GURPS®

BIO-TECH™

THE NEXT STEP IN HUMAN EVOLUTION

BY DAVID PULVER

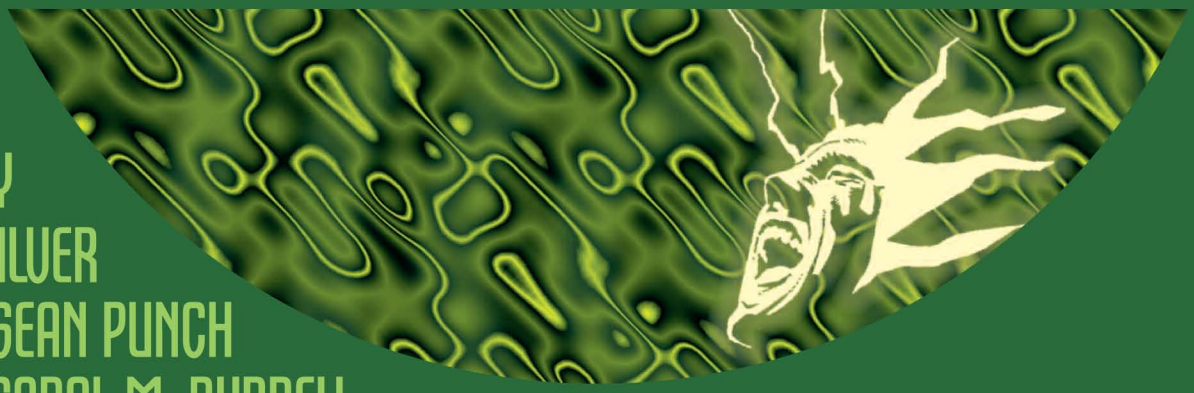
STEVE JACKSON GAMES

THE FUTURE IS ALIVE

"Who needs chrome, pal? Raw meat is where it's at now. Mother Nature always did it best – she just needed a little help. Get down to the black clinic, old-timer, and you can be 15 again. That is, if you still want to be human at all . . ."

Who needs silicon and steel? Upgrade your old body with steroids and smart drugs, transplants and viral nano . . . or just get a new one. Or maybe you don't think being human is so great? Then improve on nature with eugeneering and genefixing, or just go *para*human: Why just admire cats when you can *be* one? The technology's changing fast, but you'll have lots of time to get used to it – death is a temporary nuisance with cryonics, cloning and braintaping.

Welcome to the post-human age. Have you upgraded your genetics this year?



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Both ***GURPS Basic Set,*** *Third Edition Revised* and ***Compendium I: Character Creation*** are *required* to use this supplement in a ***GURPS*** campaign. However, the detailed, factual discussions of cutting-edge biotechnology will support high-tech adventures with *any* game system!

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The Next Step in Human Evolution

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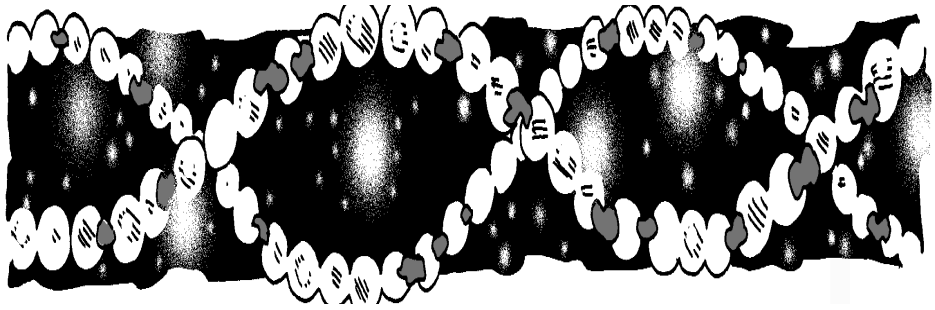
INTRODUCTION

Genetic engineering and other biotechnology are about to change the world in ways we can only begin to guess at.

