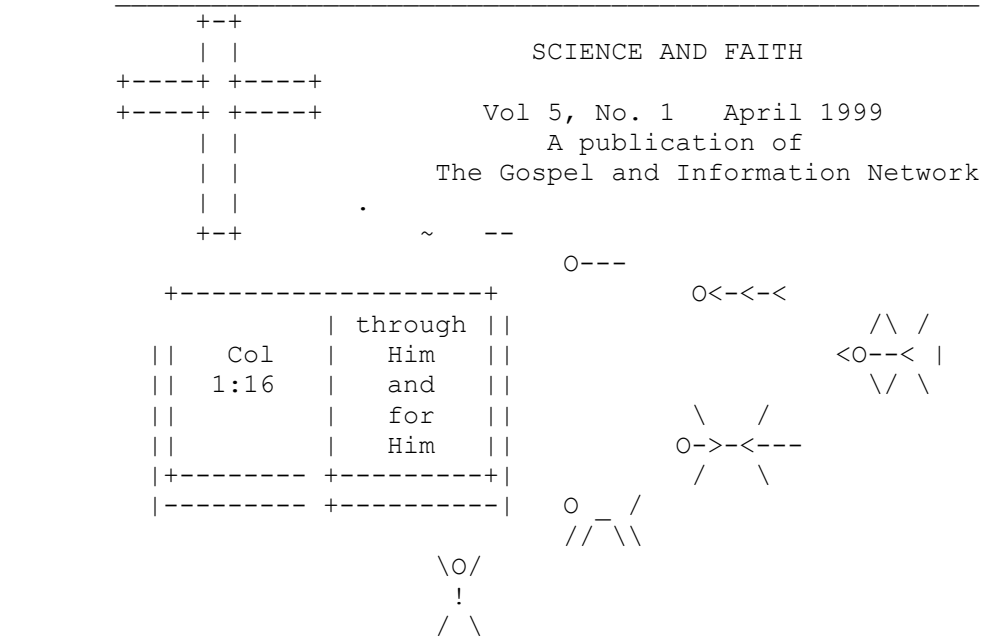

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Co-editors: Andy D Potts, Mike L Anderson

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GENETICS AND GENETHICS: ARE WE PLAYING GOD? ..... (Ted Peters)

"New knowledge gained from genetics research is raising a host of challenging ethical questions, and these ethical questions are prompting theological reflection. The dramatic scale of the biomedical challenges throws us back upon first principles, back to questions about the nature of human nature, about our relationship to ourselves and to our divine source, God. In the popular press the issue is formulated this way: are we playing God? Another, and perhaps more instructive, way the question might be formulated is..."

Ted Peters is a professor of systematic theology at Pacific Lutheran Theological Seminary and the Graduate Theological Union in Berkeley, California. He served as principal investigator of the CTNS research project funded by the NIH to study the "Theological and Ethical Questions Raised by the Human Genome Initiative." He is author of _Playing God? Genetic Determinism and Human Freedom_ (Routledge 1997). This article is adapted from his book.

Wisdom from the Past
THE NECTARY OF THE FLOWER .....(Hugh Macmillan, 1892)

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THE MOMENT OF METAMORPHOSIS 26/4/1996

Frank Opie

There was another shriek of delight as another tiny insect or mite was discovered living in and around the domation pits on the back of the assegai leaves she was studying.

Micelle was exploring her own deep fascination with the little wonders of life. If a caterpillar or pupa could anticipate the joyful freedom day when the chrysalis of its known world would be transcended and broken to allow a butterfly to pump up its wings in undreamt of space and light - the moment could be no greater and now it had come again, and I was privileged to watch from a distance and share her joy.

There are new worlds out there beyond the safe soft edge of our knowledge which beckon with allure the mind that is prepared to search beyond the edge. Then the moment of wonder bursts like sunrise over the horizon and commitment is no problem. Other routines are swept away by the challenge of an untrodden path and

the pushing back of personal frontiers.

Micelle stepped easily from the physical wonder of life to its spiritual significance. Worlds nested within worlds. Tiny creatures, perfectly formed beyond the threshold of unaided vision, startlingly alive at twenty magnifications beneath a binocular microscope. Unaware of our god-like observation as we illuminated and twisted their whole world to suit our searching perspectives, the mites ignored us. We were simply unimaginably big, beyond all experience, therefore we did not exist for them. They had for so long been too unimaginably small to have been looked for by us...

So we had not existed for them and they had not existed for us before the moment of truth - the interface of two worlds. There had been a reaching out and a discovering -two unalikes - a great mind probing into a small universe with awe.

Have we been observed and visited in the same way? We would be unlikely to know in any event unless unmistakeable signs were given. The absence of mental contact does not mean that no contact has occurred. Our perception ends at the end of our leaf - we measure our life times by circuits of one star in a universe of stellar clusters and galaxies beyond our effective probings.

Does the Creator watch our assegai leaf in space? Does he visit us? I believe he does! But until we know as we are known, we will have to look for the divine freeing moments lifting us one by one to new levels of conscious discovery as we find the Creators fingerprints on the worlds beyond the edge and break through afresh to the conclusion and realisation that we are visitors in someone else's backyard.

