

ENTROPY

VACCINE FOR FUTURE SHOCK

Darwin's Difficulty

Morality Returns

Meme Alert!

Breakfast
of the
Immortals



New
Nanotech

NO. 2

WINTER ISSUE

JAN. 1989

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Front cover: "Drawing Glances", by Tom W. Bell. Inspired by M.C. Escher's "Drawing Hands", which shows two hands drawing each other, this drawing creates a cooperative relationship along another dimension - from image to viewer, rather than from image to image. By regarding the image, the viewer re-creates it in thought, giving it the only sort of existence that we can ever really know. On the other hand (so to speak) the image of the drawing hand points outwards, as if it were creating the very viewer who looks at it. And is it not true that we are created by the symbols we experience?

Back cover: "Bad Thoughts", by Tom W. Bell. This symbolizes Eden's *truly* evil temptation: to live in fear of knowledge. Yes, Christianity is taking a beating in this issue, but justifiably so; it has rendered plenty of beatings itself.

Editorial

Though this is EXTROPY's winter issue, it comes to you in Mid-January because, being graduate students in philosophy, we co-editors must work around our school's class schedule. Rest assured that you will receive four issues in a year's time, however. Expect your next EXTROPY in about two months - at the end of our spring break.

Please indulge your urges to send us material on any extropian topic. We welcome articles on the following subjects, among others: Artificial intelligence, cognitive science and neuroscience advances and possibilities, intelligence increase technologies, life extension, cryonics and biostasis, nanotechnology, hypermedia, spontaneous orders, space colonization, libertarian economics and politics, reviews of science fiction, intelligent use of psychochemicals, extropian self-improvement psychology, mind-fucking and weirdness, extropic moral and amoral theories, exciting developments in science and technology, memetics, and aesthetics.

In the next few issues there will be articles on: New perspectives on handling friendships and romantic relationships (look for an explanation of SEXTROPY!), with alternatives to conventional marriage; the intelligent use of LSD-25 and THC delta-9 (marijuana) for pleasure and self-improvement; an overview of cyberpunk science fiction; new theories of personal identity and survival; a materialist explanation of the phenomenon of consciousness; and currently available means of boosting your memory and learning abilities.

Extropy is edited and published by Tom W. Bell and Max T. O'Connor. Please send articles and letters for publication to:

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To the Editors...

To the Editors,

EXTROPY is very promising - lots of potential. There is a bit of understandable overambitiousness in your first issue - for example, what can you say about aesthetics (p.13) in a brief compass? (I devoted an entire book, "Understanding the Arts," to the subject, and THAT barely scratched the surface. The 'what is beauty' type question is not easily discussed and certainly not easily disposed of.)

But my main suggestion is that you are really too optimistic about the future. I remember when I was in college, all diseases would be cured or curable within 25 years, and there would be no more wars. (That was two years before World War 2 broke out.) Some of my optimist fellow students were killed in that war. Briefly, a few points:-

1. In the optimistic future scenario, the possibility of war is rather discounted. I hope you're right, but wouldn't bet on it. When ideologies find no other way to promulgate their views, they do it by force, and I see no reason why they won't continue to. At the moment the Middle West (Iran, Israel etc.) is a big trouble spot; it can't keep forever on the tightrope as it is doing now. The situation of Israel in spite of its military power is very insecure, surrounded by enemies who only need to win once; if fundamentalist Islam continues to grow, Israel's goose is cooked anyway. But they have said that if they are surrounded they will use nuclear bombs to obliterate first Moslem capitals, then Moscow, then Washington. I see no reason to think that might not happen.

2. Nuclear wars will be seen to be self-destructive (though a mad dictator like Hitler wouldn't care). But chemical weapons such as nerve gas are more than 2,000 times cheaper to produce, and could kill a city in a short time, without nuclear fallout. Russia and a few others are making it like mad. What makes you think that they won't use it when they have it?

3. I don't see a very good future for the environment. Even if the amount of garbage and pollutants were to remain stable starting tomorrow, the oceans might be doomed, as well as lakes and wetlands. And then there's the ozone hole, the greenhouse effect, and a few such delicacies to worry about. We have soiled our own nest so badly that there will surely be SOME horrendous consequences.

4. Growing old, life extension, is a mixed bag. Growing old for what? To be the same at 120 as most people now are at 90? To sustain life as people in nursing homes how experience it? Horrible! If people could continue at 30 till they die, fine, but I don't see anyone saying that. Surely it's the quality and not the quantity of life that counts. To have people preserved in old age centers for decades is not a very alluring prospect.

Moreover, as medical science extends life, the expense of it becomes astronomical. Many people could live to 89 instead of 88, at the cost of half a million dollars. Is it worth it? As medicare spreads, they will have to put some limitation on it (to avoid bankruptcy) as England does, e.g. no expensive treatment for people over 70, even though their taxes have paid for the care.

treatment for people over 70, even though their taxes have paid for the care.

5. And as life is extended, there will be an ever greater gap between the birth rate and the death rate. So there will be ever more people on this planet. I think that this planet is already overcrowded. To see it more so, with more people crawling over it than there are worms on an apple, is a horrifying prospect. I would like to reduce the population to what it was before 1900, when people could at least have a bit of living space, though there is no way to do that without killing lots of people, and that of course is out of the question. But we have to avoid increased numbers in the future; and having a birth rate that doubles the death rate is NOT a way to do that!

Anyway, good luck with your new venture.

Best Wishes,

John Hospers

(Editors' note: Dr. Hospers is a professor emeritus of philosophy at USC, author of several books and countless articles on subjects such as aesthetics and political philosophy, and in 1972 became the first presidential candidate to run on the Libertarian Party ticket. His points are well taken, but we'll respond to them in upcoming articles. We deal with points 3,4, and 5 in this issue's articles on supercomputing and nanotechnology.)



Hans Moravec -

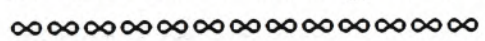
Mind Children: The Future of Robot and Human Intelligence.

Harvard University Press 1988.

Reviewed by Max O'Connor

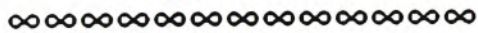
This is a book that every extropian not only should read but would enjoy immensely. It is packed with fantastic, imaginative, wild ideas which are almost all solidly based in real science. The ideas in the book revolve around the coming massive boost in intelligence resulting from advanced artificial intelligence (AI) and an upbeat, optimistic view of our future. It is impossible to do justice to all the invigorating ideas and style of presentation here but I will try to convey some impression of the treasures to be found in the book.

The first chapter sets the stage with a survey of the history and current state of robotics and AI. In the second chapter, 'powering up', Moravec forcefully demonstrates the growth in computational power and speed this century and convincingly argues that we already know that it can continue its onward charge without slowing down for decades to come. Careful calculations of the computational of the human brain (based on the retina's processing capabilities) are made to give us a benchmark by which to compare computing power. According to Moravec the retina's processing can be matched by one billion computer calculations per second. The brain has 1,000 times as many neurons as the retina but they are packed into a volume 100,000 times as large. A guesstimated calculation suggests that (using a compromise value of 10,000) the human brain could be matched in processing power by a computer performing 10 trillion (10^{13}) operations per second (teraops). This is 1 million times faster than the machines used to run robots now and 1,000 times faster than the most powerful supercomputers around. If the standard processing-to-memory ratio continues to hold our humanlike computer would require about 10 trillion words of memory, or about 10^{15} bits (computer words are between 16 and 64 bits long). It is only an estimate, although one based on



Since 1900 there has been a trillion-fold increase in the amount of computational power that a dollar will buy.

what is known of the brain, the 10^{15} bit memory of a humanlike computer should be comparable to the information encoded in the 10^{14} synapses of a human biological brain. From these calculations we can say that the most powerful supercomputers (costing \$10 million dollars) of the late 1980s are a match only for the one gram brain of a mouse. This is quite a testament to evolution. How long before the humanlike computer will be possible?