Can we resist the temptation to tinker with our genes when the potential rewards include immortality? Will exotic wonder drugs soon be produced in cows and goats? Will genetically-enhanced plagues threaten to wipe us out, or will bio-nanotech let us conquer disease and transform ourselves into post-human superbeings? Just how do genetic engineering, cloning and braintaping work, anyhow?

GURPS Bio-Tech answers these and other questions by looking at current and future technologies from a science-fiction perspective. In this book, we'll take a detailed look at many of the biotechnologies that other ***GURPS*** books have taken for granted and see how they stack up against the latest developments in the real world. The answers may surprise you . . .



Using This Book

Biotechnology breeds its own jargon. While most unfamiliar technical terms are explained as they are introduced, definitions can also be found in the *Glossary,* p. 139. If you run into an obscure term, check the glossary.

This book introduces few new advantages or disadvantages, but does add a wide range of new enhancements and limitations. These are explained in the *Appendix,* p. 135.

Finally, fictional quotes introduce many sections of this book. Capsule biographies of our "commentators" appears in Chapter 6, in the sidebars on pp. 132-34.

About the Author

David L. Pulver is a freelance writer and game designer based in Kingston, Ontario. He is the author or co-author of over 20 books, including a novel and various roleplaying supplements, such as ***GURPS Reign of Steel*** and ***Psionics,*** and ***Bubblegum Crisis: Before and After*** (for R. Talsorian Games). David's interests include science fic-

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Internet. Visit us on the World Wide Web at **www.sjgames.com** for an online catalog, errata and updates, and hundreds of pages of information. We also have conferences on Compuserve and America Online. ***GURPS*** has its own Usenet group, too: rec.games.frp.gurps.

GURPSnet. Much of the online discussion of ***GURPS*** happens on this e-mail list. To join, send mail to majordomo@io.com with "subscribe GURPSnet-L" in the body, or point your World Wide Web browser to: **www.io.com/GURPSnet/www**.

Page References

See ***GURPS Compendium I,*** p. 181, for a full list of abbreviations for ***GURPS*** titles. Any page reference that begins with a B refers to ***GURPS Basic Set, Third Edition Revised;*** e.g., p. B144 refers to page 144 of ***Basic Set.***

CI refers to ***GURPS Compendium I,*** CII refers to ***Compendium II,*** CW to ***Cyberworld,*** CY to ***Cyberpunk,*** FF to ***Fantasy Folk, Second Edition,*** P refers to ***Psionics,*** RO to ***Robots,*** S to ***Space, Second Edition,*** SU to ***Supers,*** Second Edition, UT to ***Ultra-Tech, Second Edition Revised,*** UTT to ***Ultra-Tech 2*** and VE to ***Vehicles, Second Edition.***

1 BIOTECHNOLOGY

Tika Dawnstar frowned – she needed money. Her scholarship covered her tuition in the University of Mars' genetic engineering program, but cost of living at Nix Olympica was awful, thanks to the terraforming taxes. She needed a winter job, one that would pay for the cutting-edge neurovirus with which she hoped to upgrade her brain in time to ace the upcoming term's exam.

Plugging into her biocomputer, she scanned the "Help Wanted" column on GeneWeb. Assistant on a project to develop a pollution-eating, cryogenic bacteria to clean up a vatspill on Titan? Bleah. Design new porkapple plants? Yuck. She was a vegetarian, anyway. She scrolled down the page, then stopped. High Arcadia was an orbital habitat – an adventure theme park based on Greek mythology. They wanted a freelancer with grad-level expertise to design one of the creatures that would populate the park: a lamia, with a snake's body and a human head. Tika's eyes widened . . . The lamia was to be fully sapient!