"...entering my heart unbidden even as one of the common crowd, unknown to me, my king, thou didst press the signet of eternity upon many a fleeting moment of my life. And today when by chance I light upon them and see thy signature, I find they have lain scattered in the dust mixed with the memory of joys and sorrows of my trivial days forgotten. Thou didst not turn in contempt from my childish play among the dust, and the steps that I heard in my playroom are the same that are echoing from star to star."
Rabindranath Tagore

YOU KNOW YOU ARE AN ENTOMOLOGIST WHEN ... Mike L Anderson

you find the dinner conversation is distracting you from examining the fly in your soup.

you are delighted to discover a new species of bedbug in your home.

you are disappointed to discover that "Lord of the Flies" is not a documentary.

your daughter is rebuked for scaring the boys in her class with a giant water bug.

you try to get your son to eat his peas by saying: "You're a spider, these are flies" - and it works.

your spouse complains that her roses are being eaten and you defend the caterpillars.

you spot a rare butterfly from 50 metres but fail to spot the double-decker bus into which you have collided.

NEWS BRIEFS ..... (From the Internet)

* Discovery of the first multi-planet solar system
* Hubble sees the beginning of time
* Adaptive Radiation observed in action
* Skeleton of earliest known North American may have been found
* Once in a blue is not once in a blue moon
* Discovery of a possible Neanderthal/Human Hybrid
* Biggest explosion ever observed
* 92 million year ant fossils discovered
* Tomatoes may protect against cancer
* The secret of gigantism found in ancient crocodiles.

* Discovery of the first multi-planet solar system

Earlier this month astronomers announced the discovery of the first system of planets around a star. The find was made from a search of only a hundred or so stars. The implication is that planetary systems are abundant in our Milky Way. The large size of these planets and their close proximity to their sun could upset the current theory of planet formation.

* Hubble sees the beginning of time

Astronomers have found the most distant object ever detected at 13 billion light years away. Since the light has taken so long to reach us, the Hubble telescope is a window into the distant past. The object: a galaxy with new stars. Actually the stars are long dead. Hubble sees them as they were in their infancy.

* Adaptive Radiation observed in action

"Adaptive radiation" refers to the rapid evolution of a few forms into many species within a new geographical area. The radiation of Darwin's finches in the Galapagos is an often-cited example. Now researches have observed the phenomenon in the laboratory. When the bacterium _Pseudomonas_ _fluorescens_ is provided with ecological opportunity, identical populations diversify morphologically. Under uniform environmental conditions no such divergence occurs. The researchers conclude that the elementary processes of mutation and selection are enough to promote rapid proliferation of new designs.

* Skeleton of earliest known North American may have been found

Bones of a woman found on California's Channel Islands have been estimated at 13 000 years old. The find suggests that the first Americans came by sea rather than via a land bridge.

* Once in a blue is not once in a blue moon

Current understanding is that a blue moon is the second full moon with the same month. This is a mistake according to Sky & Telescope and their own fault. They had perpetrated the error in a 1946 aricle. The correct definition is that a blue moon occurs when a season has four full moons instead of the usual three.

* Discovery of a possible Neanderthal/Human Hybrid

According to paleoanthropologists a 25000 year old skeleton of a child found near Lisbon is compelling evidence that today's humans have evolved from mating

between Neanderthals and anatomically modern humans. The femur and tibia are neanderthal-like in size while the jaw and teeth are modern.

* Biggest explosion ever observed

Imagine an explosion equivalent to thousand billion years of light from a sun in a few seconds. That is what astronomers observed earlier this year from a spot 9 billion light years away. The cause of the explosion is still being investigated.

* 92 million year ant fossils discovered

The finds, in fossilized amber, were made in New Jersey (USA). They push back the estimated time of origin of ants by 40 million years.

* Tomatoes may protect against cancer

Evidence has come to light suggesting that the nutrient lycopene, that makes tomatoes red, can shrink prostrate tumours. To think that there was a time when Europeans thought tomatoes were poisonous! Now you can feel good about eating all those chips - just add lots of tomato sauce!

* The secret of gigantism found in ancient crocodiles.

How does a crocodile get to eat dinosaurs, weigh 5000 kg and be 10 metres long? By living longer. This is what researchers believe about the gargantuan Deinosuchus that lived two decades longer than living crocodiles. Could living crocodiles get to be such monsters by sticking to a healthy diet?

DINOSAUR IDENTIFICATION BY COUNTING NOSES OR ARGUMENT TO THE PEOPLE

Mike L Anderson

There has been much excitement in the paleontological world over the recent discovery of feathered dinosaurs. The find is significant because it clinches the theory that birds are descended from dinosaurs. As Philip Currie, a curator at a museum of paleontology puts it: "Dinosaurs did not become extinct. In fact, they are alive and well and represented by over 10,000 species of birds" (1). The alternative that birds and dinosaurs evolved feathers independently is too improbable to warrant serious consideration. The theory itself is not new. Before its feathers were discovered, Archaeopteryx was classified as a dinosaur. Birds have the remnants of a hole in their skull called the antorbital fenestra that is a diagnostic dinosaurian trait. So, the find is not a surprise. It is exciting because it confirms what was long suspected.

