Discussion Reading Assignments for Honors 350: Biology and Society

Instructor David L. Alles

Introduction

The discussion portion of this course uses a different essay or assigned reading as the focal point for each discussion. The function of the reading assignment is to expand upon selected topics introduced in lecture so that each student can engage in a deeper exploration of these topics. To accomplish this, students should carefully read the assigned reading and prepare a written summary in advance of the discussion. Each student will then be responsible for discussing a portion of the reading during the discussion period.

Assignment Format

There are 9 discussion assignments worth 25 points each for a total of 225 points for the course. Grading for the discussions will be 10 points for participation / attendance and 15 points for the written summary.

Participation

Participation will be measured by the verbal responses of each student when asked to comment on the reading. Verbal responses will be judged on the student's knowledge of the reading assignment and how well the student relates the material to other subjects and issues. I will take attendance each discussion and substitute attendance for participation if a student is not called on during the period.

Written Summary

Each summary **must be typed** and include:

1. The central issues or topics of the reading assignment.
2. The major points or conclusions of the reading assignment.
3. A list of other subjects and issues related to the topic but not mentioned in the reading assignment itself.
4. A list of questions about the reading assignment to clarify in the discussion.

The written summaries should be brief and serve as notes for discussion.

Discussion 1) Topic: Is science a religion?

Worldviews, Religions, and Naturalism

By David L. Alles

Is science a religion? This question underscores one of the most confusing issues in the tension between science and religion. And that is how these terms are defined. To sort them out we must untangle the relationships between three concepts: worldviews, religion, and philosophical naturalism (Alles 1995b).

The idea of a worldview has a long and distinguished philosophical ancestry, dating back at least as far as Voltaire, who used the notion to characterize the difference between Cartesian and Newtonian science (Laudan 1996). What follows is a formal definition of worldview that incorporates this philosophical precedence with what we've learned of the neurobiology of the brain.

"A worldview is the environmentally determined state of the cognitive neural structure (or structures) in the human brain that is organized by "computational rules" (Real 1991) to provide for adaptive decision-making in human behavioral responses to the external environment. This mental model of external reality consists of theories about the processes that operate in the external world—or how the world works; theories as to the state of external reality—or how the world is; theories of self-identity that are derived from our mental model of the world; and a set of values derived from our self-identity that assigns priorities in decision-making. From these elements we build an image of how the world came to be and our place in that world. This image of our personal identity, in turn, determines what we hold to be important—our values. "—Alles 1995a

Griffiths gives this picture of what a worldview is and does. "Our view of the universe is built up slowly from input acquired since the beginning of consciousness. This viewpoint represents our identity as individuals. It drives our attitudes and our actions and, as such, determines the kind of people we are and ultimately the kind of society we have." (Griffiths 1991).

With this definition of worldviews in mind we must next define "religion" and philosophical "naturalism". To this end, I provide the following definitions from *Webster's Encyclopedic Unabridged Dictionary of the English Language* (1989). Webster's dictionary was purposely used to obtain generic meanings for these terms.

"religion, *n.* 1. concern over what exists beyond the visible [physical] world, differentiated from philosophy in that it operates through faith or intuition rather than reason, and generally including the idea of the existence of a single [supernatural] being, a group of beings, an eternal principle, or a transcendent spiritual entity that has created the world, that governs it, that controls its destinies, or intervenes occasionally in the natural course of its history,"

"naturalism, *n.* 1. the view of the world which takes account only of natural elements and forces excluding the supernatural or spiritual. 1b) the belief that all phenomena are covered by laws of science and that all teleological explanations are therefore without value. 2. a theory denying that an event or object has a supernatural significance; specifically: the doctrine that scientific laws are adequate to account for all phenomena."

Even a cursory examination of these definitions brings up the obvious question: How does philosophical naturalism differ from science? It's important to note that naturalism does not out of necessity entail scientism. You can reject a belief in the supernatural without accepting or knowing the knowledge claims of science. The definition of naturalism from Webster's stating that "[naturalism accepts] the belief that all phenomena are covered by laws of science" is misleading. The only "belief" that naturalism accepts is that a rational, skeptical, prescriptive epistemology is the best method we have to arrive at reliable knowledge about external reality, nothing more. As a result, naturalism does not accept knowledge claims made in the name of science uncritically. They, like all knowledge claims, must meet the requirements of skeptical epistemology. This remains true even while recognizing that the combination of naturalistic philosophy with scientific knowledge is what we normally think of as the "naturalistic worldview".

Science, as a human endeavor, does accept many of the same epistemological tenets as naturalism, in particular many of the same epistemic rules for acceptable evidence. This explains the use of the term "methodological naturalism" when describing science. It is this shared epistemology that accounts for much of the confusion between science and naturalism. It also explains how a scientist can be a deist—someone who believes in a god based on reason rather than revelation, and accepts that their god has set the universe in motion but does not interfere with how it runs. Science is, however, very different from naturalism in the goal it sets for its participants. The fundamental goal of science as a human enterprise is the production of reliable new knowledge about the natural, physical world. As a result, science can provide only part of the elements that makes up a worldview—namely theories of process, theories as to the state of external reality, and theories of self-identity.

What fundamentally sets naturalism apart from science is that naturalism, as a philosophy, is primarily concerned with the derivation of ethical principles to guide our behavior (Alles 1997). Science is committed to the production of reliable knowledge. Whereas, naturalism is committed to using *only* reliable knowledge in addressing philosophical questions including ethics. Science addresses the past and the present—the "is" of our world. Naturalism addresses the future—the "what should be". It is the combination of naturalistic philosophy and scientific knowledge that forms a complete view of the world. And this explains how someone can be a philosophical naturalist, but not a scientist.

By the same definition are religions also worldviews? The answer is yes; they are. And here is the key. Philosophical naturalism and the all of the world's religions are competing worldviews. We must be clear, however, that while naturalism and religion are both worldviews, naturalism is not a religion. As I've shown, naturalism by definition is the antithesis of religion. Science, because of its limited scope, is not a worldview. And it is clear that science is also not a religion. Therefore, science is not the proper target of religious animosity. It is philosophical naturalism, not science, that competes with the world's religions for the minds, if not the hearts, of humanity.

References

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Discussion 2) Topic: Corporate Science

Excerpt from **The Weaknesses of Science for Profit**

By Harold Varmus

New York Times, Op-Ed, A23, December 4, 2001

Last week Americans briefly diverted their eyes from Afghanistan to consider the announcement by a small New England biotechnology company that it had created human embryonic clones. President Bush expressed grave concern, and some members of Congress made renewed calls for legislation to ban the practice outright. One might think that a cloned human baby had been born.

In truth, what the investigators did was much less significant, and it was undertaken for a different purpose. They attempted to adopt one step of the process used for cloning animals—the transfer of a cell nucleus—as part of a strategy to develop human embryonic stem cells. They removed the nuclei from several human cells and placed each one in another cell, an egg cell. In a very few instances, the reconstructed cell went through one or two divisions, generating no more than six cells — not enough to allow the derivation of stem cell lines.

Many of us in the scientific community criticized the company's report as premature because it showed little experimental progress and advanced no new ideas. Supporters of medical science lamented the company's naïveté because the announcement precipitated an unnecessary political firestorm and provoked the threat of new barriers to potentially beneficial research.

So why did the company make its announcement? Although its executives claimed to be excited about the findings and said the information would promote educational debate, the actual reasons may be more self-serving. Biotechnology companies are dependent on investors, and investors like publicity.

Such behavior is, of course, both legal and expected, but it is one of the unhealthy aspects of confining certain kinds of research to the private sector. Our country is notable for doing this in areas of ethically sensitive science. In Britain and most other countries with major investments in science, a national decision is made at the outset about whether to allow such work to be done at all, regardless of who pays for it. In contrast, Americans tend to focus our debate on whether it is permissible to use federal funds—taxpayers' dollars—to finance the work.

This odd strategy does have the benefit of allowing such work to proceed in at least one venue: commercial labs. For example, over the past two decades, federal financing for in vitro fertilization—as a therapy for infertility or as a topic for research—has been prohibited. But this policy has not kept the private sector from pursuing in vitro fertilization as a practical solution to infertility; tens of thousands of new parents and their babies have been the beneficiaries.

Thus the policy achieves two goals: it does not offend taxpayers who oppose the use of federal money to support work that violates their ethical standards, yet it allows researchers to pursue innovation on the frontiers of science—so long as it's privately financed.

On the other hand, because this policy prevents academic investigators from studying in vitro fertilization with funds from the National Institutes of Health, it compromises efforts to learn the fundamental principles of fertilization and to improve the basic technology. Moreover, it leaves the field largely in the hands of the for-profit sector—where commercial realities must be considered along with scientific progress, where full disclosure is not the norm, and where oversight is limited.

Last week's episode further illustrates the importance of involving federally financed scientists in work that is permitted in the private sector. The "nuclear transfer" strategy pursued by the company in question is not intended to produce cloned human beings ("reproductive cloning"), a goal that nearly all agree is unacceptable. But the approach is excluded from federal financing by a provision in the N.I.H.'s annual appropriations bill, and federal money could not even be used to study any resulting stem cells, since President Bush's Aug. 9 directive prevents the use of federal funds for research into any stem cells not already in existence at the time of his speech.

