that monitors every living human every hour of the day. The concept of privacy is rooted out. The ultimate totalitarian state is created.

Final Words

In this essay I have described some of the nanotechnological devices that may become available in the next 15-50 years. It is clear that they will have a great impact on the world community. They will change the way we live, work, spend our free time, view the world, and relate to other people.

Predicting how nanotechnology will affect us is really an excercise in futility, it is like trying to peer inside the singularity of a black hole, but there does seem to be many more roads leading to oblivion, than to Utopia. Modelling a believable game world is therefore not easy. It is an undertaking worth doing though. The nanotechnical revolution may be a few years off yet, if it will ever come, but meanwhile, nanotech offers almost virgin territory for roleplaying.

References

In writing this article, I made good use of several sources. If you are interested, you might want to look some of them up:

1. *Nano!*, by Ed Regis, Bantam Books.
   A popularized account of the history and development of nanotechnology.

2. *Nanotechnology, Molecular Speculations on Global Abundance*, edited by BC Crandall, The MIT Press, ISBN 0-262-53137-2.
Ten scientists and engineers describe their vision of how nanotechnology will shape our future. Several nanotechnological inventions are described here, notably the Companion, phased array optics, and utility fog.

3. *Protein design as a pathway to molecular manufacturing*, by Eric Drexler, http://www.imm.org/PNAS.html.
The landmark paper from 1981, where Eric Drexler described an engineering approach to building complex molecular machinery.

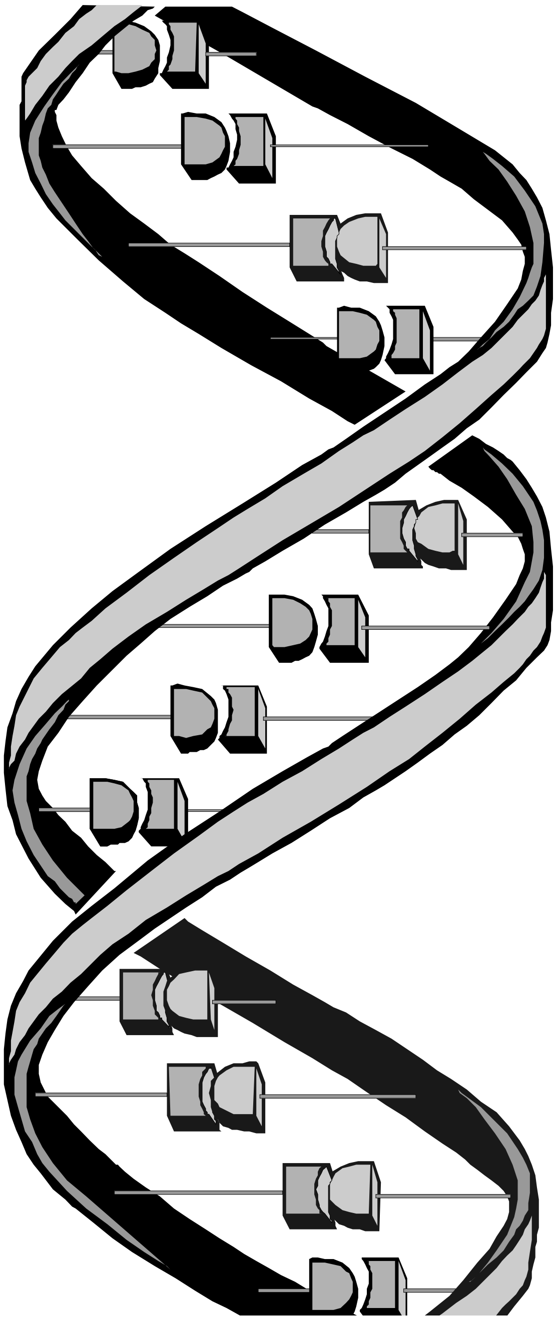
4. *There's Plenty of Room at the Bottom*, Richard P. Feynman, http://nano.xerox.com/nanotech/feynman.html.
A transcript of a classic talk by Feynman, given on December 29, 1959, at the annual meeting of the American Physical Society at the California Institute of Technology.

5. *Design considerations for an assembler*, by Ralph C. Merkle, Xerox PARC, http://nano.xerox.com/nanotech/nano4/merklePaper.html.
This paper describes the subsystems and components required for a simple, first generation assembler.