Now the animal kingdom is not just the province of scientists. When my son announces that there is a worm in his apple, I don't inform him that it is actually an insect larva. I allow some license and deal with the offending insect. This is all fine as long as it is understood that the child's understanding is not the final court of appeal. For someone to argue that the animal must be a worm because every child "knows this" is to commit a fallacy - argument to the people or argumentum ad populum.

Imagine my surprise when I found an astrophysicist trying to refute the dinosaur expert Phillip Currie in this way.

"To say, "dinosaurs did not become extinct" is to contradict an enormous body of well-established evidence. New evidence suggests that dinosaurs were wiped out more than once. Thanks to dinosaur mania, nearly every child today knows that

the final dinosaur era, the Cretacious era, was terminated some 65 million years ago when an asteroid collided with Earth" (2).

(Let us ignore the remarkably westocentrism is this comment - apartheid and Christian National Education ensured that most children in South Africa have never heard of the Cretacious period let alone what happened to the dinosaurs in it).

The astrophyicist seems to think that the child masses have greater authority than the curator of dinosaurs at the Royal Tyrrell Museum of Paleontology! This from one who says the "rules of logic must be used to test the plausibility of the interpretation!" His "logic" leads him to conclude that the interpretations of the paleontologists do not deserve a passing grade. But, as C.S. Lewis would have said, counting noses is no necessary criterion for truth. Yes, popular understanding is that dinosaurs went extinct in the Cretacious era. Phillip Currie knows this. His object was to improve public understanding.

If our astrophysicist applied nose counting to his own faith he might not have become a Christian. Globally, most children do not acknowledge the deity of Jesus Christ. But God the Father's verdict carries more weight than a world of children: "This is My beloved Son in whom I am well-pleased."

So, while attempting to take the speck out of the paleontologists interpretive eye he failed to see the plank in his own. This is unfortunate. God has blessed this astrophysicist with a fruitful ministry. But, with his poor handling of paleontologists and their data, he is unlikely to open channels of communication with them. And they need the gospel no less than anyone else.

Notes

1. Qiang, J., Currie, P.J., Norell, M.A. and J. Shua-Ab (1998) Two Feathered Dinosaurs from Northeastern China. _Nature_ 393:753-761.

2. Ross, H. (1998) Darwinism's Fine Feathered Friends- A Matter of Interpretation. _Facts & Faith_ 12:(3):1-3.

* * * Feature article * * *

Genetics and Genethics: Are We Playing God?

By Ted Peters.

Adapted from his book _Playing God?_ (Routledge, 1997)

Available in paperback from Barnes & Noble.

Introduction

New knowledge gained from genetics research is raising a host of challenging ethical questions, and these ethical questions are prompting theological reflection. The dramatic scale of the biomedical challenges throws us back upon first principles, back to questions about the nature of human nature, about our relationship to ourselves and to our divine source, God. In the popular press the issue is formulated this way: are we playing God? Another, and perhaps more instructive, way the question might be formulated is: how might theological reflection on the frontier of genetic research guide and direct ethical deliberation?

The ethical questions emerging from the field of genetics are creating a sense of urgency due to the enormous scale of research associated with the Human Genome Project (HGP), sometimes referred to as the Human Genome Initiative (HGI). Begun in 1988, HGP is a "big science" project, international in scope, involving numerous laboratories and associations of scientists strewn across the landscape, having a current annual U.S. budget of $200 million with a fifteen-year timeline and a $3 billion total price tag. The scientific goal is to map and sequence the human DNA. Mapping will eventually tell us the position and spacing of the predicted 100,000 genes in each of our body's cells; and sequencing will determine the order of the four base pairs - the A,T,G and C nucleotides - that compose the DNA molecule. The study's motive is to identify the 4,000 or so genes that are suspected to be responsible for inherited diseases and to prepare the way for treatment through genetic therapy. For the human beings whose cells contain the DNA being studied the new knowledge will require new thinking about the ethical, legal, and social dimensions of life.

It is significant to note that in the case of HGP, we have scientists who are already aware that their research will have an impact on surrounding society and are willing to share responsibility for it. When James D. Watson counseled the U.S. Department of Health and Human Services to appropriate the funds for what would become HGP, he recommended that 3% of the budget be allotted to study the ethical, legal, and social implications of genome research. "We must work to ensure that society learns to use the information only in beneficial ways," says Watson, "and, if necessary, pass laws at both the federal and state levels to prevent invasions of privacy...to prevent discrimination on genetic grounds." Watson, who along with Francis Crick, is famed for his discovery of the double helix (graphic here) structure of DNA, was the first to head the Office of Human Genome Research at the National Institutes of Health (NIH). He recently resigned amidst a dispute with former NIH director Bernadine Healey over the morality of patenting of DNA sequences. Moral controversy has already broken out on this and numerous other issues. Hence, we can expect genetics and ethics to court one another for the next few years, leading perhaps to a marriage, to genethics.