Still, stem cells made by nuclear transfer could have substantial advantages over existing stem cell lines for studying basic processes of human development. This is an aspect of the work more likely to be pursued by academic scientists than by those working in industry, because its commercial uses are much less certain, although extraordinary discoveries might be made.

Nuclear transfer has more obvious value, both economic and medical, as a method to make stem cells for therapy: such cells would not be rejected if returned to the original donor of the cell nucleus (or to others with a similar genetic makeup). This is one of the potentially viable means to overcome immune barriers to cell- based therapies for a variety of dire diseases.

Such research is vital not just to biotechnology companies and their investors, but to the nation as a whole. By structuring our system so that only those with private funds or a commercial motive do this pioneering work, we curb our full capacity to expand our scientific understanding.

Harold Varmus, a Nobel laureate in medicine, is president of Memorial Sloan-Kettering Cancer Center and former director of the National Institutes of Health.

Discussion 3) Topic: Secular Ethics

Excerpt from **The Secular Sphinx: The Riddle of Ethics Without Religion**

By Michael Shermer

On Friday, May 24, 1996, the 103rd Archbishop of Canterbury (starting with St. Augustine in 597), spiritual leader of over 70 million Anglicans, told 425 civic, business, and religious leaders at the Los Angeles Biltmore Hotel that "secularism" is the cause of much of the West's moral woes. Paradoxically, this was followed by a litany of "unspeakable atrocities against innocent people" committed in the name of religion, as in Bosnia and against the Christian minority in Islamic Sudan. The Archbishop-the Most Reverend George L. Carey-told his audience that only faith can stop these atrocities (Stammer, p. 1):

> How else can momentum be found for combating the worst excesses of poverty and inequality around the world? How else can we find the self-restraint in the interest of future generations in order to save our environment? How else can we combat the malignant power of exclusive nationalism and racism? All this requires the dynamic power of commitment, faith and love. The privatized morality of "what works for me" will not do.

Agreed, what-works-for-me morality will not do. But is this all there is to secular morality? And are these our only choices? Can we lead moral lives without recourse to the hereafter and a spiritual being who may or may not exist? Can we construct an ethical system without religion?

The Sphinx was a mythical creature who delighted in posing seemingly insoluble riddles. I use the term "Secular Sphinx" to describe a longstanding ethical riddle that must be solved if we are to consider a secular alternative to religion-based ethics.

The Riddle of Ethical Decisions - How Are We To Act?

As soon as one makes an ethical decision, that is, an action that is deemed right or wrong, it implies that there is a standard of right versus wrong that can be applied in other situations. But if so, why isn't that same standard obvious and in effect all around the world? Instead, observation reveals many such systems, most of which claim to be "the truth." But if there is no absolute ethical standard and instead only relative standards, can we speak of right and wrong? An action may be wise or unwise, prudent or imprudent, profitable or unprofitable. But is that the same as right or wrong? One solution to the riddle may be found in a middle way between Absolute Ethics and Relative Ethics known as Provisional Ethics.

Absolute Ethics

When I was 17, I became a born-again Christian, not for any rational or noble reason, but because most of my buddies were doing it, in particular my best friend George Oakley, whose sister I liked. Still, shallow, trivial reasons can become entrenched serious ones, and I really got into the spirit of the movement, going to Bible-study classes, "witnessing" to non-Christians

(trying to convert them), and even enrolling at Pepperdine University to major in theology (later changed to psychology for practical reasons like getting a job).

My first inkling of a problem with absolute ethical systems came soon after my conversion. My friend Frank was really religious so I figured he would be delighted at my new-found faith. He wasn't. In fact, he scolded me for choosing the wrong Christian faith and told me I was still doomed if I didn't switch to his church: Jehovah's Witnesses. The more churches and faiths I examined, the more aware I became of the fact that they all think they alone are right and everyone else is wrong.

Most ethical systems are absolute and most absolute systems are derived from religious sources. In the last 2,000 years, for example, there have been approximately 28,000 different Christian denominations. Today alone there are approximately 1,500 different Christian sects, all of which claim sole possession of the absolute truth. They cannot all be right.

Most absolute ethical systems are based on a simplistic reward and punishment, heaven and hell duality, a very childlike morality, as Isaac Asimov observed (1989, p. 6):

> They assume that human beings have no feeling about what is right and wrong. Is the only reason you are virtuous because that's your ticket to heaven? Is the only reason you don't beat your children to death because you don't want to go to hell? It seems to me that it's insulting to human beings to imply that only a system of rewards and punishments can keep you a decent human being. Isn't it conceivable that a person wants to be a decent human being because that way he feels better? Because that way the world is better?

Obviously the reward-punishment system doesn't work anyway, as the Archbishop of Canterbury observed, since even the most religious of societies have an abundance of crime, violence, and sin of all sorts. As Laura Schlessinger notes in her book about the abdication of morality, in response to a Christian having an adulterous affair but unable to articulate why this was bad (other than to say it was "a sin"): "no one these days is worried about bolts of lightning and everlasting fire and brimstone, so calling a behavior a sin, in and of itself, just doesn't seem to impress" (1996, p. 33). We need more precise definitions.

Absolute Ethics, then, may be defined as an inflexible set of rules for right and wrong human behavior derived from God, the Bible, the Koran, the State, Nature, or some canon of ethics or philosophy. The problem with all systems of absolute moralities is that they set themselves up to be the final arbiters of truth, creating two types of people: Good and Bad, Right and Wrong, True Believers and Heretics.

This was expressed by that sage philosopher, Maxwell Smart, who observed: "Don't be silly, 99. We have to shoot, kill, and destroy. We represent everything that's wholesome and good in the world." Sadly, such rhetoric is not restricted to silly television shows. Richard Nixon used this rhetoric for political gain (in Askenasy, 1978): "It may seem melodramatic to say that the U.S. and Russia represent Good and Evil, Light and Darkness, God and the Devil. But if we think of it that way it helps to clarify our perspective of the world struggle." In a similar vein anti-abortionist Randall Terry, founder of Operation Rescue, clearly summarized the absolute problem with absolute ethics: "Let a wave of intolerance wash over you….Yes, hate is good….Our goal is a Christian nation….We are called by God to conquer this country….We don't want pluralism" (in Sagan, 1995, p. 430).

One might argue that a few bad apples don't spoil the bunch. Immanuel Kant's Categorical Imperative, for example, is a reasonable (but flawed) attempt at a rational absolute ethics. For Kant, if you want to judge the rightness or wrongness of an action:

> "Act only on that maxim through which you can at the same time will that it should become a universal law" (1785, p. 268).

Would we ever want to universalize lying, stealing, or adultery? Of course not. That would put an end to contracts, property, and marriage. But we do lie and often there are perfectly rational reasons to do so.

The problem with absolute ethics is that since virtually everyone claims he knows what constitutes right versus wrong action, and since virtually all moral systems differ from all others to a greater or lesser extent, then there is no such thing as a rationally demonstrable absolute ethics.

Relative Ethics

After graduating from Pepperdine University and studying evolution and ethology at California State University, Fullerton (as part of a graduate psychology program), I realized the limitations of Christianity and other faiths, and turned to science and philosophy for answers. In the process I tried out a number of what might be considered relative ethical systems. Existentialism was appealing to me because of its emphasis on freedom and individual responsibility. In fact, I found it to be one of the most optimistic ethical philosophies I had encountered but discovered I was in a rather small minority in that regard. Most existentialists seemed to agree with one of the philosophy's founders, Albert Camus, when he wrote: "There is but one serious philosophical problem. That is suicide. Why stay alive in a meaningless universe?" Suicide may be painless, as the M*A*S*H theme song goes, but it brings on one major change I find unappealing.

After existentialism I tried Jeremy Bentham's utilitarianism-the principle of the greatest happiness for the greatest number. Specifically I found his quantitative utilitarianism attractive since it attempted a type of hedonic calculus where one can quantify ethical decisions. But by "hedonism" Bentham did not mean a simple pleasure principle where, in the vernacular, "if it feels good do it." He specified "seven circumstances" by which "the value of a pleasure or a pain is considered," including (1789, p. 30):

1. Purity - "The chance it has of not being followed by sensations of the opposite kind."
2. Intensity - How intense is the pleasure?
3. Propinquity - How near in place or time is the pleasure?
4. Certainty - How certain is the pleasure?
5. Fecundity - "The chance it has of being followed by sensations of the same kind."
6. Extent - "The number of persons to whom it extends; or (in other words) who are affected by it."
7. Duration - How long will the pleasure last?

For fun I used to use the above table in my psychology course to draw the students into the problems of assigning actual numbers to these seven values (the boxes were blank), in making a rather simple choice between spending money on a good meal, a good date (with the possibility but not certainty of sex), or a good book. The values above are my own (I was single at the time).