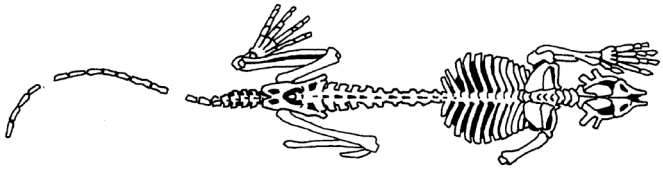
Wasn't that illegal? Tika called up a law database and cross-checked: Nope. It was bioethically questionable, but High Arcadia was an autonomous extra-national entity, not a signatory to the Genetic Regulatory Protocols; she could work with human DNA. Tika hugged herself – this would be fun!

She considered the problem. A snake/human cell fusion, so she'd have to smooth out the biochemical differences between species . . . and probably get lots of false starts and aborted embryos before she got it right, even if she rented time on the university's vatbrain megacomputer. But she could do it with the facilities they were promising, and the advance would pay for her new brain! Humming to herself, Tika began composing her application letter to the Arcadia Entertainment Group.

Biological manipulation is nothing new. Humans have been influencing the genetics of plants and animals for thousands of years through selective breeding. For example, most sheep once had long legs. That's better for the sheep, since they can run away from predators, but not so good for a farmer, who finds it harder to control and shear a nimble animal. So shepherds bred the sheep with shorter legs together. The result? After many generations, the "improved" sheep are all short-legged, and farmers need specially-bred sheep dogs to keep the predators away.

The trouble with selective breeding is that it takes generations to produce results. Consequently, much of what we know about genetics comes from studying organisms that have relatively short lifespans, such as fast-growing plants, fruit flies or bacteria.

Today, dramatic breakthroughs in molecular biology have led to genetic engineering, a technology that allows the work of centuries to be done in months or years. In the 21st century, gengineering may create modified animal species, or even an "improved" breed of human. But who determines what is an "improvement" – the sheep or the shepherd?



Basic Principles

All terrestrial life is made up of *cells:* one cell in the case of simple organisms like bacteria or protozoa, and about 800 billion in a human. A cell consists of a membrane which encapsulates a watery soup of subcellular bodies. Among the most important of these are skinny strands called *chromosomes.* Bacteria (the simplest life forms) have a single chromosome (and several, smaller ring-shaped bodies called *plasmids*). In more complex forms of life, multiple chromosomes are housed inside a nucleus in the center of the cell; e.g., each human cell contains 23 pairs of chromosomes. Every cell in a particular organism, except the reproductive cells, has the same number and type of chromosomes. Collectively, the chromosomes form an instruction manual that contains all the information an organism needs to grow and reproduce.

Biotech Tech Levels

TL1-3 (pre-1450). Farming leads to a practical understanding of basic heredity; plants and animals bred for desired traits. Microbes exploited to make bread, wine and cheese.

TL4 (1450-1700). Development of the optical microscope makes cells visible for the first time.

TL5 (1701-1900). Mendel develops laws of heredity. Nature of cells and reproduction understood. Germ theory of disease developed, along with early vaccines. Darwin postulates evolution. Galton theorizes eugenics.

TL6 (1901-1950). Mutation of plants and microorganisms using chemicals and radiation. Biochemistry comes into its own. Penicillin and other antibiotics developed. Electron microscope allows viruses to be seen. Experiments in eugenics.

TL7 (1951-2000). DNA, chromosomes and genes discovered, related to heredity. Genome mapping begins. Recombinant DNA and transgenics allow simple gengineering. Organ transplants, genetic testing, and experimental gene therapy and cloning.

TL8. Human genome is mapped and sequenced, along with the genomes of many other terrestrial animals. Complex genetic modifications become possible. Cloning perfected. Artificial wombs ("growth tanks").

TL9. Mature gengineering. Limited genetic control over mental traits. Development of bio-nanotechnology permits braintaping and the use of nanoviruses in germline gengineering.

TL10. Gengineering of complex mental traits, such as intelligence. Routine genetic reconstruction of ancient DNA traces.