Moravec has a beautiful and exciting chart on p.64 of computing power from 1900 to the present and projected orward at the same, constant rate until 2030. Since 1900 there has been a trillionfold increase in the amount of computation a dollar will buy. At the same rate of increase the 10 teraops needed for a human equivalent computer will be available before 2010 for \$10 million, and in a \$1,000 PC by 2030. A cautionary note - Moravec's calculations are only for advances in hardware; we don't know whether the ability to program (or teach to self-program) a computer to work like a human brain will come about as

quickly. Moravec does give plenty of examples of current research and research paths that show how vast advances are still ahead of us. To take us out on the far reaches of possibility Moravec mentions nanotechnology and the plans for nanocomputers by Eric Drexler and Conrad Schneiker. These computers would use small molecules for their parts and so would have switching times a million times faster than the fastest computer components now. Nanocomputing would allow the human-equivalence criterion to be exceeded a millionfold! A true extropian, Moravec speculates further: Recent physical theories involving superstrings suggest that, in principle, ultradense matter would make possible switching times much faster than the speed of light. Moravec speculates that someday, our non-human progeny may exploit the ultradense matter of collapsed white dwarfs and neutron stars to build machines with a million million million million (10^{30}) times the power of a human mind. I intend to be around long enough to *become* one of those creatures.

We can leave our weak, vulnerable, stupid bodies and brains for something enormously superior.

Chapter 3, 'Symbiosis', discusses the trend towards ease of use of computers, with better menus, icons and so on. Much research is underway in trying to make computers more interactive with humans. Moravec tells us about early versions of 'magic glasses' (leading to an entire 'magic wardrobe') which will be able to create any artificial environment of sight, sound, and touch. The consequences of such a technology will be the subject of an article in a forthcoming issue of Extropy.

The fourth chapter - 'Grandfather Clause' - takes us into areas with which many readers of this magazine will be familiar. The discussion is set up with a description of a robot 'bush' with a trillion fingers, each able to move a million times per second. Just one possible use of such a device would be surgery at the cellular level. Moravec shows his extropic, pro-survival orientation in not being happy at the prospect that we will be left behind as our vastly superior progeny explore the inner and outer universe. Fortunately, for those of us with the desire and guts to do it, that need not be our fate. Moravec presents us a particularly compelling scenario in which a robot surgeon maps your still-functioning brain layer by layer as it writes a program that models the behavior of the brain tissue. At the end of the process, your brain has gone but you (the information that is your identity) resides in a computer brain which is

housed in a body of your choice. This is only one possible method of technological transmigration but the point is that we can leave our weak, vulnerable, stupid bodies and brains for something enormously superior. Once in the new computer-brain you could flip a switch to speed up your thinking by a factor of a thousand or more. Moravec talks of many other changes that would then be open to us, from retarding the onset of boredom so that we could fully use the immense new speed and computational power, to making copies of yourself. Copies may be made to ensure against catastrophic accident resulting in total destruction of a unit. Merging with other people or with copies of yourself that have spent some time accumulating independent experiences would also be options. Taking up temporary residence in bodies of animals such as whales might be an entertaining activity, and matter transportation would be possible although, rather than transmitting matter they would actually transmit the information necessary to reconstitute you at the other end.

A wide-ranging discussion in the chapter on 'Wildlife' brings in present and computer viruses and provides an intriguing warning for SETI advocates about possible parasitic computer or information viruses from space. After having got the reader alarmed by the worrying possibilities that come with the virtually unlimited new power, Moravec ends the chapter on a highly optimistic note. He discusses Robert Axelrod's ideas from his (highly recommended) book *The Evolution of Cooperation* in which it is demonstrated that rational, self-interested agents will cooperate and be 'nice' to each other because this is their best strategy. Axelrod found that, out of a large number of strategies submitted by many people, the most effective one was the 'tit-for-tat' strategy. This involves always cooperating with others for mutual advantage when they do not cheat, never cheating yourself, punishing cheaters, and not holding grudges after the punishment has been given. Cooperation and absence of hostility is boosted to the extent that agents understand the long-term consequences of their actions, remember past interactions, and understand the workings of the world around them. This leads to the extremely extropic and optimistic likelihood that a universe populated by incredibly intelligent, unforgetting agents pursuing their own interests will be one of *maximal* peace, harmony, and productivity.

The final chapter, 'Breakout', is the most far out (yet well-connected to reality) and so hardest to describe. I urge the reader to go out and discover Moravec's ideas in their full glory for him or herself. Speculations are presented as to how we can experience an infinity of subjective experience and thinking in a universe which will have a final end, and, more radically, how we may eventually overthrow the tyranny of the 'laws' of nature and set our own terms. More speculation appears in the third appendix on 'The Outer Limits of Computation'. Here we are told

about nondeterministic computers which can produce endless copies of themselves and which involve using the many-worlds interpretation of quantum mechanics.

Moravec's *Mind Children* will take its place alongside other recent extropian and scientific classics such as Eric Drexler's *Engines of Creation*, Freeman Dyson's *Disturbing the Universe*, and *Infinite In All Directions*, and Robert Ettinger's *The Prospect of Immortality*. I can't recommend this book highly enough. Anyone who shares the perspectives that we present in Extropy will find it a rich source of wonderful ideas, and even the ones that you have come across before will acquire new life.

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Why does the belief in creationism prove so difficult to eradicate? The authors seek an understanding of this stubborn meme, and offer a mental vaccine to combat its spread.

DARWIN'S DIFFICULTY

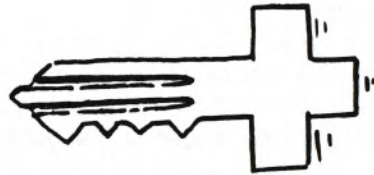
By H. Keith Henson and Arel Lucas

The widespread and long-lived opposition to evolution by Fundamentalist Christian sects is not the first time the religious sector has opposed the findings of science. Copernican astronomy excited centuries of opposition before finally being accepted. Why did the Catholic Church defend theories of a long dead Greek? Why do 'creation science' followers defend a bishop's calculations of a world only a few thousand years old?

We would like something better than an intuitive, hand-waving answer to these serious questions. We would like to be able to make specific predictions and recommendations. Our attempt to answer the creation science question will be in two parts: Why do humans have beliefs at all? And why does the belief in evolution excite so much opposition?

In attempting to find answers, we will invoke Darwin in two places. First, in asking where human evolution has gone in the last few million years. Second, to consider the evolution of ideas (which we also call memes, replicating information patterns, or beliefs) and the forces that shape them. Human and meme evolution are inextricably tangled. This

discussion will switch back and forth from one to other in seeking an understanding (in evolutionary terms) of why evolutionists run into so much opposition from certain segments of the wider community. An understanding of the modern concepts of evolution is assumed. If this gets a bit beyond your level, try reading Richard Dawkins' *The Blind Watchmaker*, a well written and entertaining book on how modern gene-centered evolution works.