The task of this essay will be to identify and formulate seven of the major ethical questions which are already appearing on the genetic horizon, and to help bring them into focus by drawing out their theological implications. A handful of theologians and ethicists have begun a serious dialogue with research scientists to sort through the issues.

Genetic Discrimination

One ethical issue on the genetic horizon has already begun to take focus, namely, genetic discrimination. A possible scenario runs like this. In the next few years researchers will identify and locate most, if not all, genes in the human genome that either condition or in some cases cause disease. Already we know that the gene for Cystic Fibrosis is found on chromosome 7 and the gene for Huntington's disease on chromosome 4. Alzheimer's disease is probably due to a defective gene on chromosome 21, and certain incidences of colon cancer to one on chromosome 2. Disposition to muscular dystrophy, sickle-cell anemia, Tay-Sachs disease, certain cancers and numerous other diseases have locatable genetic origins. More knowledge is yet to come. When it comes, it may be

accompanied by an inexpensive method for testing the genome of each individual to see if he or she has any genes for any diseases. Screening for all genetic diseases may become routine for newborns, just as testing for phenylketonuria (PKU) has been since the 1960s. A person's individual genome would become part of a data bank to which each of us, as well as our health care providers, would have future access. The advantage is clear: alert medical care from birth to grave could be carefully planned to delay onset, appropriately treat, and perhaps even cure genetically based diseases.

This is an unlikely scenario, however. As good as it may sound, the specter of genetic discrimination may slow it down, if not retard it completely. Any grand plan to employ new genetic knowledge for preventive health care for Americans is likely to be impeded, if not blocked entirely, by the U.S. system of financing medical care through commercial insurance. The problem begins with insurability, and may end up in a form of discrimination that for genetic reasons prevents certain individuals from obtaining employment and, hence, medical services. Even with a government regulated program of access to basic health services, the need to purchase supplemental insurance to cover serious diseases makes many of us with certain genetic configurations vulnerable to discrimination.

Insurance works by sharing risk. When risk is uncertain to all, then all can be asked to contribute equally to the insurance pool. Premiums can be equalized. Once the genetic disorders of individuals become known, however, this could justify higher premiums for those demonstrating greater risk. The greater the risk, the higher the premium. Insurance may even be denied those whose genes predict extended or expensive medical treatment.

For three-quarters of Americans, medical insurance is tied to employment. Among Fortune's 500 top companies, twelve already report using genetic screening for employment purposes. Although screening in the past was justified initially for public health purposes, employers may increasingly be motivated to use screening to cut premium costs for the medical insurance they pay on behalf of employees. Underwriters already deny or limit coverage to some gene-related conditions such as sickle-cell anemia, atherosclerosis, Huntington's disease, Down's syndrome, and muscular dystrophy. This list could increase. Individuals with genetic dispositions to expensive diseases may become unemployable, uninsured, and finally unable to acquire medical care. Between thirty to forty million persons in the United States currently live with insufficient or no medical coverage; and, despite its promises for a better life, HGP could inadvertently add a whole new class of poor and uninsuredpeople.

At this writing, as many as nine pieces of proposed legislation in the U.S. Congress, plus many state initiatives, include provisions aimed at protecting us from genetic discrimination. Prompted by ethicists operating out of rights' theory, these proposals invoke the principles of confidentiality and privacy. They argue that genetic testing should be voluntary and that the information contained in one's genome be controlled by the patient. This "privacy defense" argument presumes that if information can be controlled, then the rights of the individual for employment, insurance, and medical care can be protected.

There are some grounds for thinking this approach will succeed. Title VII of the 1964 Civil Rights Act restricts preemployment questioning to work-related health conditions, and its paragraph 102.b.4 potentially protects coverage for the employee's spouse and children. Current legislative proposals seem to favor privacy.

Nevertheless, it seems the privacy defense can, at best, be a mere stop-gap effort. In the long run, it will probably fail. Insurance carriers will press for legislation more fair to them, and eventually protection of privacy may slip. In addition, the existing state of computer linkage makes it difficult to prevent the movement of data from hospital to insurance carrier and to anyone

else intent on finding out. In addition, one of the most important factors is the principle that genome information should not finally be restricted. The more we know and the more who know, the better the health care planning can be. But this is contingent on whether we can have information without discrimination. The only way to obtain this is to restructure the employment-insurance health care relationship. The current structure seems to make it profitable for employers and insurance carriers to discriminate against individuals with certain genetic configurations - that is, it is in their best financial interest to limit or even deny health care. A restructuring seems called for so that it becomes profitable to deliver, not withhold, health care. To accomplish this the whole nation will have to become more egalitarian - that is, to think of the nation itself as a single community willing to care for its own constituents.