TL11. Living machines. Sensa-skin. Nanoviruses and gengineering can alter the fine structure of an adult mind.

TL12. Complex nanoviruses, including contagious ones, make radical transformations possible in humans and animals.

TL13+. Near-total control over biological processes through mature nanotechnology. Chrysalis machine.

The time frame after TL7 is simply speculation. Also, while the ***GURPS Basic Set*** suggests that TL8 may represent 2001-2050, it's possible that biotechnology will outpace this – in fact, if the wildest prophets of molecular nanotechnology prove to be on target, we might even see a TL increase in the field of biotechnology each generation, or even each decade! Thus, instead of being "far, far future," TL13 biotech may be 2100 or even 2050!

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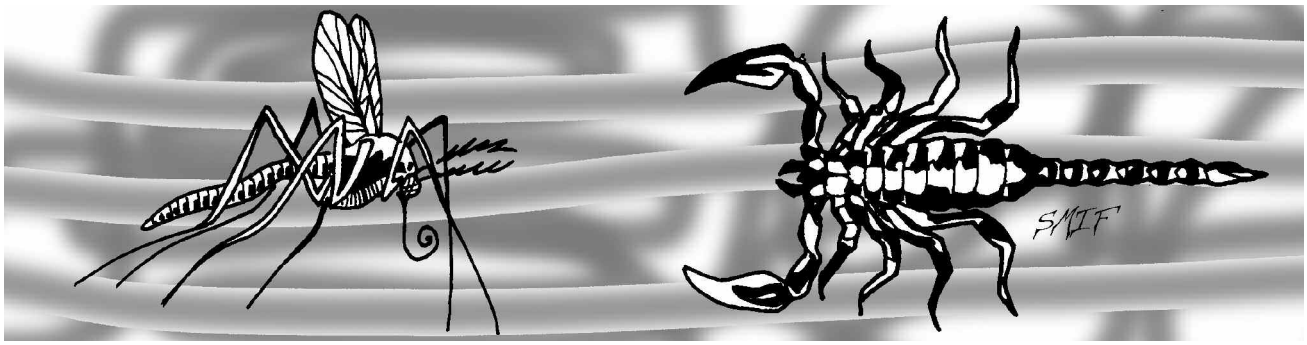


Examples of Insect Agents

Smart Mosquito (TL10)

Amongst the most common insects to be modified are female (bloodsucking) mosquitos. A mosquito's ability to fly, its small size, its excellent sense of smell and, most of all, its ability to be modified to deliver chemicals into the blood make it a highly useful organic platform for covert operations.

A smart mosquito has the usual mental and physical modifications common to insect agents. It also has a pheromone gland that allows it to mark objects with a distinctive scent so that it can find them later. It will always mark its owner.

The insect can fly at about 20 mph. It has an effective Tracking skill of 10, which can be used to find objects or people it has been programmed to recognize. It can be programmed to scent-mark an object it has found. Provided that target is not behind a sealed barrier or more than a mile or so distant, this gives the mosquito +3 on any Tracking rolls to find it later on.

The mosquito can be programmed to perform one of several tasks if it finds its target:

Payload: The mosquito cannot carry anything heavier than a few grains of sand, but sometimes that can be enough! Useful payloads that it can be programmed to pick up or deposit include tiny, pinhead-sized listening devices and messages that are coded as microdots ($1 each). These can also be deposited on someone and scent-marked for later retrieval.

Sampler: The mosquito can draw blood from a subject and retain it without consuming it for up to six hours. This can provide a blood sample for analysis.

Target Marking: Mark the object with a pheromone marker. This can be combined with any other task.

Vector Attack: The insect can carry and transmit a dose of a germ-warfare agent or proteus virus (designed not to affect the mosquito). It may also carry a drug or poison, but as it can only carry a small dose, HT rolls to resist are at +4. Delivery is by biting. This won't penetrate armor, but many people won't even notice a mosquito bite (IQ-2 roll to do so).