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Minor items such as bipedality aside, human evolution in the last few million years has been in the direction of elaborating brains and learning ability. Humans live over a wider range of the Earth's surface than any other animal of comparable size. Our brains/learning abilities are the reasons we have been successful in occupying such a wide variety of habitats.

We learn skills and, once in a while, discover new knowledge as individuals. But most of our learning is from others. a simple example: Learning by trial and error that streets are dangerous because of cars is not a practical approach for children. A good deal of our learning is across generations, the rest from our contemporaries, or from information stored in some material form (books, etc.).

Most of what we learn is from the 'meme pool' (analogous to gene pool) of our culture, and a selected part of it gets passed on to the next generation. A meme pool may be imagined as a set of circulating information patterns (ideas, blueprints for making artifacts, customs, and so on) which structure the behavior of a culturally distinct group.

Once culture got started, it took off in a hyper-cycle where improving knowledge made human survival ever more likely, and the resulting larger populations discovered and passed on an ever increasing amount of (mostly) useful knowledge. Humans and a huge, abstract mass of information have become fully dependent on each other.

In addition to humans evolving the capacity to learn and spread memes, we see Darwinian forces acting on the replicating information patterns themselves. One evolutionary force affecting the frequency of a particular piece of shared information has been the reality of the physical environment. Because they shape behavior, memes which are too far removed from the way the world functions lose influence either by being refuted or by inhibiting the survival of their hosts. Memes which cause severe harm to their carriers usually become inactive, though it may take a long time. The Shaker meme persisted in its active force for about 100 years despite incorporating a ban on host reproduction. Another primary force in the evolution of memes is the rest of the meme pool. Simple competition between similar replicating information patterns for a limited number of 'slots' in human minds results in the survivors of this process being very good at getting themselves into new hosts and, once they have, excluding competitors.

A few meta-memes apply powerful selective forces to the rest. The scientific method is perhaps the best known 'artificial' meme selection force. Phrenology (as a replicating information pattern) is no sillier than palmistry. In spite of a fairly good start, it failed to survive in the scientific meme pool where a close relation to reality is an asset. But a goodly number of memes have no significant relation to reality at all, yet they are quite successful (in the Darwinian sense of existing in many copies). Into this class we would place astrology, Marxist economics, and religions. Our concern in this article is with those schemes of memes¹ which excite those infected with them to actively oppose Darwin's meme(s). How can we account for the opposition?

We will start by showing that our minds developed organizational quirks as a byproduct of interacting modules in enlarging human brains, and then show how these quirks provide a mental substratum for the spread of a whole class of replicating information patterns. Among them we will find the one(s) which excite opposition to Darwin's meme.

Why did our brains enlarge? The advantage may have been larger than the high cost in terms of increased infant care and maternal mortality from getting those oversized heads born. William Calvin in *The Throwing Madonna* proposed one continuous selection mechanism that would come into play for a primate that started throwing rocks and obtained a survival advantage by killing the target instead of just scaring it away.

Timing the release of stones or spears to hit small targets must be

¹Cooperating groups of memes. Credit this clever turn of phrase to Douglas Hofstadter.

done much more accurately than the nerves can usually achieve. Rebuilding the basic chemistry of nerves, or converting to electronics is out of range for the small steps of evolution, but adding more of the same is an old story. Parallel redundant neural networks reduce timing error by well understood mechanisms. Better accuracy would have brought to our ancestors more protein on the table and more surviving children. However they came to enlarge, the brains we now possess support even self-awareness.²

Recent work has found the mind to be organized into a vast number of interacting, simpler modules. A substantial amount of data has arisen from the work of neurologist Michael Gazzaniga, artificial intelligence expert Marvin Minsky, and others. (In some ways, this is an extension of the early work on the structure of the mind by Freud & Co.) Mental modules or 'agents' (Minsky's word) combine into larger agencies to accomplish tasks of great complexity. Starting from a base of hardwired connections from the senses to the brain, Minsky shows how motor activity and feedback from the physical world builds agents that allow a child to stack blocks. Stacking blocks is not a task to be sneered at. Many a graduate student-year has gone into building machines that fall short of the abilities of a three year old! Memes may be seen to program or direct the formation of more complex agencies such as those for chipping rock or making clay pots or shoes.

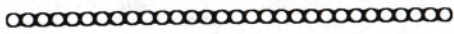
Minsky speculates that a substantial number of our agents are censors. It's easy to see how, with an enlarging number of modules in potential conflict, we need censors to stop us getting into logical tangles or 'inappropriate' behavior. They may work by detecting unfruitful 'loops' or painful thought activity in other parts of the brain, and inhibiting the part that is thinking 'improper thoughts'.

One 'improper thought' is to think about our mortality. In getting smarter and being able to plan far enough ahead to store food or plant a crop, we have gained powerful agents with 'think ahead' ability, and they have been so successful in helping us survive, that we can't 'wire out' the ability to think about the future and our own end. This is, however, an unproductive and (at least potentially) a survival-threatening class of thinking. Such thoughts are likely to activate censor modules that powerfully inhibit further thought about the topic.

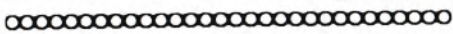
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²Marvin Minsky proposed in *Society of Mind* that what we call 'consciousness' arose as the result of the evolutionary reassignment of redundant capacity to new tasks. Thus, the larger brain may have preceded the 'smarter' brain. 'Newer' thinking skills (which have had less evolutionary honing) may still have more variation than older skills.

So far we have Minsky's censors and 'think ahead' agents. Gazzaniga clearly demonstrated the presence of another agent, an 'inference engine'. This mental module detects or invents plausible 'causal' relations, sometimes when there aren't any. New replicating information patterns seem to be invented (or recombined) here. The same hardware seems to be involved in judging meme input from others for plausibility. It makes evolutionary sense that unsatisfied inference engine problems would be anxiety provoking. If there is no 'explanation,' there is no way to predict



Ritual passed on through memes gives the illusion of control . . .



(or control) when similar events, especially frightening ones, will happen. Almost any answer, no matter how far fetched, reduces anxiety. There is a great deal of data on the functioning (and malfunctioning) of this module in Gazzaniga's The Social Brain, and in the landmark Human Inference by Nisbett and Ross. Ritual passed on through memes (praying, rites, etc.) gives the illusion of control over events, a psychological function known to be essential for mental health.

Though the plausibility standard of the inference engine is pure National Inquirer, the importance of this module should not be underestimated. It was a milestone in our evolution, and lies behind every advance we make. But it was shaped by evolution to jump to the conclusion that the noise in the bushes is a bear. People who reject its less plausible outputs do so at the conscious level, making use of difficult-to-learn logical and mathematical skills.

To sum up, our think ahead (and look back) capacities raise painful questions, for which our inference engines either invent 'causes' or judge acceptable some meme obtained from others. The effect of these modules has been to open our minds to replicating 'explanations' of our origin or fate. Religions and such 'new age' philosophies as 'cosmic consciousness' memes or beliefs satisfy the inference engines in most of us, providing explanations - superficial or profound - to account for times before birth or after death.

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Just as chemical replicators were the consequences of the primal soup, this entire class of memes is the consequence of the way our mental processors were long ago wired up by evolution, and the recent growth (in evolutionary terms) of these processors. Beliefs in this class can be traced back at least as far as the beginnings of oral history, and probably go back much farther, given the findings of pollen in 70,000 year old graves.

By now, the difficulties evolution has as a replicating information pattern should be apparent. In explaining one side of the where-did-we-come-from /where-are-we-going question, evolution is in serious competition for limited mind space with a large group of well-adapted, fearsome competitors, many of which have induced groups of those infected to incredible physical exertions, from building cathedrals to flaying infidels.