According to Bentham, once the figures are assigned, "Sum up all the values of all the pleasures on the one side, and those of all the pains on the other. The balance, if it be on the side of pleasure, will give the good tendency of the act upon the whole, with respect to the interests of that individual person; if on the side of pain, the bad tendency of it upon the whole." So the book wins out over the meal or date. But this is just my opinion. To apply the principle to society as a whole, Bentham says (p. 31):

> Take an account of the number of persons whose interests appear to be concerned; and repeat the above process with respect to each. Sum up the numbers expressive of the degrees of good tendency, which the act has, with respect to each individual, in regard to whom the tendency of it is good upon the whole: do this again with respect to each individual, in regard to whom the tendency of it is good upon the whole: do this again with respect to each individual, in regard to whom the tendency of it is bad upon the whole. Take the balance; which, if on the side of pleasure, will give the general good tendency of the act, with respect to the total number or community of individuals concerned; if on the side of pain, the general evil tendency, with respect to the same community.

Dismissing the obvious impossibility of doing this on a daily basis and being able to even leave the house, it is obvious that you can "cook" the numbers to make it come out almost any way you like. Doing this on a societal level is simply impossible.

These are just two of the many interesting attempts to construct a relative ethical system, defined as a flexible set of rules for right and wrong human action derived from how the situation is defined individually or socially. The problem with relative ethics is that one can justify almost any behavior, implying that all moral actions-from self-sacrifice to human sacrifice-are equal. On a practical level no one believes this.

Provisional Ethics

In thinking about which ethical system to choose I asked myself this question: how do we know something is true or right? In science we accumulate evidence and assign a probability of truth to a claim. Claims are not true or false, right or wrong in an absolute sense. They are probably true or probably false, probably right or probably wrong. Yet probabilities can be so high or so low that we can act as if they are true or false. Stephen Jay Gould said it best (1983, p. 25): "In science, 'fact' can only mean 'confirmed to such a degree that it would be perverse to withhold provisional assent.'" That is, scientific facts are conclusions confirmed to such an extent it would be reasonable to offer our provisional agreement, as with heliocentrism and evolution. Moral choices in a provisional ethical system might be considered analogous to scientific "facts" in being provisionally true or false, right or wrong, moral or immoral:

In Provisional Ethics, "moral" or "immoral" means confirmed and justified to such an extent it would be reasonable to offer provisional assent. That is, in Provisional Ethics it would be reasonable for us to offer our provisional agreement that an action is moral or immoral if the

evidence for and the justification of the action is overwhelming. It remains provisional because, as in science, the evidence and justification might change. And, obviously, some moral principles have less evidence and justification for them than others, and therefore they are more provisional and more personal.

What I'm getting at here is that there are moral principles by which we can construct a secular ethical system. These principles are not absolute (no exceptions), nor are they relative (anything goes). They are provisional-true for most people in most circumstances most of the time.

Reference: Shermer, Michael (1996). The Secular Sphinx: The Riddle of Ethics Without Religion. *Skeptic*, 4(2), pp. 78-87.

Discussion 4) Topic: Science and Medicine

Excerpt from **Cystic Fibrosis Gene Protects Against Typhoid Fever**

NIAID Public Press release 6 May 1998

The gene mutation that causes cystic fibrosis also appears to protect against infection with typhoid fever bacteria, a study supported by the National Institute of Allergy and Infectious Diseases (NIAID) has found. The finding could explain why an estimated 12 million people in the United States carry the gene for such a highly fatal childhood disease. Researchers led by Gerald Pier, Ph.D., of Brigham and Women's Hospital and Harvard Medical School in Boston, report the finding in the May 7, 1998, issue of the journal *Nature*.

> "This is an interesting finding that underscores how basic research in one disease area often leads to discoveries in another area," says NIAID Director Anthony S. Fauci, M.D. "It also is a good example of how pathogenesis research - the study of how pathogens interact with the host to cause disease - creates opportunities for applied research."

Approximately 2,500 babies with cystic fibrosis are born each year in the United States. Before the 1950s, most children with the disease died by age 1 or 2. Today, with better methods for managing the disease, the average survival of these individuals is about 30 years.

> "In most cases of inherited disease with high rates of childhood mortality, the defective gene does not remain in the gene pool," says Dr. Pier. "The disease and the gene causing it literally die out. When that doesn't happen, we find that it is because carriers - healthy people with one good copy and one bad copy of the disease gene - have some enhanced survival advantage."

For example, Dr. Pier notes that individuals with a single copy of the sickle cell disease gene are more resistant to malaria infection than people who do not have the gene. Scientists have speculated that cystic fibrosis carriers also have enhanced protection against an infectious agent, but until now, they didn't know which one.

Background

Cystic fibrosis develops in children who inherit two mutant copies—one from each parent—of the gene that encodes a protein known as cystic fibrosis transmembrane conductance regulator (CFTR). In these children, abnormal CFTR blocks the movement of chloride ions and water in the lungs, gastrointestinal tract, and other tissues and causes them to secrete large amounts of mucus. As mucus accumulates in their lungs, these children become increasingly susceptible to life-threatening respiratory infections.

Infection with Pseudomonas aeruginosa is one of the primary clinical features of cystic fibrosis. Last year, Dr. Pier and his colleagues reported that the normal CFTR protein acts as a receptor for P. aeruginosa and helps clear this bacterium from the lung. When CFTR protein is abnormal or missing, it does not bind and ingest this bacterium, and lifelong infections are thus established in many individuals with cystic fibrosis.

The researchers hypothesized that other bacteria might interact with CFTR in a similar manner. Finding no other lung pathogens that use the CFTR entry pathway, Dr. Pier and his

colleagues turned their attention to the gastrointestinal tract, since its tissues also are affected directly in people with cystic fibrosis.

The Study

Dr. Pier and his colleagues showed that normal CFTR protein also acts as a receptor for Salmonella typhi, the gastrointestinal pathogen that causes typhoid fever. In tissue culture experiments, they found that human cells expressing normal CFTR took up significantly more S. typhi than did cells expressing mutant CFTR. The researchers then added to the cells antibodies and synthetic molecules designed to bind to a segment of the CFTR molecule that protrudes from the cell membrane. These agents blocked the uptake of S. typhi by CFTR, thus identifying the protruding CFTR segment as the S. typhi binding site through which it enters cells.

> "Uptake and ingestion of S. typhi by epithelial cells is part of the body's normal protective response," explains Dr.Pier. "Epithelial cells ingest the bacterium, then slough off of the epithelial surface. New epithelial cells soon take their place. At low concentrations of S. typhi, this process prevents infection. High concentrations, however, can overwhelm this protective response. After S. typhi-ingesting epithelial cells have been shed from the epithelial surface, any excess S. typhi are free to attack the underlying tissue, which lacks this defense mechanism."

Since abnormal CFTR binds poorly to S. typhi, cystic fibrosis gene carriers would be protected from this infectious process and thus spared the high mortality associated with typhoid fever. Dr. Pier notes that before 1900, typhoid fever was a major infectious disease in the United States that killed about 15 percent of infected individuals. It remains a serious problem in countries that lack adequate sewage treatment facilities, since contaminated water is a major source of S. typhi transmission.

Implications

Dr. Pier speculates that, in addition to advancing the understanding of how pathogens interact with host tissues to cause disease, this finding could have relevant applications in vaccine research, particularly in ongoing efforts to develop S. typhi-based vaccine delivery vehicles.

S. typhi stripped of its ability to cause disease is an attractive tool for vaccine researchers. Vaccines based on this gastrointestinal pathogen would be delivered orally, and thus might be useful for stimulating immunity at the mucosal surfaces that line the stomach and gut. AIDS researchers supported by NIAID recently initiated a clinical trial of an experimental vaccine composed of a weakened form of S. typhi into which a gene for a human immunodeficiency virus (HIV) protein had been inserted.

> "Our work provides an understanding of how S. typhi gets into the tissues of the host's immune system," says Dr.Pier. "By manipulating S. typhi or other organisms to deliver antigens via the CFTR-uptake pathway, we may be able to develop better vaccines."

In future studies, he and his colleagues will try to define the S. typhi surface molecules that bind to CFTR. "It may be possible to use this structure to make non-living antigen delivery vehicles that target antigens to the immune system following oral ingestion."

NIAID supports research on AIDS, tuberculosis, malaria and other infectious diseases, as well as allergies and immunology. In addition to NIAID, the National Heart, Lung and Blood Institute (NHLBI) supports Dr. Pier's current research. NIAID and NHLBI are components of the National Institutes of Health (NIH). NIH is an agency of the U.S. Department of Health and Human Services.

Discussion 5) Topic: Is "race" a scientific concept?

Excerpt from **Do Races Differ? Not Really, DNA Shows**

By Natalie Angier

In the glossy, lightweight days of the last election, it seemed, they couldn't build metaphorical tents big or fast enough for every politician who wanted to pitch one up and invite the multicultural folds to "Come on under!" The feel-good message that both parties sought to convey was: regardless of race or creed, we really ARE all kin beneath the skin.

Yet whatever the calculated quality of this new politics of inclusion, its sentiment accords firmly with scientists' growing knowledge of the profound genetic fraternity that binds together human beings of the most seemingly disparate origins.