Where is the nation's church leadership now that the debate is beginning to heat up? It is clear that religious ethicists oppose genetic discrimination. In 1989, the Church and Society commission of the World Council of Churches released a study document, "Biotechnology: Its Challenges to the Churches and the World," which draws attention to "unfair discrimination...in work, health care, insurance and education." Similarly, in the proposal approved by its 1992 General Conference, the United Methodist Church Genetic Task Force listed prominently among possible HGP repercussions, "discrimination: the suffering and/or hardship that may result for persons with late-onset disease like Huntington's or Alzheimer's disease, or with a genetic predisposition to diseases like high cholesterol levels or arteriosclerosis." And, in 1989, the Seventeenth General Synod of the United Church of Christ meeting in Fort Worth, Texas, approved a Pronouncement which included a rejection of "screening as a basis for determining civil, economic, or reproductive rights." A resolution passed at the 70th General Convention of the Episcopal Church in July of 1991 states forcefully: "The use of results of genetic screening of adults, newborns and the unborn for the purpose of discrimination in employment and insurance is unacceptable."

This clear stand against genetic discrimination provides a solid foundation from which to build an ethical proposal; but it stops here. There are hints that church ethicists will side with those who advocate privacy; and there are hints that they favor some sort of national program guaranteeing health care to everyone. What we do not see as yet among religious leaders is any overall vision regarding the potential value (or nonvalue) of widespread use of genome information for health care delivery.

The Abortion Controversy Intensifies

Perhaps the most divisive moral issue in America is the practice of abortion on demand. The advance of genetic knowledge and the development of more sophisticated reproductive technologies will only add nuance and subtlety to an already complicated debate. Techniques have been developed to examine in vitro fertilized (IVF) eggs as early as the fourth cell division in order to identify so-called "defective" genes, such as the chromosomal structure of Down's syndrome. Prospective parents may soon be able to fertilize a dozen or so eggs in the laboratory, screen for the preferred genetic make-up, implant the desired zygote(s), and discard the rest. What will be the status of the discarded preembryos? Might they be considered abortions? By what criteria do we define "defective" when considering the future of a human being? Should prospective parents limit themselves to eliminating defective children, or should they go on to screen for desired genetic traits such as blue eyes or higher intelligence? If so, might this lead to a new form of eugenics, to selective breeding based upon personal preference and prevailing social values? What will become of human dignity in all this?

The ethical question we face today - by what criterion do we deem a genetically

defective or undesirable fetus abortable? - was not addressed by Roe v. Wade in 1973. The present practice of abortion by choice prior to the third trimester places the choice with the pregnant woman (actually her doctor), but it does not provide distinctively ethical criteria for distinguishing better from worse choices.

The Roman Catholic tradition has set strong precedents regarding the practice of abortion. The precedent against aborting the unborn is clear from the Second Vatican Council: ". . . from the moment of its conception life must be guarded with the greatest care, while abortion and infanticide are unspeakable crimes." The challenge to ethicists in the Roman Catholic tradition in the near future will be to examine what transpires at the preimplantation stage of the embryo (or pre-embryo) to determine if the word "abortion" applies. If it does, this may lead to recommending that genetic screening be pushed back one step further, to the gamete stage prior to fertilization. The genetic make-up of sperm and ovum could be screened separately, using acceptable gametes and discarding the unacceptable. The Catholic Health Association of the United States pushes back a step further by recommending the development of techniques of gonadal cell therapy to make genetic corrections in the reproductive tissues of prospective parents long before conception takes place - that is, gametocyte therapy. Other issues, such as the criteria for genetic acceptability remain, to be sure, but the problem of post-conception abortion may be solved in this way.

Patenting God's Creation

One might think that the controversy over whether we should patent knowledge of DNA sequences would be limited to an argument among scientists, biotechnology companies, and the government. Yet, religious voices have been raised. The louder of the religious voices have shouted "No!" to patenting intellectual property regarding genes, on the grounds that DNA belongs to God's creation. Where are we on this?

The 1990s chapter in the larger story of the controversy over patenting life forms began with the initial filing, by J. Craig Venter, in June, 1991, for patent property rights on 337 gene fragments, and a second filing in February, 1992, on 2,375 more partial gene sequences. Venter's method of research, based on a deceptively simple insight, was key. The task of the Human Genome Project has been to sequence the entire 3 billion nucleotides in the DNA and to locate where on the DNA the genes are sited. Relatively speaking, only a small portion of the DNA functions as genes, about 3%. The non-genetic material has been affectionately labeled "junk DNA." If one wants to find only the genes, thought Venter, then why bother with plodding through all the junk DNA? Noting that only the genes, not the junk DNA, code for proteins by creating messenger RNA (mRNA), Venter set his focus on mRNA. He began making sturdier clone copies of the otherwise fragile mRNA; and these stronger and analyzable copies he called cDNAs. By sequencing only the cDNAs he could be assured that he was gaining knowledge of actual genes; and by focusing the research this way he brought the price of sequencing down dramatically. By sequencing a short stretch of cDNA clones& - about 300 to 500 bases, and not necessarily the entire gene - Venter created what he called an "expressed sequence tag," or EST. Venter had begun using automatic sequencing machines to the limit of their capacity and was churning out 50 to 150 such tags per day.