There is an even more important strike against evolution in this competition. Most of the religious memes provide for both origin and fate. Unlike them, evolution deals only with origin and says little (certainly nothing comforting) about our fate, either as individuals or as a species.

With so little going for it, why has the meme of Darwinian evolution had any success at all? First, physical evidence - especially from geology and biology - and the meta-meme of the scientific method are supportive of evolution as a meme. Second, our tolerant, secular world, with its diverse religions and rapidly increasing scientific knowledge was complex enough when the concepts of evolution were introduced that space in minds was available that was not wholly committed to competitive memes. Had there been no diversity in the religions at the time of Darwin, the religious meme carriers might have succeeded in suppressing ideas about evolution, or at least censoring those holding such beliefs as they did temporarily with Copernican astronomy.

As it turned out, the memes of evolution have spread well in the subpopulation of receptive humans. They fit in seamlessly with the scientific meme pool. Since Darwin, most religious schemes have evolved to at least ignore natural history, waxing metaphysical and getting vague about the meaning of passages written by (or about) nomads thousands of years ago. But a few of the religious belief patterns have successfully evolved into an expanding niche (especially in the Southern part of the US) where organized opposition to evolution memes is a distinguishing, even driving feature. The beliefs evolved fit comfortably into a meme pool that is almost an inversion of the scientific one. The developing situation is reminiscent of the struggles driven by memetic competition that sometimes turn into physical conflict between groups of people infected with different religions.

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On this rather alarming note, let us resume thinking about mental models and see if a better understanding of the processes within the minds of 'creation scientists' and their ilk can come out of it.

We are going to assume some 'mental space', and speculate a little about the shape and function of it. We are not proposing a literal, physical space into which ideas tumble and take root, like fertilized eggs in a uterus, yet the metaphor is useful. Consider 'mind' to be composed of various 'modules', or functioning computational sites like parallel processors within a computers. The form and identity of many of these modules are shaped by memes. Thus we could say (from examination) that a person has the baseball meme (or memes). That is, enough knowledge so that they could teach a recognizable game to a group of children who had never seen or heard about it.

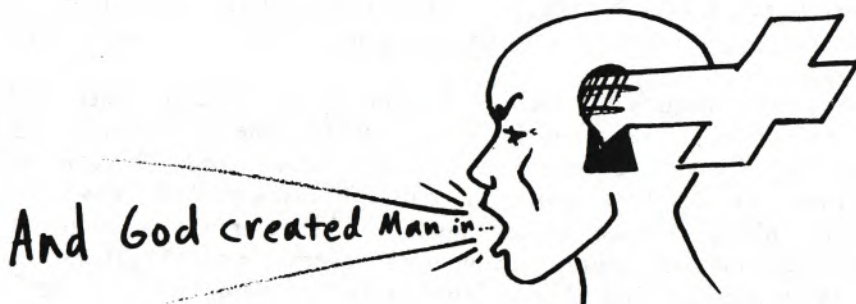
'Game' memes seem to have relatively little competition with each other. Knowing about baseball probably has little susceptibility to learning marbles, hockey, or hopscotch, though there is competition among these memes for a person's 'game time'. This is not true of all memes. Memes of the religious class are quite effective in excluding each another. Games do not include a 'play only this game' sub-meme; religions ordinarily do. Religion memes may be taking advantage of the mortality censors, i.e., having acquired an 'explanation' that accounts for 'after death', the censors close off thinking that may change the structures of this area. For those who already have one religion, there is little to be gained by acquiring a different one. In former times, and to some extent today, changing religions often cost you your social group. During our tribal past, questioning the tribe's beliefs or ritual was potentially disruptive, a threat to the group, and, even up to late historical times, put your survival in question.

Anything statistically affecting survival can cause genetic bias to emerge if there is variation in the available genetic material. Edward Wilson and Charles Lumsden in *Genes, Mind and Culture* provide suggestions as to how units of cultural transmission may influence hereditary 'biases' toward certain kinds of behavior via a cycle of both physical and cultural reinforcement over several hundred generations. It seems fairly obvious that if your tribe makes its living with chipped rocks, inability to learn how to chip rock will be bred out after a while. Likewise, we may have coevolved with religious memes to accept, and not question, the one of our tribe.

Memes of the religious class infect a majority of the people in most countries of the Western world. The combination of widespread vulnerability to these memes and (normally) exclusive rule of one set of memes per mind has led one of us (Henson) to propose a 'religious meme receptor site' in human mental space, with the usual properties (selective

stickiness and exclusion) of chemical receptor sites). Selective stickiness means that only 'religious' beliefs can occupy the site. The 'energy currency' to measure stickiness might be the lower level of anxiety from 'solving' inference engine problems of the where-did-I-come-from/where-am-I-going kinds. Exclusion provides a test of what is a religious belief, and forces us to include (for example) communism in the class of competitors for the site. Unless our analogy is misleading, the site may be shaped/prepared by other memes (concepts) and experiences that are commonly learned in childhood. Wherever it is in human mental space, the 'religious meme receptor site' appears to be ROM-like. That is, once occupied, programmed, or constructed, its content does not change, and its influence is not likely to change in intact people (though ablating a small region in the temporal region of the brain destabilizes beliefs of this category, according to Gazzaniga). It is not that people never change religious beliefs, but just that they are relatively more stable in this aspect than say, political opinions. 'Changing' religious beliefs seems to be more of a process of building a new mental structure and cutting the old one off from behavioral connections.

Religious meme receptor sites may be 'close' in mental space to the 'mortality censors' mentioned above. Religious memes may be protected by the censors, normally preventing us from thinking about (and potentially changing) beliefs near to this area.



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Since we are discussing receptor sites, let us mention 'module activation sites'. This would be a recognition activity on the 'surface' of the module built by a meme. For example, the baseball agency built by the baseball meme would recognize a physical baseball (or a bat, a mitt...) through visual or tactile senses and activate the appropriate parts of the module given the context. These sites would recognize the spoken or

written word 'baseball' and the names or pictures of prominent players. There might even be a site that recognized roasting peanut smell. (The baseball agency might respond by bringing up the memory of a particular game.)

In the case of a person with an influential creationism programmed meme, the very words 'evolution' or 'Darwin' may instigate complex behavior patterns, especially when a child comes home and mentions that they were studying the 'E' word.

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Are there practical applications of these theories? That is, can we make predictions with this knowledge? Most of the predictions we have thought of so far are post hoc: we already know that those spreading the evolution meme run into dedicated opposition. The theory partly accounts for the difficulty we have in trying to explain our case, but we already knew that logical arguments have little effect in changing the beliefs of people who believe in the creation meme.

Perhaps one idea to try would be to avoid the trigger words that arouse these mental structures. It is in fact more descriptive to refer to principles of 'variation and selection' than to evolution. Richard Dawkins' 'biomorph' computer program is particularly good at demonstrating these phenomena. Copernican astronomy displaced the Ptolemaic system because it provided a superior world view. For the same reason Creationist beliefs will eventually be displaced.

This analogy might be of use in public arguments. The comparison alone may be a useful argument if it opens a chink in 'mind armor' enclosing creationist memes. The most effective people in spreading Creationist memes are intelligent, but have mental agents that put up strong defenses against the commonly used arguments. New arguments may engage other mental mechanisms. It is even possible that novel thoughts about the mental structures holding their beliefs may shake a few of them.