Scientists have long suspected that the racial categories recognized by society are not reflected on the genetic level. But the more closely that researchers examine the human genome -- the complement of genetic material encased in the heart of almost every cell of the body -- the more most of them are convinced that the standard labels used to distinguish people by "race" have little or no biological meaning.

They say that while it may seem easy to tell at a glance whether a person is Caucasian, African or Asian, the ease dissolves when one probes beneath surface characteristics and scans the genome for DNA hallmarks of "race."

As it turns out, scientists say, the human species is so evolutionarily young, and its migratory patterns so wide, restless and rococo, that it has simply not had a chance to divide itself into separate biological groups or "races" in any but the most superficial ways.

"Race is a social concept, not a scientific one," said Dr. J. Craig Venter, head of the Celera Genomics Corporation in Rockville, Md. "We all evolved in the last 100,000 years from the same small number of tribes that migrated out of Africa and colonized the world."

Dr. Venter and scientists at the National Institutes of Health recently announced that they had put together a draft of the entire sequence of the human genome, and the researchers had unanimously declared, there is only one race—the human race.

Dr. Venter and other researchers say that those traits most commonly used to distinguish one race from another, like skin and eye color, or the width of the nose, are traits controlled by a relatively few number of genes, and thus have been able to change rapidly in response to extreme environmental pressures during the short course of *Homo sapiens* history.

And so equatorial populations evolved dark skin, presumably to protect against ultraviolet radiation, while people in northern latitudes evolved pale skin, the better to produce vitamin D from pale sunlight.

"If you ask what percentage of your genes is reflected in your external appearance, the basis by which we talk about race, the answer seems to be in the range of .01 percent," said Dr. Harold P. Freeman, the chief executive, president and director of surgery at North General Hospital in Manhattan, who has studied the issue of biology and race. "This is a very, very minimal reflection of your genetic makeup."

Unfortunately for social harmony, the human brain is exquisitely attuned to differences in packaging details, prompting people to exaggerate the significance of what has come to be called race, said Dr. Douglas C. Wallace, a professor of molecular genetics at Emory University School of Medicine in Atlanta.

"The criteria that people use for race are based entirely on external features that we are programmed to recognize," he said. "And the reason we're programmed to recognize them is that it's vitally important to our species that each of us be able to distinguish one individual from the next. Our whole social structure is based on visual cues, and we've been programmed to recognize them, and to recognize individuals."

By contrast with the tiny number of genes that make some people dark-skinned and doe-eyed, and others as pale as napkins, scientists say that traits like intelligence, artistic talent and social skills are likely to be shaped by thousands, if not tens of thousands, of the 30,000 or so genes in the human genome, all working in complex combinatorial fashion.

The possibility of such gene networks shifting their interrelationships wholesale in the course of humanity's brief foray across the globe, and being skewed in significant ways according to "race" is "a bogus idea," said Dr. Aravinda Chakravarti, a geneticist at Case Western University in Cleveland. "The differences that we see in skin color do not translate into widespread biological differences that are unique to groups."

Dr. Jurgen K. Naggert, a geneticist at the Jackson Laboratory in Bar Harbor, Me., said: "These big groups that we characterize as races are too heterogeneous to lump together in a scientific way. If you're doing a DNA study to look for markers for a particular disease, you can't use 'Caucasians' as a group. They're too diverse. No journal would accept it."

Yet not every researcher sees race as a meaningless or antediluvian notion. "I think racial classifications have been useful to us," said Dr. Alan Rogers, a population geneticist and professor of anthropology at the University of Utah in Salt Lake City. "We may believe that most differences between races are superficial, but the differences are there, and they are informative about the origins and migrations of our species. To do my work, I have to get genetic data from different parts of the world, and look at differences within groups and between groups, so it helps to have labels for groups."

And there are a handful of researchers who continue to insist that there are fundamental differences among the three major races that extend to the brain. Dr. J. Philippe Rushton, a psychologist at University of Western Ontario in Canada and author of "Race, Evolution and Behavior," is perhaps the most tireless proponent of the belief that the three major races differ genetically in ways that affect average group I.Q. and a propensity toward criminal behavior.

He asserts that his work reveals east Asians to have the largest average brain size and intelligence scores, those of African descent to have the smallest average brains and IQs and those of European ancestry to fall in the middle.

Yet many scientists have objected to his methods and interpretations, arguing, among other things, that the link between total brain size and intelligence is far from clear. Women, for example, have smaller brains than men do, even when adjusted for their comparatively smaller body mass, yet average male and female I.Q. scores are the same. For that matter, fossil evidence suggests that Neanderthals had very sizable brains, and they did not even last long enough to invent standardized tests.

Dr. Eric S. Lander, a genome expert at the Whitehead Institute in Cambridge, Mass., admits that, because research on the human genome has just begun, he cannot deliver a definitive, knockout punch to those who would argue that significant racial differences must be reflected somewhere in human DNA and will be found once researchers get serious about looking for them. But as Dr. Lander sees it, the proponents of such racial divides are the ones with the tough case to defend. "There's no scientific evidence to support substantial differences

between groups," he said, "and the tremendous burden of proof goes to anyone who wants to assert those differences."

Although research into the structure and sequence of the human genome is in its infancy, geneticists have pieced together a rough outline of human genomic history, variously called the "Out of Africa" or "Evolutionary Eve" hypothesis. By this theory, modern Homo sapiens originated in Africa 200,000 to 100,000 years ago, at which point a relatively small number of them, maybe 10,000 or so, began migrating into the Middle East, Europe, Asia and across the Bering land mass into the Americas.

As they traveled, they seem to have completely or largely displaced archaic humans already living in the various continents, either through calculated acts of genocide, or simply outreproducing them into extinction.

Since the African emigrations began, a mere 7,000 generations have passed. And because the founding population of migrants was small, it could only take so much genetic variation with it. As a result of that combination -- a limited founder population and a short time since dispersal -- humans are strikingly homogeneous, differing from one another only once in a thousand subunits of the genome. "We are a small population grown large in the blink of an eye," Dr. Lander said. "We are a little village that's grown all over the world, and we retain the genetic variation seen in that little village."

The human genome is large, though, composed of three billion-odd subunits, or bases, which means that even a tiny percentage of variation from one individual to the next amounts to a sizable number of genetic discrepancies. The question is, where in the genome is that variation found, and how is it distributed among different populations?

Through transglobal sampling of neutral genetic markers -- stretches of genetic material that do not help create the body's functioning proteins but instead are composed of so-called junk DNA -- researchers have found that, on average, 88 percent to 90 percent of the differences between people occur within their local populations, while only about 10 percent to 12 percent of the differences distinguish one population, or race, from another. To put it another way, the citizens of any given village in the world, whether in Scotland or Tanzania, hold 90 percent of the genetic variability that humanity has to offer.

But that 90/10 ratio is just an average, and refers only to junk-DNA markers. For the genetic material that encodes proteins, the picture is somewhat more complex. Many workhorse genes responsible for basic organ functions show virtually no variability from individual to individual, which means they are even less "race specific" than are neutral genetic markers.

Some genes, notably those of the immune system, show enormous variability, but the variability does not track with racial groupings. Then there are the genes that control pigmentation and other physical features. These also come in a wide assortment of "flavors," but unlike immune-related genes, are often distributed in population-specific clusters, resulting in Swedes who look far more like other Swedes than they do like Australian Aborigines.

A few group differences are more than skin deep. Among the most famous examples are the elevated rates of sickle-cell anemia among African-Americans and of beta-thalassemia, another hemoglobin disorder, among those of Mediterranean heritage. Both traits evolved to help the ancestors of these groups resist malaria infection, but both prove lethal when inherited in a double dose. As with differences in skin pigmentation, the pressure of the environment to develop a group-wide trait was powerful, and the means to do so simple and straightforward, through the alteration of a single gene.

Another cause of group differences is the so-called founder effect. In such cases, the high prevalence of an unusual condition in a population can be traced to a founding ancestor who happened to carry a novel mutation into the region.

Over many generations of comparative isolation and inbreeding, the community, like it or not, became "enriched" with the founder's disorder. The founder effect explains the high incidence of Huntington's neurodegenerative disease in the Lake Maracaibo region of Venezuela, and of Tay-Sachs disease among Ashkenazi Jews. But Dr. Naggert emphasized that medical geneticists had a much better chance of unearthing these founder effects by scrutinizing small, isolated and well-defined populations, like the northern Finns, the Basques of Spain, or the Amish of Pennsylvania, than they did by going after "races."

Dr. Sonia S. Anand, an assistant professor of medicine at McMaster University in Ontario, proposed that clinicians think about ethnicity rather than race when seeking clues to how disease patterns differ from one group to the next. "Ethnicity is a broad concept that encompasses both genetics and culture," Dr. Anand said. "Thinking about ethnicity is a way to bring together questions of a person's biology, lifestyle, diet, rather than just focusing on race. Ethnicity is about phenotype and genotype, and, if you define the terms of your study, it allows you to look at differences between groups in a valid way."

In investigating the reasons behind the high incidence of cardiovascular disease among people from the Indian subcontinent, for example, Dr. Anand discovered that Indians had comparatively elevated amounts of clotting factors in their blood. Beyond tallying up innate traits, she also takes into account how Indian culture and life habits may pose added risks for heart disease -- noting, for example, that a woman's status in India is directly proportional to her number of belly rolls.