In the fall of 1992, the U.S. Patent and Trademark Office made a preliminary ruling denying the applications, on the grounds that gene fragments could not be patented without knowing the function of the gene. This threw the ball into the court of the private sector, where similar patent applications have been filed. Some have been filed by Venter and his colleagues after he left NIH, having garnered $70 million in venture capital to start a private biotech company, The Institute for Genomic Research (TIGR). The result has been controversy with numerous hotly debated questions.

Should knowledge of DNA sequences in the original or natural human genome be patentable? In order to qualify for a patent, an invention must meet three criteria: It must be novel, non-obvious, and useful. At this writing, the U.S. Patent and Trademark Office has issued more than 1,200 patents of the type mentioned above, assuming that these patents meet the three criteria. Do they?

Relevant philosophical questions are: Should intellectual knowledge regarding natural processes in principle be patentable? Does witnessing an existing natural phenomenon in itself warrant patent protection for the witness? Should an astronomer be able to patent every new galaxy he or she discovers? Someone like Justice Douglas would answer no. Writing for the majority in the 1948 U.S. Supreme Court case of Funk Brothers Seed Co. v. Kalo Inoculant Co., he wrote: "Patents cannot issue for the discovery of the phenomena of nature. . . . [Such] are manifestations of laws of nature, free to all men and reserved exclusively to none."

Are cDNAs a natural phenomenon or a human invention? The cDNA does not occur naturally, and is not a gene per se. Rather, it is a copy version of a gene with the introns edited out. It is coded into messenger RNA by the process that reads the raw cellular DNA. This fact leads to an interesting double-mindedness on the part of Daniel Kevles, historian of science, and Leroy Hood, molecular geneticist. On the one hand, they argue that "since it can be physically realized by a devising of human beings, using the enzyme reverse transcriptase, it is patentable." On the other hand, Kevles and Hood are troubled. "If anything is literally a common birthright of human beings, it is the human genome. It would thus seem that if anything should be avoided in the genomic political economy, it is a war of patents and commerce over the operational elements of that birthright."

In 1995, the Human Genome Organization (HUGO) issued a statement opposing the patenting of cDNAs because it would impede the free flow of scientific information. "HUGO is worried that the patenting of partial and uncharacterized cDNA sequences will reward those who make routine discoveries, but penalize those who determine biological function or application. Such an outcome would impede the development of diagnostics and therapeutics, which is clearly not in the public interest. HUGO is also dedicated to the early release of genome information, thus accelerating widespread investigation of functional aspects of genes."

In sum, cDNAs may prove patentable on the grounds that they are the product of a humanly devised process of gaining intellectual knowledge. But at the present moment this appears inappropriate, because the only value of cDNAs is that they tell us what is in the original DNA. As long as the Douglas principle holds that processes already occurring in nature are exempt, the human genome itself will not become patentable.

This became a religious issue on May 18, 1995, at a Washington Press Conference, called the "Joint Appeal Against Human and Animal Patenting," in which it was announced that religious leaders representing more than 80 different groups had signed a statement opposing patenting. This event marks a point of public meeting between the religious and scientific communities, a meeting that, quite unfortunately, has the appearance of a battle. Numerous Roman Catholic bishops, along with Jewish, Protestant, Islamic, Hindu, and Buddhist leaders, signed the following statement:

1. We, the undersigned religious leaders, oppose the patenting of human and animal life forms. We are disturbed by the U.S. Patent Office's recent decision to patent human body parts and several genetically engineered animals. We believe that humans and animals are creations of God, not humans, and as such should not be patented as human inventions.

According to Jeremy Rifkin, whose Foundation on Economic Trends orchestrated the event, "By turning life into patented inventions, the government drains life of its intrinsic nature and sacred value." Richard Land, Executive Director of the Christian Life Commission of the Southern Baptist Convention, was quoted as saying in papers across the country, "Marketing human life is a form of genetic slavery. Instead of whole persons being marched in shackles to the market block, human cellines and gene sequences are labeled, patented and sold to the highest bidders." Land added a judgment against playing God in the laboratory: "We see altering life forms, creating new life forms, as a revolt against the sovereignty of God and an attempt to be God."

The theology of the May 18 press conference reflects the point of view of Jeremy Rifkin, famed for his outspoken resistance to progress in biological research and medical technology. In his book, Algeny, Rifkin describes his own mission as a "resacralization of nature." The Rifkin position implies that nature prior to human creative intervention is sacred and should be left alone. This position, however, could prevent the pursuit of medical research and development of therapies that could relieve human suffering and improve the health of the human race.

Maybe we should be asking how patents can help or retard the development of genetically based therapy for cancer, heart disease, Cystic Fibrosis, Alzheimer's, Huntington's disease, Williams syndrome, and countless others. In effect, the religious leaders have unnecessarily cut themselves off from making a contribution to this central concern. We will take up this concern later when we address the question: Should we play God?