6. Nanotechnology and the next 50 years, Rick Smalley, http://cnst.rice.edu/dallas12-96.html.
A paper about the impact of nanotechnology on the global overpopulation problem.

7. Nanotechnology and Medicine, by Ralph C. Merkle, http://nano.xerox.com/nanotech/nanotechAndMedicine.html

8. NASA and Self-Replicating Systems: Implications for Nanotechnology, by Ralph C. Merkle, http://nano.xerox.com/nanotech/selfRepNASA.html



THE ROLEPLAYING MARKUP LANGUAGE

Part 2: The RML Document Production Environment

By Henrik Mårtensson

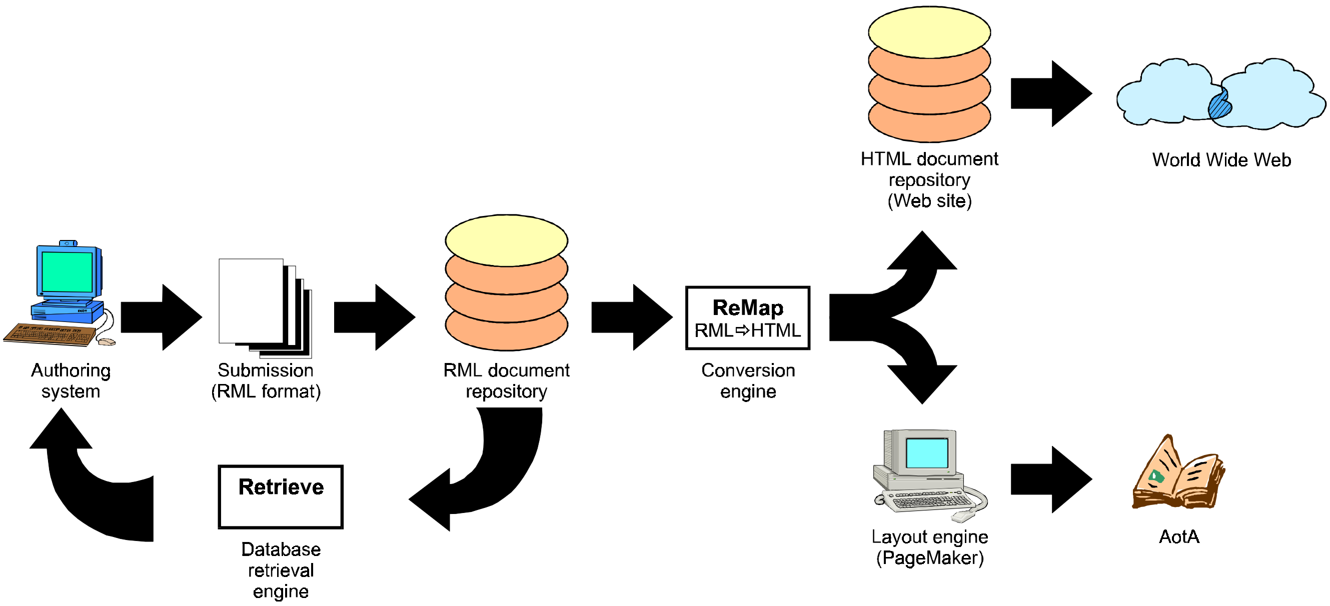


Fig. 1 The RML Document Production Environment

In the previous issue of Northern Lights, published in AotA #30, I presented the Roleplaying Markup Language (RML), a system for simplifying file submissions to AotA. Though hastily cobbled together, I hope the article showed the benefits of using RML for publishing (both on paper and on the World Wide Web), indexing, archiving, and retrieving information. This article will continue where the previous one left off, explaining the RML environment, and bringing you up to date on the project status.

RML is only one part of a document production environment. When you write, you will only have to deal with a small part of that environment, the authoring system. Still, to get the most out of RML, it can be useful to see what other parts there are, and how they fit together.

Figure 1 shows the entire RML production environment as it is currently envisioned. As a writer,

you can work with it pretty much as you do today. The most immediate differences between the current submit-in-whatever-format-you-want system, and the RML system lies in that the RML system is much simpler for the CM to handle, and that everything we write can be easily published on the Web. When the system is fully implemented, you will also be able to retrieve and reuse information from the RML repository, and to convert from RML to other markup schemes than HTML.