In Dr. Freeman's view, the science of human origins can help to heal any number of wounds, and that, he says is sweet justice. "Science got us into this problem in the first place, with its measurements of skulls and its emphasis on racial differences and racial classifications," Dr. Freeman said. "Scientists should now get us out of it. They need to be leaders in promoting an evolutionary understanding of the human race."

Reference: Angier, Natalie (22 August 2000). Do Races Differ? Not Really, DNA Shows. *New York Times* (Science and Health Section)

Discussion 6) Topic: Right to Death?

Excerpt from **French Uproar Over Right to Death for Unborn**

By Marlise Simons
New York Times, International, A3, 19 October 2001

PARIS, Oct. 18 — During the 18 years of his fragile life, Nicolas Perruche has had little contact with the world around him. He cannot hear or speak and is largely blind. His heart is weak, and he moves only when carried or put into a wheelchair. Nicolas was born this way because his mother contracted German measles, an illness often harmful to the fetus. Four weeks into her pregnancy, Nicolas's mother told her doctor that she wanted an abortion if she had the disease, but a laboratory and the doctor failed to diagnose it.

In a landmark ruling that has followed 13 years of litigation, France's highest court has recently ordered that damages be paid not only to the Perruche family but also to Nicolas himself, because medical errors allowed him to be born. The decision has provoked an uproar in France. While debates still rage here and in other countries about the right of the unborn child to life, the new court decision is seen as signaling that an unborn child has a right to be aborted, or at least that a handicapped child has a right to recognition that his or her birth was a mistake.

In the two months since the ruling was upheld, politicians, philosophers and lawyers have variously argued that it is absurd, dangerous and unethical and that it will for the first time put a price on a human life. An advocacy group for the handicapped found the ruling so offensive it announced that it was suing the court.

In France, where more than 90 percent of pregnant women receive regular prenatal care from very early in their pregnancy, the Perruche case is so far unique. But it has quickly generated fresh confusion over the question of where responsibility for a fetus begins or ends. Many see the ruling as potentially opening the door to similar suits — against doctors held accountable for the condition of a baby whose birth they supervise, or against parents by a child born with any variety of defects.

Doctors have spoken out already, some saying they fear that the ruling will encourage malpractice suits, drive up their insurance costs and lead them to recommend more abortions. "This is the first time that doctors have been condemned for not having killed," Dr. Jacques Milliez, head of gynecology at Saint-Antoine Hospital in Paris, said of the decision. Dr. Milliez, an early supporter of legalized abortion, said the ruling might well strengthen anti-abortion arguments because it reinforces the legal status of the unborn.

Only a few commentators have focused on the plight of Nicolas, the severely handicapped teenager, and have agreed that damages are appropriate because he will require lifelong and costly care. Among them is Nicolas's father, Christian Perruche, a bank employee. Mr. Perruche and Nicolas's mother, Josette Perruche, declined to be interviewed. But through his lawyer, Mr. Perruche said of the new ruling: "It's wonderful for my son. This decision will ensure that he is looked after forever, even after we are dead."

The story of Nicolas, as recounted in court documents, began one day in 1982, when Mrs. Perruche found her 4-year-old daughter covered with red spots that were diagnosed as German measles. One month pregnant at the time, Mrs. Perruche told her doctor that if she had been infected, she wanted an abortion rather than risk giving birth to a severely handicapped child. German measles often cause congenital deformation to a fetus in the early months of pregnancy, and a mother's infection is a common reason for abortion in many countries.

Mrs. Perruche underwent two blood tests, two weeks apart. The results were contradictory, but instead of pursuing the question, the court documents said, the doctor assured Mrs. Perruche that she could safely continue her pregnancy. After a court much later demanded a re-test of the same blood samples, the laboratory admitted that it had made a mistake.

Nicolas's severe congenital defects became clear soon after his birth in January 1983. By the time he was 2, his mother had suffered a mental breakdown, requiring psychiatric care. His parents have since divorced. Today, the boy is being cared for by a government institution and spends alternate weekends with his mother and father. "I know they love the child," said the family lawyer, Jean-Louis Chalanset. "Even though they cannot communicate with him, they always pick him up on weekends. I know of other parents who rarely or never see their retarded children."

Mr. Chalanset said the legal battle was not yet over because a lower court still had to set the amount of damages due to Nicolas. But he added that since the High Court's ruling cannot be appealed, the Perruche family can at last see an end to their 13 years of emotional turmoil and frustration in the courts. The Perruche family first went to court in 1988 and, after a ruling that both the laboratory and their doctor had erred, the family was awarded close to $13,000 for their suffering. But Mr. Chalanset said the parents sued anew on behalf of their son, who, after age 20, would probably have to leave the institution and require permanent private care.

In 1992, a court awarded $68,000 to the parents and $250,000 to the institution. But the insurance companies appealed and won. To the family's horror, bailiffs arrived at their home to recover the money. "It was more than shameful, it was offensive," Mr. Perruche told his lawyer at the time. On three occasions, Nicolas won damages, but each time the verdicts were reversed on appeal.

The ruling of the Cour de Cassation, France's equivalent to the Supreme Court, cannot be overturned. In its decision, first made last year and confirmed in July, it said that because the "errors" of the doctor and the laboratory "had prevented Mrs. Perruche from exercising her choice to end the pregnancy in order to avoid the birth of a handicapped child, the latter can ask for compensation for damages resulting from this handicap."

Lawyers familiar with the decision said the court did not use the words "wrongful birth," as some critics have argued. It also avoided words such as "quality of life," the lawyers said, to avoid giving the impression that life of the handicapped is a life of lesser quality, but critics said this was the implication. Yet the High Court has recently thrown out three other cases in which parents of handicapped children demanded damages because abnormalities of the fetus were not detected by ultrasound tests.

"This sends a message to handicapped people that their life is worth less than their death," said Christine Boutin, a conservative legislator who heads the Alliance for the Right to Life, an anti-abortion group. Jean- Francois Mattei, head of the conservative Liberal Democratic Party and himself a doctor, said the ruling "validates the principle that the birth of a handicapped child in itself is an abnormality," and a reason for awarding damages. This view was echoed by others. "Life cannot be treated as an error, whatever the error may be," said Catherine Fabre, a member of the Federation of French Families. Elisabeth Badinter, a writer and philosopher, who is not opposed to abortion, said she was troubled by the decision because "it is untenable to demand damages for being born and even more untenable to grant them."

Several lawyers warned of the potential negative effects of the ruling. Jean Hauser, professor of family law at the University of Bordeaux, said that if doctors were held responsible

for the condition of the babies they help deliver, "they will be encouraged to recommend abortions at the first suspicion of abnormality." "That is what eugenics is all about," he added.

Didier Le Prado, another lawyer, said that the door was now regrettably open for France to follow the recent American practice of permitting children to sue mothers who have knowingly contributed to their handicaps. Some critics say that the outcry is overblown because human reproduction is already widely manipulated as parents test for gender, order male or female babies and have ultrasound and amniocentesis tests to learn of problems early and avoid defective births.

Society and medicine want more and more control to produce perfect children, said Israel Nisand, professor of gynecology at the University of Strassbourg. "If the doctor had discovered the problem, he could not have prevented or cured the handicap; he could only prevent the birth." He called the ruling a disaster, because "in essence this verdict says that the child should not have been born. What does this mean for parents who have the courage to face up to a diagnosis casting doubt on the state of the baby?" Mr. Chalanset, the lawyer for Mr. Perruche, said the issue had been distorted in the public debate. "This is not a complex philosophical problem," he said. "It is about medical errors and about who must bear the consequences."

France: 'Right Not To Be Born' Overturned

NYT, Section A, February 2, 2002

Parliament approved a law to reverse a precedent widely attacked by doctors, jurists and the handicapped as establishing a right "not to be born." The law is intended to supersede the so-called Perruche ruling, under which a badly brain-damaged boy was awarded compensation because he had not been aborted. Doctors said they were unfairly being made responsible for failing to spot defects in the womb. Ethicists said the ruling made it more likely that doctors would recommend abortions at a hint of a problem.

Discussion 7) Topic: Reproductive Technologies

Excerpt from **Research doesn't Denigrate Humanity**

By Hubert Markl

Probably nowhere in the world is the debate about the nature of humanity, its rights and obligations, more heated than in Germany. The debate extends far beyond current concerns about stem-cell research and pre-implantation genetic diagnosis, to fundamental questions about the nature of humanity, the freedom of science and its mission.

Who could fail to recognize that we are living in a year of the life sciences? The BSE crisis; devastation to sheep and cattle by foot-and-mouth disease and its control; panic over genetically modified crops; threats to global biodiversity; HIV; the whole area of stem-cell research, therapeutic cloning and pre-implantation genetic diagnosis of hereditary diseases — these are enough to make some people long for the good old days of the century of physics!