If someone is being stalked by a smart mosquito, he should get an IQ-3 roll to notice it (Acute Hearing or Vision helps, as does Alertness). A mosquito-sized insect is -12 to hit due to its small size, but *any* hit will kill it. If the character has a fly swatter or area-effect attack, like bug spray or a flamer, there is only a -2 penalty to hit.

A smart mosquito has a lifespan of only two months. This can be extended by keeping it in suspended animation when not in use. A smart mosquito costs $8,000; it can be carried in a matchbox-sized carrying case. Drugs that are capable of extending the smart mosquito's life span by one month per dose cost $100 per dose. They are effective on a roll of 15 or less; roll each month. Smart mosquitos are LC 3.

Smart Bug (TL10)

A smart ant or small spider uses the same rules as a smart mosquito, except that it is limited to moving on the ground at Move 2, cannot act as a blood sampler, has Tracking-7, and can carry a little more (gives only +2 to resist any drug or poison). While it can't fly, it can walk up walls. Its other advantage is that it's harder to notice, as it's effectively silent; an IQ-4 roll is required to spot an ant or spider sneaking up on you. On the other hand, it's easy to kill – just step on it.

Smart ants or spiders are slightly easier to construct than mosquitos, and cost $5,000. They can also be equipped with two additional biological modifications:

Hardened Mandibles (TL10): This allows the bug to perform sabotage, eventually chewing tiny holes in ducts, slicing wires or biting for 1 point of damage per minute. Add $1,000.

Vacuum Adaptation (TL11): The insect's body has been surgically adapted to survive for a short time (up to an hour) in space, or other high- or low-pressure environments. Add $10,000.

Other Insect Agents

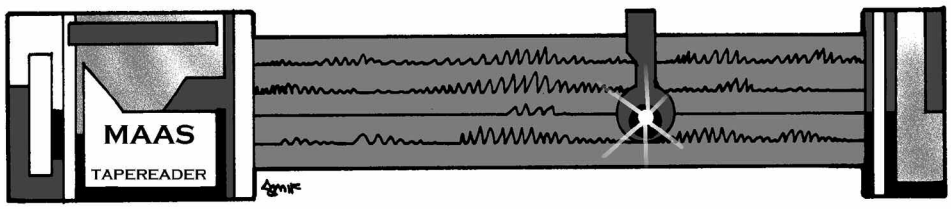
House flies, moths, cockroaches, dragonflies – all might have their own uses. The GM is encouraged to come up with other types of insect agents for specific applications.

Designing Plants, Microorganisms and Insects

New types of plants, microorganisms or insects, for both peaceful purposes and warfare, can be created using either the *New Inventions* rules on p. B186 or the expanded version on pp. CI121-127. Use Genetics (Genetic Engineering)-15. Gengineers should base the design on an existing organism, splicing additional genes into it to produce the desired effect.

Plants, insects and bacteria are usually easier to customize than viruses; apply an extra -2 on all rolls to gengineer viruses. Other suggested modifiers: +1 to +5 for minor variations on an existing organism; +2 to copy a gengineered design if you know it exists and have a description but not a model; -5 if trying something new (up to one TL higher may be possible) or complex. The GM *may* wish to apply an additional modifier of -(TL-6) per extra modification made to the original organism, where "TL" is the minimum TL required for that particular modification.

To make the "conception" roll, the gengineer *requires* a Complexity 3+ computer that is running the appropriate gengineering software.



At any TL, if the brain itself was badly damaged by injury, radiation or illness *before* freezing took place, the new body may be missing the memories or personality of the original. See *Braintaping* (p. 116), for the limitations.