A more attractive possibility would be to construct a 'scheme of memes' which includes science and evolution memes but is more effective in competing for the religious meme receptor site. This is what the Humanist movement is about. The memes behind this movement appeal in that they are in concert with the memes of science. In competing for religious meme receptor sites in human minds, however, we see two ways in which scientific/humanist beliefs fare poorly in comparison to the opposition. First, humanist beliefs answer where-we-are-going with no hope for anything beyond a short life and oblivion. Second, it denies human control over the forces of nature (except through raw engineering efforts). As human control over our environment increases, the second will become less of a drawback. We have personally found a way to hope

for less than oblivion through cryonics and the developing concepts of cell repair machines, but going into detail would take too much space.

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Even if we can't do much now about the spread of creation memes or with those who are infected with these memes, it is useful to know what we are facing. The knowledge may eventually lead to really effective programs, but even if it does not, it may keep us from wasting our time on futile activities. At least for us, we are less upset by the irrational behavior all around us now that we know it has an understandable origin in our evolutionary past.

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(Editors' note: Keith Henson was one of the founders of the L5 Society, which was dedicated to preparing us for space colonization. He now devotes some of his considerable energies to political and legal action in defense of cryonics. Arel Lucas is also involved in the cryonics movement and works with the Alcor Life Extension Foundation.)

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Extropian people protect their health both for its immediate benefits and because it increases their chances of living to a time when science has conquered aging and death. But extropians are also busy enjoying their lives to the fullest, and staying healthy takes precious time. In this article, Dr Harris' describes a breakfast that will not only save your time - it could save your life, as well!

A Truly Instant Breakfast

by Steven B. Harris, M.D.

Most people who have been on a health food kick at one time or another have attempted to make some sort of blenderized health food drink a part of their dietary regimen. This phase usually lasts about a week. It seems that although recipes for such concoctions abound in every book on the subject of health, they all have one thing in common: they taste just awful.

The main reason for this sad fact seems to lie with the ingredients that health advisors insist on choosing for such drinks. There is, for instance, brewer's yeast -- a nauseating substance that was a favorite of the late Adele Davis. If the truth were told, brewer's yeast has little to recommend it now that any vitamin or mineral is available in pill form, yet it is still finding its way into health food drinks today as though Glucose Tolerance Factor were the elixir of life. Another favorite drink component



for those with a Calvinist approach to nutrition has been lecithin - a granular, fatty material derived from soybeans. Lecithin has been touted for its effect on cholesterol, an effect which is similar to (but no more potent than) that of corn oil. Unfortunately, lecithin's peculiar taste for many people grows rapidly intolerable and impossible to disguise. Yet another frequently recommended additive to "health" drinks is protein supplement powder, a stuff which seems to come in as many different forms as it does terrible flavors.

Add to the use of all these substances the faddist's impulse to put in his blender any vegetable which looks like his mother may have wanted him to eat as a child, and you have a recipe for what doctors call "nutritional noncompliance". Faced with such messes, it isn't surprising that, before long, the well-intentioned folks who swore to eat healthily are found back at their old habits of coffee for breakfast, and a trip to vending machine at 10am.

This is a shame, for there are compelling reasons for having some sort of nutritional breakfast drink. The obvious one is that many people have little time in the morning, yet would benefit from breakfast. Few people operate at top efficiency at the end of a 16-hour fast, yet that is the time between the average supper, and lunch the next day. Then too, people who "skip" breakfast often snack before lunch, and when they do, they invariably snack on "snack foods" that are nutritional disasters. Breakfast, on the other hand, because it is a meal which is often invariant (at least during weekdays), affords an ideal chance to easily put together one meal of the day which has the right things in it.

So what to do? A few years ago, the people at Carnation Company came up with a partial answer: the "Carnation Instant Breakfast™". The thing that distinguished the Instant Breakfast was this: it actually tasted good. The product was billed by Carnation as being complete nutrition in a single glass. "Makes milk a meal!" they said.

Of course, it didn't. Although an instant breakfast has a third of the RDA for vitamins and minerals, it is marginal in protein (15 grams, or about 30% of the RDA of milk protein for a 70kg man), and is way short on calories. A mixed Instant Breakfast has only 280 Calories. In fact a recent product variation containing Nutrasweet (a sop to the mistaken public

view that sugar is unhealthy) has only 220 Calories when mixed.

And calories aren't the only problem. While there is very little evidence that simple sugars in the diet cause any harm for the average person (beyond increasing the chance of dental decay for those who don't brush carefully), there is much evidence that the big killer in the Western diet is saturated fat. Percentage of calories in the diet as saturated fat correlates better with blood cholesterol levels and heart disease incidence than any other factor. Unfortunately, a "low-sugar" instant breakfast mixed with the recommended whole milk delivers 20% of its calories as saturated fat - a ratio worse even than average for the American diet, and on a par with the most atherogenic diets in the world, such as those of Finland and Ireland.

Fortunately, some manipulation can be done fairly easily to make things come out better. Carnation Instant Breakfast can be mixed with skim milk, and the missing calories and even some extra protein added by appropriate supplements. The following recipe uses powdered milk to add protein, and maltodextrin (a kind of soluble, nearly tasteless, partially broken-down corn starch) to add calories. The resulting fortified drink tastes pretty much like a regular Instant Breakfast (a bit thicker), but is more impressive nutritionally. It has 470 Calories, 27 grams of protein, and an insignificant amount of fat (1 gram). It also (for what it may be worth) shares the Instant Breakfast's good micronutrient nutrition.

Fortified Instant Breakfast

Prepare 4 to 8 cups of 1:1 dry mixture of Carnation powdered milk and maltodextrin powder. Maltodextrin may be purchased from Vitamin Research Products, 2044 Old Middlefield Way, Mountain View, CA 94043. (I'm going to be on the lookout for a cheaper source of this, and will advise). Keep this mixture at room temperature in a small flour can (or sealed bag if you don't have one) with a measuring cup, ready for use.

For Fortified Instant Breakfast, add to a 16 oz. glass:

- 1) One pkg. regular (no Nutrasweet) Carnation Instant Breakfast.
- 2) 2/3 cup maltodextrin/powdered milk mixture.
- 3) 10 Oz. skim (NON-fat) milk.

Preparation and mixing time (with a spoon) is less than 60 seconds. (Real morning speed freaks who like only one flavor of Instant Breakfast can even add an appropriate number of envelopes of Instant Breakfast dry to the other ingredients beforehand, and simply measure out a cup of the resulting dry mixture in the morning.) Although Fortified Instant

Breakfast isn't quite a third of your needed daily calories, it is almost guaranteed to get you through until lunch.

Questions

Q: Is this the optimal breakfast?

A: No, but this is about the best you can do at low expense (less than \$1.50), if you require good taste and almost no preparation or eating time. It lacks fiber, and could be improved by adding a bran muffin (no butter) or a piece of fruit. A banana can even be added to the drink itself for those who insist on using a blender. Perhaps an even better breakfast is hot oatmeal, dry toast and jelly, fresh fruit, and skim milk - but of course all that takes time.

Q: Why bother adding all the calories? I don't need an extra 470 calories in the morning.

A: Yes you do. Humans regulate their total caloric intake to a remarkable extent over the course of an average day. The idea that one is cutting down on calories by missing meals is usually wishful thinking. Rather, every hundred Calories you eat in the morning at home is likely a hundred Calories you won't eat at work, where nearly all the available food is nutritionally sub-optimal. A larger breakfast discourages snacking before lunch. Low-fat diets contribute to weight loss, since studies have shown that dietary fat is somewhat more efficient at promoting weight gain than its caloric value would suggest. And low saturated fat diets drastically cut the risk of atherosclerosis and death.