We have witnessed the unparalleled spectacle of Francis Collins and Craig Venter climbing down from a mountain of data like Moses from Mount Sinai, holding in their hands stone tablets engraved with 3.2 billion nucleotides. Lo and behold, the people were celebrating the sequenced genome, with songs of rejoicing in the feature and opinion sections of every newspaper. Who cares if it had only been partially sequenced and — as it now turns out — is not even quite correct? The extent of biotheological exaggeration was limitless. Some said the handwriting of God had been deciphered. Well, if the Bible is the book in which man described God, then surely it is a short distance from the reverse, though erroneous, conclusion, that genes are the writing in which God (or nature) has formulated the essence of mankind.

Ethical education

Despite the exaggeration, biologists and doctors have seldom learnt so much about the basics of life in such a short time, or faced so many possibilities for using this knowledge. And never before has such a wide public noted that much of what is new and not yet understood affects our most personal decisions: from what we eat to having children, from life insurance to jobs. This fills us with insecurity as well as hope. Because even we scientists can hardly keep up with the pace of research progress, we have to take this worry seriously and show that we understand it via public debate on these biological innovations. The media cacophony is an unavoidable, even indispensable, part of this debate. By this process, many people will see that their anxieties are exaggerated, as may be their hopes.

We shouldn't be surprised that so many people are calling loudly for the authorities to give them clear direction and visible boundaries, anchored in eternal values and truths. Yet no ethics council, however careful, can spare us from educating ourselves on vital issues so that we can make our own judgments, for every human being is ultimately responsible for the decisions he or she makes. Those who wish to end the confused debates with well-intentioned words of moral or legal authority will discover that the debates will go on for that very reason.

This all boils down to the eternal question: "What is a human being?" Heated debate has already progressed to the extent that some biologists will soon not dare enter the laboratory or appear in public unless accompanied by a constitutional lawyer and a moral theologist, or both. Every human being is new, unique and developed from a fertilized egg cell. However, the fertilized egg is far from being a human being in the full sense of that word: it can be called a

human being only if the word is given a meaning totally different from its usual definition. When we refer to an organism as 'human', this is an expression of self-reference, the meaning of which is stipulated not by nature but by humans themselves. 'Human' is a culturally defined attribute, not a purely biological fact — we consider a person who has died still to be a human being.

What is a human?

Every living human today belongs to the species *Homo sapiens*. Yet we call our biological ancestors 'human' more or less arbitrarily, as we cannot test ancestors to see if they can reproduce, or tell by looking at a fossil to which genus or species it should be assigned. As Jared Diamond has so clearly pointed out, from a purely genetic point of view, *Homo sapiens* could be designated as the third species of a genus of chimpanzee. But another insight, which we owe to Ernst Mayr, is that *Homo sapiens* should be classified not merely biogenetically, but according to its emergent, cultural level of achievement. Though humans are rooted in their biology, they simultaneously tower above it. That is why humanness cannot be defined exclusively in molecular-genetic facts such as the 3.2 billion nucleotides arranged in a specific order inside a zygote.

Today, as in the past, different cultures take different approaches to deciding the point after fertilization when a developing embryo becomes a human being. Judaism, to take a convincing example, assigns special significance to the fact that a human can only develop when in intimate contact with the mother's body. Assigning to a zygote before implantation in the womb, or an embryo not physically and psychologically accepted by its mother, a quality such as 'human dignity', means subjecting human embryos to different norms from those used for other species — mouse embryos for example — in terms of authorization for use in research. The quality of humanity has to be attached to a stage of embryonic development. Otherwise, the largely respected legal regulations regarding abortion and the generally accepted use of implantation-blocking drugs or devices as a means of birth control would not be possible.

At the end of last year, the British parliament voted by a large majority to allow research on human embryos and cell cultures made from such embryos, even including therapeutic cloning, in the first two weeks of life under strictly controlled, justified conditions. Similar regulations are imminent in France, and will probably soon follow in other European countries. Of course, there is nothing forcing us in Germany to follow suit. But perhaps it is not a bad idea to consider the careful arguments of other countries in our community before we and the Vatican alone take the high ground of final moral justification, as is supported by our president, churches, some political parties, bioethics councils or many sections of the mass media.

In bioethical decisions, a free society must value highly the conscience and action of every individual, whatever their religion. Parents, especially mothers, must be allowed to decide whether to carry a baby to full term when there is possibility of severe developmental disorders in the embryo. When others take it upon themselves to dictate such decisions, it is as though a woman and her reproductive capacity (and even disabled people themselves) belong first to society or to the state, which either grants or denies her freedom about the most private of human rights, that of deciding when and how to use her own reproductive capacity.

The older I get, the more I consider it wrong when old men such as myself try to force young men to go to war or young women to reproduce against their will. It may be true that parents have no legal entitlement to a healthy child, but they certainly have the human right to strive for one! Nor does a society have the legal right to force people to give birth to disabled babies as proof of its moral principles. I call for freedom: not necessarily for freedom of research

—that is a minor, though valid, concern—but for the freedom of every citizen in a democratic society, which is under threat from the coercion of a zealous 'moral majority'.

When does an individual human life begin? Of course, the egg and sperm are both alive: they have genomes, each genetically is an individual. But the development, or epigenesis, of a new person is made possible by the formation of a zygote, not determined by it. The zygote has the potential to become a human being, but only under certain conditions in which, for mammals, being linked to the mother is not like the relationship between a landlord and tenant renting a biological apartment, but constitutive for normal development.

What is life?

Biologically, this fact has far-reaching significance. To begin a symbiotic relationship with an embryo is an individual decision full of tremendous consequences for success in life, because a mammal cannot simply abandon her embryo as a bird can leave her eggs. For long-lived species with only a few chances of producing offspring, such as ours, this decision is especially crucial to life. The 'biological' decision to create a human being is made not at conception but when the zygote becomes implanted in the uterus, which happens in only relatively few cases.

Embryos that spontaneously abort often have genetic anomalies. The most common anomaly due to triplication of a single chromosome occurring in humans is trisomy 21. Anyone tempted to suggest that the resultant developmental defect (Down's syndrome) is ordained by God has to accept that most other trisomies of single chromosomes also occur in humans, and must be just as ordained by God, but are spontaneously aborted.

It would, of course, be a naturalistic fallacy to take the natural selection in the womb of genetically defective embryos as justification for attempts to achieve similar effects by artificial selection. Nevertheless, humans, who have during our evolution towards reason been largely set free from genetic determinism, are entitled to do what nature would do anyway through intentional intervention if an individual considers it right. It seems to me that humanity's concentration on the possession of a set of human genes, and the fatalistic acceptance of every negative twist of fate as being in the make-up of these genes, is the ultimate in 'biologism', degrading us to simply a product of biology and depriving us of precisely that which makes us human: our culturally based freedom of choice.

Facts such as these should not be disregarded in the evaluation of pre implantation genetic diagnosis of severe genetic disorders, which is sometimes misleadingly or maliciously equated with the Nazi methods of selecting victims for the gas chamber. Those who do not recognize the difference between a parent's decision about an embryo or fetus, and the murder of children and adults to serve the supposed public interest, have the least chance of doing justice to the memory of the victims of Nazi state-sponsored terrorism.

The German president, Johannes Rau, was right to warn us scientists to uphold ethical values. Only last month, I apologized to the victims of biomedical and racist research madness during the Nazi era for the moral failures of the guilty members of the Kaiser Wilhelm and Max Planck societies, and I asked the victims for forgiveness. But we must categorically distinguish between the atrocities of scientists in a regime of terror, and the procedures used in research and medicine for pre-implantation genetic diagnosis, therapeutic cloning and development of treatments for serious diseases using cell cultures from embryos. Equating the one with the other is totally wrong and belittles the suffering of the Nazis' victims. Everyone agrees that these victims were misused and humiliated human beings, whereas there is no biological reason to

attribute complete personhood to a few-celled embryo simply because, in interaction with a mother organism, it has the ability to become one—although its dignity should certainly be respected from its very beginning.

This is why, as a member of the senate of the DFG (Germany's main funding agency for university research), I voted in favor of its position on stem-cell research. The DFG's suggested course of action is moderate and the planned further research appropriate. I thank the president of the DFG, Ernst-Ludwig Winnacker, for standing firm despite personal insults and widespread denigration from the public.

Basic researchers seeking knowledge for its own sake have no need to experiment on human embryos, as they can use mice or other lab animals. It is the therapeutic goal of healing severely ill patients that must be considered by legislators when deciding whether to allow human embryo research. The vast majority of researchers desire to benefit individuals, society and the environment, and do not have delusions of grandeur or visions of creating a Frankenstein's monster. The Rubicon does not have evil looming on the other side, for if evil is anywhere, then it is right here with us and has been for some time. Instead, we must find new ways to navigate this river, and cross it only in the knowledge of our full responsibility for our actions.

Hubert Markl was president of the Max Planck Society, Munich, Germany. This article is an edited version of a speech given by the author at the plenary assembly of the Max Planck Society on 22 June 2001.