Cloning

The world woke up on February 23, 1997, to the fact that the era of cloning had dawned. At the Roslin Institute near Edinburgh, Scotland, embryologist Ian Wilmut produced a live adult lamb from cells originating in a sheep mammary gland. The method was simple, technologically speaking; Wilmut took a mammary cell from an adult sheep and placed its DNA into the egg of another sheep. He removed the egg's DNA and fused the adult DNA to the egg. The fused cell began to grow and divide, just like a normal fertilized egg. It became an embryo, was planted in the womb of a ewe and, at the time of publication, was already a seven-month-old lamb named Dolly. DNA tests show that Dolly contains only the genes of the adult ewe who provided her DNA.

What are the implications? Although concerns for animal cloning are important, the overriding ethical issue is this: Should we clone human beings? President Bill Clinton's National Bioethics Advisory Commission has said "no," by placing a ban on cloning for the purposes of creating human beings. In a press conference, the U.S. president said that replicating ourselves by this method would violate our individual identity and that we should not "play God." The Church of Scotland would agree. Donald Bruce, who directs the church's Society, Religion and Technology Project - a committee on which Ian Wilmut serves - described human cloning as a "perversity." To use technology to replicate a human being is against the basic dignity of our uniqueness in God's sight, Bruce told the press. Cloning would be ethically unacceptable as a matter of principle, because it violates the uniqueness of our lives, which God has given to each of us and to no one else.

The argument raised by the U.S. President and the Church of Scotland fits with fears enunciated by many, namely, that cloning would compromise human identity and violate human dignity. Widespread is the assumption that who we are is determined by our genetic code, that our DNA is our destiny. With this assumption we can see why some might feel their identity would be compromised when another person shares the same genome. Who we are is influenced by our DNA,

to be sure, but how the genes behave is influenced also by environmental factors. These environmental factors include the cytoplasm in the host egg, as well as our nutrition and socialization while growing up. In addition, common sense gained from everyday observation reveals that no matter how much two people share in common they still differ. Who we are as individual persons is determined by three things: our genome, our environmental influences, and the appearance of a subjective self with free will and the ability to engage in self-definition.

The experience of identical twins is informative. For siblings to be identical means they have the same genome. Yet, each twin grows up with his or her own subjectivity and own sense of identity; and he or she can claim his or her own individual rights. The experience of a cloned person would be similar. The clone would be aware that another person shares the same genetic code, and might even find this fascinating, yet he or she would be just as much an individual as any of the rest of us. It would be society's moral obligation to treat cloned persons as respected individuals. It would be most unfortunate to see the fear that cloned persons have less identity become translated by society into a stigma in which such persons are denied dignity.

Genetic Determinism, Human Freedom, and the Gene Myth

The fifth issue deals with the problem of public perception and laboratory truth. It pertains to the growing popular image of the gene as the all-determining factor in the human condition, and begins with the thought that if we could only find the gene for a certain disease, then we could find the cure by simply manipulating this gene. The logic then continues: Why stop with diseases? Do genes also determine behavior? If so, should we blame persons for their anti-social behavior, or judge them as victims of their genetic makeup? Should we try to alter the genes of individuals or groups with aberrant or unacceptable behavior?

This line of thinking belongs to what I call the gene myth, namely, a widespread cultural thought form that says, "it's all in the genes." The gene myth is deterministic in two senses. The first is puppet determinism, wherein we assume the DNA acts like a puppeteer and we dance on genetic strings like a puppet. If the DNA determines our hair color and what diseases we will have, then perhaps the DNA determines how we will behave and may even control our virtues and vices. The second is Promethean determinism, wherein we assume that once our scientists have learned how DNA works we can then take charge; that is, we can get into the DNA with our scientific tools and modify it so as to guide our own evolutionary future. Puppet determinism presumes that we are victims of our genes, whereas Promethean determinism presumes that we can take charge of our genes. Both belong to the gene myth, and both point to a significant question: Will the concept of genetic determinism - might we call it genetic predestination? - compromise our confidence in free agency?

To attempt an answer we must ask difficult scientific questions. The most obvious one is: Does the science of molecular biology support the deterministic assumptions of the gene myth? No. For the most part, laboratory scientists see little or no evidence supporting a philosophy of genetic determinism that would alter our understanding of human freedom. At minimum, nurture remains as important as nature. Molecular biologist R. David Cole, claiming that genetic determinism does not automatically erase free will at the human level, puts it this way:

1. There is no reason for the non-scientist to be intimidated by the success of the deterministic approach in elucidating the biological role of genes in human nature, and certainly no reason to be intimidated by any scientist who might try to convince us that determinism is all that is. Although the case for free will cannot be rigorously proven, those of us who believe in it need feel

no threat from the findings of the Human Genome Initiative.

However, the popularity of Richard Dawkins' book, The Selfish Gene, along with the controversy created by sociobiologists, demonstrates a growing interest in the prospect that scientists will be able to explain more and more of human behavior in biological terms. Edward O. Wilson, a sociobiologist himself, defines sociobiology as "the systematic study of the biological basis of all social behavior." He has staked out the biological claim rather forcefully: "The genes hold culture on a leash. The leash is very long, but inevitably values will be constrained in accordance with their effects on the human gene pool." Putting the issue into modern context, Dorothy Nelkin and Laurence Tancredi write, "In the long debate over the relative influences of nature and nurture, the balance seems to have shifted to the biological extreme."