Q: What about drinking this stuff at other times?

A: As it is nutritionally balanced, you can substitute a Fortified Instant Breakfast for a meal anytime, probably to your health advantage. For instance, one fast meal a day which contains 27 grams of high quality protein (as this one does) can make the planning of vegetarian diets a snap.

(Editors' note: Steve Harris works with Roy Walford at UCLA on life extension research and is an expert in the field.)

What sort of moral theory best serves extropians in their battle against entropy? The author's response offers solace to all who have sought the Good in our world of arbitrary rules and flaccid relativism.

WISDOMISM

A Moral Theory for the Age of Information

by Tom W. Bell

In the last issue of *EXTROPY*, co-editor Max O'Connor presented a number of powerful arguments for amorality in his article titled "Morality or Reality?". While I share many of Max's sentiments, I think that he goes too far in rejecting all moral systems. He reveals the attitude of one who, disappointed with physicists' failure to produce a grand unified theory, demands that we do away with physics altogether. As a guide to the behavior of rational, autonomous agents, morality serves an important role in our lives. Morality may still be imperfect, but that's no reason to quit the study of ethics altogether. Let's give morality another chance.

In the pages that follow, I'll present a new moral theory, one I call "Wisdomism". Wisdomism is a teleological moral theory that defines good acts for an agent as those that maximize the agent's wisdom. I will briefly lay out Wisdomism's basic principles, examine some of their consequences, and defend the theory against objections. As a relative newcomer to the field of ethics, Wisdomism has a way to go. Nevertheless, extropians will find particularity Wisdomism particularly appealing - more so than the formless chaos of amorality.

1. Wisdomism's Origins

A. Its Aristotelian Roots

Wisdomism takes roots in the moral theory that Aristotle presents in his Nichomachean Ethics. Like Aristotle, I seek the human telos, or end, in what is unique to humans. I consider rationality to be such a trait, as does he. Likewise, we agree that the good for humans is the fulfillment of their particular telos.

But although human rationality is unique, it is only one of many special attributes of the human brain. Humans exercise not only highly developed powers

of abstract deductive reasoning (i.e., what Aristotle means by 'rationality'), but also inductive reasoning, creativity, massive data storage and recall, great flexibility, etc. In order to embrace all these information processing powers of the human brain, I employ the general term 'wisdom'. While it is true that other animals process information, too, none do so as well as we humans. What is unique to us, therefore, is our *great power* to process information, our *particularly high degree* of wisdom. It follows that the development of wisdom is our particular telos, and the highest human good.

We see then how Wisdomism springs afresh from venerable Aristotelian stock. Wisdomism branches away from Aristotle's moral theory rather quickly, however. Along with rationality, Aristotle includes virtue and the enjoyment of the exercise of rationality and virtue in his definition of the human telos. Given that these traits depend crucially on rationality, however, I don't think they merit status equal to it. So although the two theories share a common method of determining the human good, Wisdomism asserts that there is only one uniquely human trait, only one primary human telos, and only one basic human good: wisdom. The good act for any moral agent is therefore the act that maximizes that agent's wisdom.

B. Wisdomism and Ethical Egoism

Though I've rooted Wisdomism in Aristotelianism, we might also graft it onto ethical egoism. Ethical egoism claims that each person ought to act in her or her own interest. Fine, but what makes a person a person? Is it a body? No, for we grant personhood to the handicapped, mutilated, and deathly ill - as long as they can *think* like persons. Is it a brain, then? No, for even if we could download into computers we would retain our personhood. How? By downloading our memories and thought processes - that is, our wisdom. This particular interpretation of selfhood leads us far from everyday ethical egoism, however. To Wisdomism, the self *is just* wisdom. The self combines a particular set of memories with a particular set of thought processes, knowledge with intelligence, data with processing rules, . . . As I like to say, the self is an 'information construct'.

But this means that like any other meme, selfhood follows information across the barriers of body and brain. If another brain in another body has exactly the same memories and thought processes as you do, it *is* you. Likewise, if someone shares a great deal of the ideology of a particular nation, church, or culture, he may find himself in a situation where he advances his self-interest, as embodied in the ideology he follows, at the expense of his body and brain. Sociobiologists say that natural selection has led to much the same result in regards to genetic selfhood: a mother sacrificing her own life for those of two or more of her children actually maximizes the preservation of her genetic self, since each of her offspring carries one-half of her genes. Likewise, whereas ethical egoism tells us to act in the interests of our selves as bodies and brains, Wisdomism tells us each to act in the interests of our selves as information constructs - no matter what medium we find 'ourselves' expressed in.

2. Some Consequences of Wisdomism

A. The Computability of Wisdom

While Wisdomism springs from Aristotelian roots, it bears one of the fruits

of Utilitarianism: quantitatively determinate moral values. Just as Utilitarianism defines the good as utility, Wisdomism defines the good as wisdom. Theoretically, we can calculate utility via the hedonic calculus. Wisdom offers us the same measure of exactitude. As stated earlier, the information processing powers of the human brain give rise to our wisdom. We will someday, possess sufficient knowledge of the brain's operation to describe its information processing in terms of inputs, outputs, and functional states, thus allowing us to determine the precise amount of wisdom in the human information processing system. Then Wisdomism will allow us to bridge the gap between science and morality. Wisdomism's moral principles will no longer be proscriptive, but descriptive. 'Is' will finally imply 'ought'.



total wisdom =
 knowledge X
 intelligence X
 duration X
 probability



Until such time, we may confidently employ what Mill called "rules of thumb" to guide our moral choices. For example, death is *prima facie* a great evil, for it destroys the fantastic information processing powers of the human brain and renders inaccessible the vast amounts of data encoded in the dead individual's memories. Seen in this light, death destroy's one's unique wisdom, one's special information construct, one's only complete self. Likewise, we generally ought to encourage telling the truth, for the transmission of false information hinders our abilities to process information correctly, thereby decreasing our wisdom.

Perhaps most importantly, Wisdomism tells us to generally pursue our own individual interests. We must restrict our moral decisions to the realm we know best. To try and decide the fate of all the information constructs similar the one's own would not only waste time, it would result in terrible miscalculations. So except in those rare situations where we wield great power and are extremely well-informed, Wisdomism asks only that we breath easy and act like egoists. In these cases, and many others, we need not take the time to laboriously calculate the effects that our actions will have on the amount of our wisdom in the world at large; generally true rules of thumb will suffice.

These examples of rules of thumb also serve to suggest a possible format for Wisdomism's particular 'calculus': "total wisdom = knowledge X intelligence X duration X probability" (where knowledge is the amount of information in a system and intelligence is the efficiency with which the system processes information). Under Wisdomism, therefore, the moral act for an agent is the one that maximizes the total amount of the agent's knowledge and intelligence, for these acts also maximize the agert's wisdom.

B. Wisdomism and Extropy

A *fully* developed functional description of the brain will be couched in the terms of physics. It is common for physicists to equate entropy with the loss of order, or information, in a system. It seems appropriate to posit wisdom as the exact opposite of entropy, making the two opposed as good and evil forces. We see then that wisdom equals extropy, and that Wisdomism defines extropy as the highest good.