Suspended Animation (TL9)

Being able to revive a frozen corpse is one thing, but freezing people without killing them requires a far more advanced technology. This process is "suspended animation," sometimes called "bio-stasis" or "freeze." The suspended animation chamber, or "freeze tube," uses a combination of cold and drugs to preserve the occupant, often with automatic drug dispensers built into the tube itself so that a person need only lie down and close the tube to be put into freeze within minutes. The "freeze drugs" used may be advanced versions of current cryo-protective drugs, or biological nanomachines.

Whatever the means, a *live* person who has undergone suspended animation is *not* dead. Rather, his metabolic processes have been effectively halted, but can be restarted using the machinery contained within the suspended-animation chamber. In this way, an injured or dying person can be preserved, perhaps long enough to reach a medical facility that can cure him. If no cure is available, he can be frozen between life and death until future science can devise one.

The obvious non-medical use of suspended animation is for space travel. If a space voyage takes years, suspended animation may be necessary for manned flight. Even if it takes weeks or months, it would still reduce tedium and save on life-support costs.

Healthy people may also choose suspended animation to "time travel" into the future. The motive could be unwillingness to wait for an event ("wake me up when you're ready to marry me"), boredom ("wake me up in a hundred years") or even a desire to monitor a long-term process, such as a team of sociologists monitoring a culture's development ("wake me up when the Tang Dynasty falls").

Individuals – or entire organizations – who live only for a specific mission may be kept in suspended animation most of the time, being revived only when needed. For instance, a super-assassin or an entire army of bio-soldiers could be too dangerous or expensive to maintain in peacetime. Instead, such individuals could be kept in suspended animation, to be thawed out and briefed whenever a crisis threatens, then put back to sleep afterwards. (This might make an interesting campaign, as each adventure could be set progressively farther into the future.)

Finally, a *dead* person kept in suspended animation can be more easily braintaped. If cloning and memory transfer are feasible, a freeze tube will keep the body "on hold" until a clone can be prepared. The occupant will not deteriorate until 1d hours after removal. Suspended animation is also useful for keeping spare bodies on hand (see *Cloning of Multicellular Organisms,* p. 14).

Freeze Tubes (TL9)

Putting someone into freeze or taking him out takes one hour. Unlike nitrogen-based cryopreservation units, freeze tubes are electrically-powered, with a built-in E cell for backup. A freeze tube can run on this backup power for six months at room temperature. No other maintenance is needed. Freeze tube storage costs $250/day for short periods, or $50,000 annually; discounts of 10% to 60% off the annual fee are available for long-term storage of 50 years or more. This price includes a very safe, well-guarded storage space.

A freeze tube, with dedicated monitoring computer, costs $55,000. Weight is 750 pounds and volume is 50 cubic feet.

Braintaping Fees

At TL9+, many commercial clinics that have clone facilities also have braintaping equipment, and vice versa. Here's a typical schedule of fees that would be charged by a hospital or similar organization, assuming that braintaping is perfectly legal:

• $2,000 to direct-program a blank-minded clone, whether for the first time or with a memory update. The clone will cost extra – see *Cloning Costs and Times* (p. 16).

• $25,000 to make a braintape copy on MMSD or digital media, or to update such a braintape with more recent memories. This price drops to $12,500 at TL10, or $6,250 at TL11.

Memory Storage

We are our memories – but while memory is known to be seated in the cells of the brain, its exact workings are still somewhat mysterious. According to current theories:

Short-term memory is stored electrochemically, and is not durable. Within a few minutes to an hour, short-term memories are either forgotten or transferred into long-term memory. In addition, trauma (especially a head injury, and probably death followed by braintaping) may result in short-term memories being lost. This means that someone who is revived via braintaping will often have no memory of the last moments of his life!

Long-term memory consists of those memories that our brain has permanently retained, by accident or design. Long-term memories seem to exist in the structure and connections of the brain cells themselves. As long as the brain has not suffered substantial damage, this should survive for a few hours after death, until the brain cell membranes themselves begin to decay. Specialized freezing techniques (cryonics or suspended animation) may be able to preserve these structures indefinitely.

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