Discussion 8) Topic: Biodiversity

Excerpt from **Can We Defy Nature's End?**

By Stuart L. Pimm, et al.
Science, 293(21 September 2001), 2207-2208

In the catalog of global environmental insults, extinctions stand out as irreversible. Current rates are high and accelerating. After a recent conference, we concluded that preventing extinctions is practical, but requires innovative measures. Enforceable protection of remaining natural ecosystems is an overarching recommendation. Our deliberations regarding the implementation of this led us to attempt to answer a number of questions. The answers outlined here represent, if not consensus, then the opinion of the majority. Supplementary material summarizes unresolved debates.

Is Saving Remaining Biodiversity Still Possible?

Globally, the harm we inflict on biodiversity often stems from impacts on vulnerable, biodiverse areas that contribute relatively little to overall human well-being and often diminish it. For example, tropical humid forests house two-thirds of terrestrial species. Within half a century, tropical forests have shrunk by half, a loss of 9 million km^2, with several times more forest damaged than cleared each year. Yet clearing tropical forests has created only ~ 2 million km^2 of the planet's 15 million km^2 of croplands. The poor soils underlying many tropical forests soon degrade and are abandoned or contribute only marginally to the global livestock production. About 10% of these cleared forests are on steep mountain slopes where high rainfall has predictably tragic consequences to those who settle there.

The Amazon, the Congo, and rivers in Southeast Asia hold almost half the world's freshwater fish species. Their fates depend on the surrounding forest watersheds. Elsewhere, most accessible rivers are dammed and channeled, causing their faunas to be more threatened than terrestrial ones. Diversion of water for irrigation threatens ecosystems, such as the Mesa Central (Mexico) and the Aral Sea and its rivers (Central Asia). Irrigation projects are often economic disasters, as salt accumulation quickly destroys soil fertility.

Fishing contributes only 5% of the global protein supply, yet is the major threat to the oceans' biodiversity. The multitude of fish species caught on coral reefs constitutes only a small, though poorly known, fraction of the total catch, but fisheries severely damage these most diverse marine ecosystems. Most major fish stocks are over fished; thus, mismanagement diminishes our welfare and biodiversity simultaneously. Conversely, protected areas enhance biodiversity and fish stocks. It is at regional and local scales that human actions and biodiversity collide. On land, 25 areas, called hotspots, contain concentrations of endemic species that are disproportionately vulnerable to extinction after regional habitat destruction. These areas retain <10% of their original habitat and have unusually high human population densities. Locally, those who destroy biodiversity do so because they are displaced, marginalized, and perceive no alternative. Others do so for short-term profit.

Is Protecting Biodiversity Economically Possible?

Although a global reserve network covering ~15% of each continent might cost ~$30 billion annually, reserves in tropical wilderness areas and hotspots need only cost a fraction of this. Tropical wilderness forests, predominantly the relatively intact blocks of the Amazon, Congo, and New Guinea are remote and sparsely populated. Land values are low and sometimes equivalent to buying out logging leases. Recent conservation concessions suggest ~$10/ha for acquisition and management. Securing an additional ~2 million km^2 and adequately managing the ~2 million km^2 already protected for biodiversity and indigenous peoples requires a one-time investment of ~$4 billion. Land prices for the densely populated hotspots are much higher. Of the 1.2 million km^2 of unprotected land, some will remain intact without immediate intervention, some is already too fragmented, and perhaps one-third constitutes the highest priority. A study of the South Africa fynbos hotspot suggests a one-time cost of ~$1 billion, and so by extrapolation, ~$25 billion for the protection and adequate management of all hotspots. Additional marine reserves would likely require ~$2.5 billion.

These sums, although large, undercut arguments that saving biodiversity is unaffordable. They are of the same order of magnitude as the individual wealth of the world's richest citizens--and 1/1000th the value of the ecosystem services that biodiversity provides annually. This suggests a strategy of leveraging funding from governments and international agencies through private sector involvement.

Will Protecting Areas Work?

The pressures to destroy ecosystems are often external. For example, the World Bank and the International Monetary Fund have indirectly encouraged governments to deplete their natural resources to pay off debt. Even when available, some countries may view foreign purchase of conservation concessions as imperialism in a 21st-century guise. Almost all the hotspots were European colonies; one is still French territory. Some countries have unstable government, and others are at war.

Some countries have welcomed pre-emptive purchasing of logging rights and other conservation actions, recognizing the advantages of protecting forests and receiving funds to do so. Unfortunately, cutting forests and otherwise depleting resources is too often a way to personal aggrandizement among some government officials. How good is even a well-intentioned government's guarantee of a forest's security when its peoples need wood for cooking or land for farms? Will the government return the concession fees to those whose livelihoods are affected?

Protected areas may be respected in one country, ignored in another, even attract exploitation in a third. Although more money generally yields more protection, richly endowed parks may be severely threatened (Everglades National Park; USA) and significant accomplishments are possible in the most economically unlikely places (Odzala National Park; Democratic Republic of Congo).

Whereas overall assessments of what conservation actions work, what do not, and why they are long overdue, discussions of possible factors typically devolve into idiosyncratic case histories. Likely, there is no single answer to these multiscaled problems. One process, however, emerges as a unanimous choice: to train and empower conservation professionals in each biodiversity-rich country.

Should Conservation Research and Management Be Centralized or Distributed?

At present, these capabilities are highly centralized in industrialized nations, while many key tropical areas have few conservation professionals. Our experiences point to the pressing need for more and better-trained people. Those at La Selva (Costa Rica), Comision Nacional Para el Conocimiento y Uso de la Biodiversidad (CONABIO), Mexico, the Humboldt Institute (Colombia), the Centre for Ecological Sciences of the Indian Institute of Science (India), and the International Centre for Living Aquatic Resources (ICLARM), Philippines have been in place long enough to assist in training a new generation. Budgets for effective centers are a few million dollars per year. Roughly half a billion dollars would support 25 centers for a decade, enough for each hotspot and wilderness forest without centers plus additional centers for marine and freshwater hotspots.

Should Efforts Concentrate on Protection or on Slowing Harm?

Most of us agree that immediate protection of ecosystems and training of in-country professionals is vital. Nonetheless, some effort should be allocated to actions to lighten the burden on future generations of conservation professionals. Others argue in favor of actions that stem the processes that harm biodiversity and encourage those that protect it, with priority given to actions yielding near-term results.

Economic subsidies that degrade the environment are a common problem across terrestrial, freshwater, and marine ecosystems. For instance, massive economic subsidies make unsustainable fishing practices possible. Biodiversity can be depleted if property rights give ownership to those whose "economic use" translates into short-term forest clear-cutting, transient crops or grazing, and longer-term land degradation.

The public is often unaware of the costs of environmentally damaging policies. Annually, subsidies for such policies cost $2 trillion globally. We recommend a focused analysis on those governmental policies that artificially alter market dynamics and that have the most detrimental impact on biodiversity. The overarching message is that sound economic and ecological strategies may often involve the same, and not conflicting, strategies. Alliances of the fiscally frugal and the environmentally concerned are a still unexplored possibility.

We recommend a major outreach to national and international institutions that make loans for actions that degrade biodiversity. Many of them could benefit from improved ecological standards that factor biodiversity protection into their decision-making. Obligations of parties to existing legal instruments (such as the United Nations Convention on Biological Diversity) should also be used to promote adequate incentives.

Biodiversity-rich countries often lack legal mechanisms to encourage conservation. Tax savings, transferable development rights, and mitigation credits would at least allow private, public or indigenous landowners to secure economic benefits. Globally, the wilderness forests, if lost, would greatly exacerbate increasing atmospheric CO_2. Their value as carbon sinks alone appears to be broadly similar to our estimates of what it would take to protect them. Capturing these values could save large areas through efforts designed to highlight their true value.

Do We Know Enough to Protect Biodiversity?

Most debate centers on identifying priority areas for conservation. Surely all remaining habitats across the species-rich tropics must be priorities, ones that do not depend on our knowing the scientific names for 1 of 10, or the geographical distributions of 1 of 100 species, or not having resolved complex issues of reserve selection. However, even modest scientific advances greatly improve the efficiency of our actions. Knowing which areas within hotspots are especially important could reduce costs considerably.

Paradoxically, we are not limited by lack of knowledge, but by our failure to synthesize and distribute what we know. Museums and herbaria are vast repositories of data on what species occurred where, while decades of remote-sensing imagery detail how fast the remains of species' ranges are shrinking. Although a few of us question the utility of these taxonomic repositories, the majority emphasize the urgent need for more, globally distributed taxonomy.

In contrast, there was broad consensus for a greatly expanded research effort into the links between biodiversity, ecosystems, their services, and people. Infectious diseases are entering human populations as our numbers increase and as we encroach upon tropical forests and other pathogen reservoirs. Global climate change will have major impacts on human health through changes in food production, access to fresh water, exposure to vector- and water-borne disease, sea-level rise and coastal flooding, and extreme weather events.

In conclusion, we share mixed senses of concern, urgency, and optimism. Concern, because humanity's numbers (and consumption) are increasing. Across several human generations, a transition to sustainable use of natural resources is essential, and we must protect biodiversity in the interim. The urgency is driven by the pending loss of a major portion of biological diversity in the first half of this century if we do not act immediately. Our optimism stems from the realization that greatly increasing the areas where biodiversity is protected is a clear and achievable goal, one potentially attainable by using funds raised in the private sector and leveraged through governments.