Authoring with RML

Using RML you write your submission using an SGML editor instead of your current word processor, or maybe with your current word processor assisted by an RML template and macro package.

The next step is to package your submission into a Zip file, and email it to the CM. This is the end of your troubles. The rest is up to the RML system, the CM, and the people who manage special functions, for instance David Carter, with his AotA index.

Writing AotA submissions using RML is not much different from the way file submissions are handled today. The only drawbacks are that you that you cannot influence the layout as much as you can today, and that you may have to switch from your regular word processor to an SGML editor. We will provide a free SGML editor, probably IADS, an editor that was developed by the U.S. Missile Command for writing on-line documentation. Testing is in progress, but preliminary results indicate that we will be able to use IADS to write RML documents, though it will require a bit of tweaking. IADS is available for Windows only.

Table 2 shows a few SGML editors you can use to write RML documents. There are more such editors available. Unfortunately, most of them are a bit pricey, but as long as you stick to IADS, you will not have to spend a dime to start using RML.

Table 2: SGML Editors

Editor	Platform	Free	Comments
IADS	Windows 3.11 Windows 95	Yes	Supported by the RML project. Requires some post processing by conversion program to produce correct RML files. If you wish to take a peek at IADS, you can visit **http://shodan.redstone.army.mil/iads/iads.htm**.
Emacs	Amiga MacOS MS DOS UNIX and others	Yes	Emacs is a very capable text editor. The project decided not to support it because of the extremely cumbersome and clunky user interface. Technically, it is fully capable of handling the RML DTD and to produce RML format documents. If you have previous experience with Emacs, and like it, you might want to use it to write RML documents. To edit SGML documents with Emacs, you need a package called PSGML. It is available at **http://www.lysator.liu.se/projects/about_psgml.html**.

Table 2: (Continued) SGML Editors

Editor	Platform	Free	Comments
MS Word	MacOS Windows 3.11 Windows 95	No	We have discussed adding a free RML template and macro package for MS Word, but such a package will not be a part of the first RML release. There is an add-on from Microsoft that handles SGML. This add-on is unfortunately not free. PC Magazine has a capsule review available at **http://www8.zdnet.com/pcmag/issues/1415/pcm00036.htm**.
WordPerfect 6.1 and later	MacOS Windows 3.11 Windows 95	No	WordPerfect does handle SGML straight out of the box[a]. It is a fairly capable SGML editor. The RML project will support WordPerfect with style sheets for RML.
Frame+SGML	MacOS Windows 3.11 Windows 95 UNIX	No	Expensive but capable SGML editor and layout program rolled into one. Will not be supported immediately, but there are plans to support it in late ‘97, or the first half of ‘98.
InContext	Windows 95	No	From InContext Corporation. Also part of the Corel Ventura 7.0 dtp package[a]. This is a true SGML editor. The interface is clunky, but it can handle most DTDs, and should not have any problems with RML. You can check the editor out at **http://www.incontext.ca/products/ic2.html**.

a. You will have to make a custom installation. The standard installation procedure does not install the SGML software.

Finding free SGML authoring software has not been easy. We can’t promise you that IADS will be as good an authoring tool as the word processor you use right now. However, we do hope that it will be good enough, so that when we add in the other benefits of the RML system, you will think RML well worth using.

Publishing with RML

Authoring a submission is only part of the story. What happens when you have emailed your submission to the CM? Using the old non-system, this was where the problems with file submissions began[1]. Using RML, the publishing process will be a lot smoother.

Your submission arrives at the CM’s mail address. The CM runs a script file that unpacks the zipped file and puts the unpacked RML format files into a document repository. This repository is just a directory (with lots of subdirectories) on a hard drive. The script file creates a subdirectory structure for the entire AotA submission, and all other submissions to the current issue of AotA that are in the repository. The same script file also starts Remap, a program that converts RML files to HTML 3.2 files, and copies a PageMaker template document to the correct place in the repository. This template contains links to the HTML 3.2 format documents created by Remap. Finally, the script starts PageMaker and opens the PageMaker document.