Equating good with extropy and evil with entropy may seem depressing in light of the second law of thermodynamics (i.e., that in a closed system entropy tends to increase or remain the same). Take heart, however: in *semi*-closed systems, such as here on Earth, entropy may actually *decrease*. It may also turn out that the universe at large is a perfectly reversible process, going from big bang to cosmic crush with no net increase in entropy. And in any case, following Wisdomism will give us the power to defeat the second law of thermodynamics. By fully understanding of the laws of nature, we may someday come to overthrow their restrictions. They have, after all, been imposed on us against our wills - we never consented to their limitations. Wisdomism offers us *ultimate* anarchy and absolute freedom: down with the laws of nature!

Wisdomism offers us
ultimate anarchy and
absolute freedom!

C. Wisdomism's Generality

The discerning reader will note that I have been referring not only to the amount of wisdom in human brains, but also to the amount of wisdom in information processing systems in general. That's because once we have a complete description of the human brain, we may expect to find functionally similar information processing systems embodied in other mediums. Only human chauvinism prevents us from admitting the possibility of wise extra-terrestrials, or conscious computer programs. We may even discover that economic and ecological systems exhibit all of the functional requirements for wisdom. Wisdomism asks that we consider the interests of these wise *non*-human systems, too - *if* they share our particular information constructs.

D. Wisdomism and Politics.

Like most moral theories, Wisdomism's tenets have political repercussions. Wisdomism naturally favors political institutions that maximize the amount of wisdom in the world, just as Aristotelianism favors political institutions that maximize eudaimonia, and Utilitarianism favors those that maximize utility. In each of the three cases, it must remain, strictly speaking, an empirical question as to which political institution (if any) actually satisfies the standards of the concerned moral theory. Wisdomism differs from its Aristotelian and Utilitarian kin, however, in placing a value on political institutions *per se*, as information processing systems.

At first glance it seems as if Wisdomism says that what political system one ought to support depends on the particular information construct in one's own

head. If you think like a socialist, you'd act most morally by supporting socialism. If you share fascist ideals, you'd advance fascism. Recall, though, that Wisdomism says the best acts maximize the total amount of one's wisdom. This means we must consider how well political systems produce and process information, as well as their duration and probability of their continued success. Things aren't as simple as making the world satisfy our thoughts - we must also to choose our thoughts so that they will satisfy the world.

Wisdomism thus tends to favor democracies, in so far as their many voters serve to enrich the inputs into the political systems. Wisdomism likewise smiles upon the sort of parallel processing that multi-party systems afford, and the free flow of information assured by constitutional rights.

Wisdomism scarcely offers a *carte blanche* for government growth, however. Political systems flourish only at the expense of economic systems, and the latter may well embody more wisdom than the former. After all, citizens vote in binary - yes or no, while consumers convey their preferences in analog, via dollars and cents. Economic consumption therefore transmits much more information than voting. It therefore seems that Wisdomism will favor minimalist democratic constitutional republics at the most, and free-market anarchies at the least.

3. Objections to Wisdomism, and its Defense

A. Is Wisdomism Anti-Human?

The most prominent worry about Wisdomism is that it might produce moral judgements contradictory to our common sense intuitions. Although I hope to assuage such worries, it bears noting that moral theories need not be too narrowly constrained by what we find most comforting. Of what use are morals if not to change our behavior? Wisdomism aims to make our actions right - not easy.

Given Wisdomism's generality, we can imagine situations where the interests of one's own brain or body conflicts with the interests of a wise non-human systems sharing much one's own wisdom. For example, suppose that the vast power needs of a super-wise computer require that an entire city of humans to forego electricity. Or suppose that it proves to be in the interests of some race of super-wise aliens to destroy the Earth in order to build a trans-universe expressway, as in A Hitchhiker's Guide to the Galaxy. Wisdomism might demand that human's sacrifice their comfort, perhaps even their lives, in such situations. Is this an acceptable result for a theory that purports to determine the good for humans?

First of all, let me note that most of Wisdomism's tenets will correspond quite nicely to the moral intuitions that most of us already possess. This was demonstrated above, in the discussion of Wisdomism's rules of thumb. Wisdomism will never ask us to sacrifice our planet to alien civilian engineers, for example, because it recognizes the disposition for egoism as a wonderful means of advancing wisdom. Note secondly that moral intuitions don't *always* favor the interests of our bodies and brains, as is evident in many current moral debates. The environmentalist movement, for example, has been initiated by people who feel a deep empathy for vastly complex, efficient and information rich ecosystems. It shows particular concern for the wisest of non-human animals: dolphins and whales. We might say that environmentalists value the wisdom of

Nature, a wisdom they feel they share. Animal rights activists and vegetarians likewise object to what they see as the needless destruction of their kin. All of these parties feel moral obligations to consider the interests of other information processing systems with which they share certain traits. It should not prove too suprising if Wisdomism asks us to do the same.

B. Is Wisdomism Cold-Hearted?

Some may object that Wisdomism is a theory that only a technocrat could curl up to. Nowhere in Wisdomism's guidelines is a mention of pity, love, or compassion. It is, they might claim, a cold-hearted theory.

Emotions are drugs, and our attachment to them is nothing short of chemical dependency. But Wisdomism does not ask that we go cold turkey!

While it's true that Wisdomism offers few of the emotional garnishes that usually accompany moral theories, I scarcely see this as a disadvantage. Though Wisdomism may be cold-hearted, at least it isn't hot-headed. I've made it clear that I consider emotions to be part of our baser natures. Emotions are drugs, and our attachment to them is nothing short of chemical dependency. But Wisdomism does not demand that we go cold turkey! For the present we must tolerate our fleshly limitations, in the hopes that someday they may be overcome.

C. Is Wisdomism Fatalistic?

Some may find it curious that while I speak of Wisdomism being based in the laws of physics, in the same breath I speak of following its tenets. If wisdom's course is determined by the laws of physics, of what use is a moral theory that tells us to help it along? Do physical laws leave any room for moral laws?

Those who make this objection make the mistake of assuming that determinism must lead to fatalism. Just because the laws of physics dictate our behavior does not mean that we are free of moral responsibilities. Wisdomism is a part of the universal mechanism, too, and its force can be denied no more readily than that of gravity or magnetism. Indeed, we would have occasion to be suprised if the same laws of physics that have given rise to complex information processing hardware did not also generate software to ensure its survival. In a sense, that's exactly what Wisdomism is: a survival program for wise information processing systems.

To conclude, we've witnessed the birth of Wisdomism, the spread of its range of applications, and its defense against various attacks. As moral theories go, it is

a mere new-born; clearly it must develop a great deal before it can hope to challenge its predecessors. In at least one sense, though, Wisdomism already has an edge. The answers to all moral questions, even those that ask what (if any) moral theory we should adopt, demand the one thing that this theory promises to best provide: wisdom.

(Though this article was written as a rebuttal of Max's own views, he has lent a great deal of his own wisdom to its writing. More than just thanking him, I would like to tell him that he has acted morally - though as an amoralist he must refuse the latter accolade!)



NANOTECH NEWS

Reported by Max T. O'Connor

Nanotechnology was unheard of just a few years ago. The word had not been coined and almost no one had thought of the idea except for the great Caltech physicist Richard Feynman. In a 1959 talk before the American Physical Society entitled "There's Plenty of Room at the Bottom" Feynman introduced the possibility of nanotechnology. Feynman, who won the Nobel Prize in 1965 for his foundational work in molecular technology, unfortunately died in February 1988, missing the startling innovations that are to come from his ideas. In this first nanotech news update I will first very briefly explain what nanotechnology is for those who don't know, and then describe some recent advances in molecular-scale memory devices.