Discussion 9) Topic: The Human Impact

Excerpts from

Integrated Science and The Coming Century of The Environment

By Edward O. Wilson

Now, at the beginning of the century, is a good time to acknowledge that science is no longer the specialized activity of a professional elite. Nor is it a philosophy, or a belief system, or, as some postmodernist thinkers would have it, just one world view out of a vast number of possible views. It is rather a combination of mental operations, a culture of illuminations born during the Enlightenment four centuries ago and enriched at a near-geometric rate to establish science as the most effective way of learning about the material world ever devised. The sword that humanity finally pulled, it has become part of the permanent world culture and available to all.

"Science, to put its warrant as concisely as possible, is the organized systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable laws and principles."(1) Its defining traits are first, the confirmation of discoveries and support of hypotheses through repetition by independent investigators, preferably with different tests and analyses; second, mensuration, the quantitative description of the phenomena on universally accepted scales; third, economy, by which the largest amount of information is abstracted into a simple and precise form, which can be unpacked to re-create detail; fourth, heuristics, the opening of avenues to new discovery and interpretation.

And fifth, and finally, is consilience, the interlocking of causal explanations across disciplines. "This consilience," said William Whewell when he introduced the term in his 1840 synthesis *The Philosophy of the Inductive Sciences*, "is a test of the truth of the theory in which it occurs." (2) And so it has proved within the natural sciences, where the webwork of established cause and effect, while still gossamer frail in many places, is almost continuous from quantum physics to biogeography. This webwork traverses vast scales of space, time, and complexity to unite what in Whewell's time appeared to be radically different classes of phenomena. Thus, chemistry has been rendered consilient with physics, both undergird molecular biology, and molecular biology is solidly connected to cellular, organismic, and evolutionary biology.

The scales of space, time, and complexity in the explanatory webwork have been widened to bracket some 40 orders of magnitude. Consider, for example, the webwork's reach from quantum electrodynamics to the birth of galaxies; or the great breadth it has attained in the biological sciences, which are not only united with physics and chemistry but now touch the borders of the social sciences and humanities.

This last augmentation, while still controversial, deserves special attention because of its implications for the human condition. For most of the last two centuries following the decline of the Enlightenment, scholars have traditionally drawn sharp distinctions between the great branches of learning, and particularly between the natural sciences as opposed to the social sciences and humanities. The latter dividing line, roughly demarcating the scientific and literary cultures, has been considered an epistemological discontinuity, a permanent difference in ways of knowing. But now growing evidence exists that the boundary is not a line at all, but a broad, mostly unexplored domain of causally linked phenomena awaiting cooperative exploration from both sides.

Researchers from four disciplines of the natural sciences have entered the borderland:

> Cognitive neuroscientists, outriders of the once but no longer "quiet" revolution, are using an arsenal of new techniques to map the physical basis of mental events. They have shifted the frame of discourse concerning the mind from semantic and introspective analysis to nerve cells, neurotransmitters, hormones, and recurrent neural networks. Working on a parallel track, students of artificial intelligence, with an eye on the future possibility of artificial emotion, search with neuroscientists for a general theory of cognition.
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> Combining molecular genetics with traditional psychological tests, behavioral geneticists have started to characterize and even pinpoint genes that affect mental activity, from drug addiction to mood and cognitive operations. They are also tracing the epigenesis of the activity, the complex molecular and cellular pathways of mental development that lead from prescription to phenotype, in the quest for a fuller and much-needed understanding of the interaction between genes and environment.
>
> Evolutionary biologists, especially sociobiologists (also known within the social sciences as evolutionary psychologists and evolutionary anthropologists), are reconstructing the origins of human social behavior with special reference to evolution by natural selection.
>
> Environmental scientists in diverse specialties, including human ecology, are more precisely defining the arena in which our species arose, and those parts that must be sustained for human survival.

The very idea of a borderland of causal connections between the great branches of learning is typically dismissed by social theorists and philosophers as reductionistic. This diagnosis is of course quite correct. But consider this: Reduction and the consilience it implies are the key to the success of the natural sciences. Why should the same not be true of other kinds of knowledge? Because mind and culture are material processes, there is every reason to suppose, and none compelling enough to deny, that the social sciences and humanities will be strengthened by assimilation of the borderland disciplines. For however tortuous the unfolding of the causal links among genes, mind, and culture, and however sensitive they are to the caprice of historical circumstance, the links form an unbreakable webwork, and human understanding will be better off to the extent that these links are explored. Francis Bacon, at the dawn of the Enlightenment in 1605, prefigured this principle of integrative science (by which he meant a large part of all the branches of learning) with an image I especially like: "No perfect discovery can be made upon a flat or a level: neither is it possible to discover the more remote or deeper parts of any science, if you stand but upon the level of the same science and ascend not to a higher science."(3)

The unavoidable complement of reduction is synthesis, the step that completes consilience from one discipline to the next. Synthesis is far more difficult to achieve than reduction, and that is why reductionistic studies dominate the cutting edge of investigation. To reduce an enzyme molecule to its constituent amino acids and describe its three-dimensional structure is far easier, for example, than to predict the structure of an enzyme molecule from the sequence of its amino acids alone. As the century closes, however, the balance between

reduction and synthesis appears to be changing. Attention within the natural sciences has begun to shift away from the search for elemental units and fundamental laws and toward highly organized systems. Researchers are devoting proportionately more time to the self-assembly of macromolecules, cells, organisms, planets, universes--and mind and culture.

If this view of universal consilience is correct, the central question of the social sciences is, in my opinion, the nature of the linkage between genetic evolution and cultural evolution. It is also one of the great remaining problems of the natural sciences. This part of the overlap of the two great branches of learning can be summarized as follows. We know that all culture is learned, yet its form and the manner in which it is transmitted are shaped by biology. Conversely, the genes prescribing much of human behavioral biology evolved in a cultural environment, which itself was evolving. A great deal has been learned about these two modes of evolution viewed as separate processes. What we do not understand very well is how they are linked.

The surest entry to the linkage, or gene-culture coevolution as it is usually called, is (again in my opinion) to view human nature in a new and more heuristic manner. Human nature is not the genes, which prescribe it, or the universals of culture, which are its products. It is rather the epigenetic rules of cognition, the inherited regularities of cognitive development that predispose individuals to perceive reality in certain ways and to create and learn some cultural variants in preference to competing variants.

Epigenetic rules have been documented in a diversity of cultural categories, from syntax acquisition and paralinguistic communication to incest avoidance, color vocabularies, cheater detection, and others. The continuing quest for such inborn biasing effects promises to be the most effective means to understand gene-culture coevolution and hence to link biology and the social sciences causally. It also offers a way, I believe, to build a secure theoretical foundation for the humanities, by addressing, for example, the biological origins of ethical precepts and aesthetic properties of the arts.

The naturalistic world view, by encouraging the search for consilience across the great branches of learning, is far more than just another exercise for philosophers and social theorists. To understand the physical basis of human nature, down to its evolutionary roots and genetic biases, is to provide needed tools for the diagnosis and management of some of the worst crises afflicting humanity.

Arguably the foremost of global problems grounded in the idiosyncrasies of human nature is overpopulation and the destruction of the environment. The crisis is not long-term but here and now; it is upon us. Like it or not, we are entering the century of the environment, when science and polities will give the highest priority to settling humanity down before we wreck the planet.

Here in brief is the problem—or better, complex of interlocking problems--as researchers see it. In their consensus, "[t]he global population is precariously large, will grow another third by 2020, and climb still more before peaking sometime after 2050. Humanity is improving per capita production, health, and longevity. But it is doing so by eating up the planet's capital, including irreplaceable natural resources. Humankind is approaching the limit of its food and water supply. As many as a billion people, moreover, remain in absolute poverty, with inadequate food from one day to the next and little or no medical care. Unlike any species that lived before, *Homo sapiens* is also changing the world's atmosphere and climate, lowering and polluting water tables, shrinking forests, and spreading deserts. It is extinguishing a large fraction of plant and animal species, an irreplaceable loss that will be viewed as catastrophic by future

generations. Most of the stress originates directly or indirectly from a handful of industrialized countries. Their proven formulas are being eagerly adopted by the rest of the world. The emulation cannot be sustained, not with the same levels of consumption and waste. Even if the industrialization of developing countries is only partly successful, the environmental aftershock will dwarf the population explosion that preceded it." (4) Recent studies indicate that to raise the rest of the world to the level of the United States using present technology would require the natural resources of two more planet Earths.

The time has come to look at ourselves closely as a biological as well as cultural species, using all of the intellectual tools we can muster. We are brilliant catarrhine primates, whose success is eroding the environment to which a billion years of evolutionary history exquisitely adapted us. We are dangerously baffled by the meaning of this existence, remaining instinct-driven, reckless, and conflicted. Wisdom for the long-term eludes us. There is ample practical reason--should no other kind prove persuasive--to aim for an explanatory integration not just of the natural sciences but also of the social sciences and humanities, in order to cope with issues of urgency and complexity that may otherwise be too great to manage.

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