PageMaker opens the template document and imports all linked HTML files. All the CM has to do

1. See the article in Northern Lights 1-97 in AotA 30.

is to print the document and mail it. (With PageMaker's scripting capabilities, we can probably make the printing automatic too. The CM won't even have to press the Print button.)

The CM then uploads the HTML version of the AotA submission to a Web server, thus providing us with instant world wide fame and adulation.

Providing support for other publishing systems than PageMaker is merely a question of providing new translation maps for Remap. (This can be easy, or very hard, depending on the system we translate to. Conversions that cannot easily be handled by Remap, are handled by pre and post processing programs, Premap and Postmap. While Remap is a general conversion utility, there will be several versions of Premap and Postmap, each tailored to a specific type of conversion.) Systems we might eventually support include LaTEX and FrameMaker. Both support formats that it is easy to convert to. Another possible use of Remap is to convert documents to markup systems like the Steve Jackson Games standard submission format.

The RML Repository

Astute as you are, you have of course noticed that in Figure 1, there is a feedback loop from the RML document repository, via a database retrieval engine, to the authoring system. This feedback loop is the one of the four[1] main reasons why we bother with RML at all, instead of writing directly in HTML.

The idea is that we should be able to retrieve information from the RML document repository, and reuse it in different contexts. Suppose, for instance, that we decide to publish a series of scenario supplements for different GURPS world books. It would be a piece of cake to retrieve all scenarios written for a specific genre from the repository, remap them to the SJG submission format[2], and voila, not only fame, but also fortune, as SJG opens the lids to their coffers to share their wealth in exchange for the gems from our scenario collection.

A good example of how a document repository of this type could be used is the recent publication of the GURPS Companion I & II. Instead of wading through 14,000 pages of GURPS material on paper, SJG could have queried the repository, and all the pertinent rules, essays, etc., could have been retrieved in a matter of hours. (SJG spent man-years doing all the necessary searching and assembling of information manually.)

Of course, there will be glitches in the beginning, making the process a bit more bumpy than outlined above in the beginning. In time, if we stick with developing the system, we will have a very smooth system for writing and publishing AotA.

Current RML Project Status

RML is a pretty big specification, covering both AotA submissions and GURPS worldbooks and supplements. The AotA submission parts is currently undergoing testing, and starting next issue, you will see experimental RML format submissions published in AotA. These submissions will also be ready for publishing on the net using HTML.

What we have available in the project so far is:

- a beta version of the RML Document Type Definition (DTD), the markup language specification.
- big plans for the future

Among the myriad things left to do is:

- an IADS RML style sheet (or, more probably, a set of style sheets for different types of articles)
- an RMLizer for IADS. This is a script that makes minor changes to an IADS document, turning it into a proper RML document.
- Remap, an SGML conversion program
- an RML to HTML 3.2 conversion map, usable by Remap

1. The second reason is that RML provides us with standardized document structures for submissions to AotA and Steve Jackson Games. The third reason is that we eliminate many file compatibility problems. The fourth reason, well, I wanted to learn more about SGML, and had to con someone into helping me.
2. This is not shown in the illustration.

- a PageMaker template
- RML support for various word processors in the form of templates and macros
- writing an RML database search and retrieval engine
- writing a conversion map for converting RML to the standard Steve Jackson Games submission format (This is fairly easy. It won't be necessary if SJG starts using RML.)
- supporting other formatting engines than PageMaker (This may not be necessary, though adding support for LaTEX and FrameMaker is as easy as writing two new conversion maps for Remap.)
- Putting together a ready-to-run RML package for AotA members.

There are stumbling blocks ahead. On the other hand, the project has been going well so far, and I am confident that we will solve the remaining problems. Considering that it is not unusual for a commercial SGML project to take eighteen months or so, we have done pretty well.

Future Articles and Feedback

In the next couple of issues of Northern Lights, I will present the RML document production environment in more detail. Expect to see articles detailing the authoring environment, document repositories, conversion engine, and layout/publishing systems. This material will eventually be part of the RML documentation, so please give me feedback. If there are things that are unclear, tell me about it as soon as the articles appear in AotA. That way I can see to it that the version included in the RML documentation is both complete and easy to understand.

If you are interested in the project, join the **aota.sgml** mailing list. There are no obligations, you do not have to contribute anything, but you will be informed about what's going on, and you can make your voice heard if you want to.

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