'Nano' is a prefix which means a one-billionth part. A nanometer is one billionth of a meter (or a millionth of a millimeter). To place this in perspective: atoms are generally 0.1 to 0.3 nanometers in diameter; a glucose molecule is just under 1 nanometer; and an average human cell is 10,000 nanometers. Nanotechnology involves the manipulation of matter right down at the atomic level and the building of machines and computers at that scale. It will allow us to build anything to exact specifications and with perfect quality by the use of molecular assemblers. We will control these molecular devices via nanocomputers, which will be only a few cubic nanometers in size and will use ultra-fast molecular tape memories instead of integrated circuits.

Nanotechnology can remove every bit of pollution from the atmosphere, giving us back crystal-pure air at last. It can build anything we want virtually cost free, move through our bodies destroying harmful viruses, fat deposits, and cancers and maintaining us in perfect health, revive cryonic suspension patients from biostasis, and construct entire colonies in space or other planets ready for us to move into. Most nanotechnology is currently theoretical, involving 'exploratory engineering' and is only just beginning to be widely discussed. Eric Drexler, author of the nanotech classic *Engines of Creation*, moved from MIT to Stanford in 1987 to teach the first course in the subject. Figures like Freeman Dyson of the Institute for Advanced Study at Princeton and MIT's Donner Professor of Science Marvin Minsky back up nanotechnology's potential. An increasing number of symposia are held in this new field by corporations as respectable as IBM, and last year's Fine Particle Society Convention was dominated by discussions of molecular electronics instead of its more usual pedestrian fare.

An excellent popular article in the November 1988 issue of *California* magazine reported on a breakthrough in the beginnings of real, concrete nanotechnology. The accidental breakthrough took place in January 1987 at a high-security lab near San Jose. It happened while IBM physicist John Foster and his colleagues Jane Frommer and Patrick Arnett were trying to find an image under a microscope that is capable of resolving images at the molecular level. In trying to remove some unwanted molecules from the tip of a very fine tungsten wire by sending some electricity through it, Foster found that he had apparently dislodged a single molecule of dioctyl phthalate and attached it to the graphite surface. It was early 1988, almost a year since that accident, before they were able to duplicate the feat. Pictures of it were taken, one of which was published in *Nature*, and 'the last technological revolution' began. It will probably be decades until mature nanotechnology arrives with its general assemblers and nanocomputers, but from now on we will see an accelerating series of advances in the field, reports of which will be printed in this magazine.

One such recent advance was reported in the *Wall Street Journal* on September 13, 1988. The prototypes of computer chips with working parts made of individual molecules have almost arrived, although the researchers say that computers based on this advance won't be available for years. While we have yet to achieve single-molecule computing, there are now ways of performing basic logic operations with groups of about a thousand molecules, and this will push miniaturization far beyond its current state. At Syracuse University lasers are being used to change molecules' shapes in order to store information, and a group at MIT is building miniscule transistors made of organic molecules.

In August 1988, scientists at the Jet Propulsion Laboratory in Pasadena, California, put forward a detailed plan for a molecular memory device which could be built with existing technology. Since computers are limited by switching speeds, and molecules can perform on-off switching 1,000 times faster than current computer chips, we can look forward to big increases in computing speed and power. Researchers have proposed several ways to use molecules as on-off switches. Robert Birge's group at

Syracuse University does it by changing the shape of a bacterial protein by firing carefully controlled bursts of laser light at it. A second burst restores its original shape. Since the two shapes have different optical properties they can be used to read and write data. The Syracuse team is currently trying to build a computer memory containing millions of these bits. One problem that has already been identified and solved is that the laser light that 'reads' the shape of the molecule also changes its shape and therefore the data that was read. This difficulty was overcome by using one laser to register the information and a second one to reset the molecule to its pre-reading state based on the information gathered by the first laser. Though problems remain in rapidly and accurately directing the laser beams, the researchers expect to have a memory device based on this technology in two years.

The JPL group, as reported in Science, also use lasers with molecular memory devices, but use electrons rather than molecular shapes to encode information. Their proposed device would be made from polymers - identical organic molecules arranged in chains - which would contain electrons. The electrons would jump from one subunit to the next when hit with laser light. By letting the presence of an electron represent a 'one' and its absence a 'zero', each polymer would act as a string of data bits. Though difficult to create, the researchers point out that it could be built with existing technology. These devices should also be ideal for inclusion in neural network computers which function similarly to our brains. This is the kind of solid research on which we base our extropic visions and projections. We will keep you informed of continuing breakthroughs as we go on and speculate about its future applications.



Warning! A particularly vicious meme has been spotted circulating through the Bible Belt. Look out for this one - the turn of the century will bring more of its type, as millennium fever strikes.

Wierdness Watch - Meme Alert!

by Mark E. Potts

This contribution to EXTROPY's "Weirdness Watch" comes partly from my own experiences. Early in 1988 an especially virulent 'meme epidemic' swept through parts of the Christian community. One of its main vectors was a retired NASA engineer from Little Rock, Arkansas, named Edgar Whisenant. Mr. Whisenant published a book claiming that the "Rapture of the Church" would occur on the Jewish holiday of Rosh Hashanah in September, 1988.

During August 25-27, Mr. Whisenant was lecturing in a rented room at the Tulsa Convention Center, and appeared as a guest on a local radio talkshow. I listened to his demented prattle for a few minutes, then called in to correct some of the patent errors he was making. He based a good deal of his prediction on the "prophecies" in the Book of Daniel, but I pointed out that the *Jews themselves* do not consider the Book of Daniel prophetic; rather, they classify it as one of the "writings", along with the books of Job, Esther, Ezra, etc. If they say their own book is not prophecy, who are we to gainsay them? Moreover, modern Jewish scholarship, such as the Encyclopedia Judaica, demonstrates that Daniel is full of mistakes and anachronisms, indicating post-Babylonian (and thus spurious) origins.

Needless to say, this was like news from Mars to Mr. Whisenant. But it failed to shut him up. On Saturday, August 27, I went to hear his final lecture in Tulsa, and was amazed to see how many adults in the audience were being infected by this self-destructive, falsifiable meme. I tried to talk some sense into a few of them, but they became hateful. The True Believers were buying literal armloads of Mr. Whisenant's book to spread the warning.

To suggest just how serious this epidemic was to become, I soon thereafter heard some stories from several sources that True Believers were pulling their children from school, putting their pets to sleep, charging their credit cards to the limit, and even committing suicide. One of my friends told me that his aunt had handed him her car title and bank account in anticipation that she would be taken while her sinful nephew would be left behind. (Now, he jokes, he's sorry the Rapture didn't actually happen.)

One can only dread what would happen if such a meme were to sweep through, say, the crew of a nuclear submarine. "Brethren, let's fire the missiles to speed the Lord's return!" The nuclear war meme is tightly bound to the Rapture meme in the minds of many Christians. An informal case study of this linkage is A. G. Mojtabai's book, Blessed Assurance: At Home with the Bomb in Amarillo, Texas. (Boston: Houghton Mifflin, 1986).

If so many people in our own country are that childlike (in a pejorative sense), how can we possibly expect them to deal with changes in human existence as profound as downloading and a-biogenesis?

(Editors' note: We'd like to thank Mark Potts, one of our readers from Tulsa, Oklahoma, for volunteering this material - and for fighting the good fight against irrational memes. We encourage all of our readers to do the same.)





...of the tree of knowledge
of good and evil thou shalt not eat...

EXTROPY

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