There is reason to worry about the consequences issuing from such deterministic interpretations of genetic power. Already surfacing are conclusions which may have deleterious social consequences; including the possibility of an exacerbation of racial prejudice and discrimination. The controversy over the widely read [Visual of Bell Curve?] book, The Bell Curve, by Charles Murray and Richard Herrnstein, is a case in point. On the basis of IQ tests, this book suggested that public policy should shuttle greater financial resources toward certain racial groups designated as the cognitive elites - Jews, Orientals, whites - and remove support from those designated as cognitively challenged - Latinos and African Americans. Sociologist Troy Duster is worried about such racial repercussions. If we identify genes with race, genes with social status, or genes with crime, then we may inadvertently provide a biological support for prejudice and discrimination. He sounds the alarm: "Today, the United States is heading down a road of parallel false precision in this faith in the connection between genes and social outcomes. This is being played out on a stage with converging preoccupations and tangled webs that interlace crime, race, and genetic explanations."

Other potential consequences of accepting a doctrine of genetic determinism relate to the potential link between genetics and sexual orientation. In the summer of 1993, Dean H. Hamer and his research team at the National Cancer Institute announced their discovered evidence of a connection between genetics and some male homosexuality. By constructing family trees in instances where two or more brothers are gay, and performing actual laboratory testing of the supposed homosexual DNA, Hamer located a region near the end of the long arm of the X chromosome that likely contains a gene influencing sexual orientation. Because men receive an X chromosome from their mother and a Y chromosome from their father (women receive two X's, one from each parent), it is assumed that the possible gay gene is inherited maternally. Mothers can pass on this gene without themselves, nor their daughters, being homosexual. A parallel study of lesbian genetics is as yet incomplete; and the present study of gay men will certainly require replication and confirmation to render indisputable proof. Nevertheless, Hamer was ready to write in the article making the dramatic announcement, "We have now produced evidence that one form of male homosexuality is preferentially transmitted through the maternal side and is genetically linked to chromosome region Xq28."

What are the implications of this? Time magazine projected an ethical and political forecast: "If homosexuals are deemed to have a foreordained nature, many of the arguments now used to block equal rights would lose force." Time cited a gay attorney saying, "I can't imagine rational people, presented with the evidence that homosexuality is biological and not a choice, would continue to discriminate." If we eventually accept as fact that male homosexuality is genetically inherited, then the ethical logic that follows could go a number of different directions.

To demonstrate this, we might begin with a couple of basic questions: Does the

genetic disposition toward homosexuality limit the person's free will in the realm of sexuality? And, if so, what are the ethical implications of this discovery? Two answers are logically possible. On the one hand, a homosexual man could claim that because he inherited this gene and did not choose a gay orientation by his own free will, he should not be discriminated against, or judged, in any way different than another member of society. He could claim this because homosexuality could not be judged immoral, on the grounds that it is natural; or, even if society believes homosexuality to be immoral, he could not help the fact that he has inherited his particular genome.

On the other hand, society could take the opposite road and refuse to accept homosexual behavior, even if it is proven to be genetically determined. Homosexuality could be accepted as a biological fact, but still be rejected socially, on the grounds that it lies outside of a culture's traditional, or preconceived, values and norms. In this way, homosexuality would parallel current societal views of other forms of unacceptable, though often genetically-based, behaviors, such as alcoholism and obesity. The underlying premise of this position is that innate genetic dispositions, though outside of a person's conscious control, do not excuse the behavior, trait, or lifestyle. We are then left with the unanswered question: Does our biological predisposition toward a specific behavior in itself make that behavior moral or immoral?

Are We Asking Our Scientists to Play God?

The debate over germline intervention brings us directly to the questions popularized by newspaper headlines: Should we ask our scientists to play God? Or, should we ask them to refrain from playing God? The way the questions are posed in the press is usually so superficial as to be misleading. Yet, beneath the superficiality we find a theological issue of some consequence, namely, do we as human beings share with God some responsibility for the ongoing creativity of our world?

The rhetoric that usually employs the phrase, "play God," is aimed at inhibiting, if not shutting down, certain forms of scientific research and medical therapy. This applies particularly to the field of human genetics and, still more particularly, to the prospect of germline intervention for purposes of human enhancement - that is, the insertion of new gene segments of DNA into sperm or eggs before fertilization or into undifferentiated cells of an early embryo that will be passed on to future generations and may become part of the permanent gene pool. Some scientists and religious spokespersons are putting a chain across the gate to germline enhancement and with a posted sign reading, "Thou shalt not play God." A Time/CNN poll cites a substantial majority (58%) who believe altering human genes is against the will of God.

Why do critics of genetic research prescribe a new commandment, "Thou shalt not play God"? The answer is that human pride or hubris is dangerous. We have learned from experience that what the Bible says is true: "pride goes before destruction" (Proverbs 16:18). And in our modern era, pride among the natural scientists has taken the form of overestimating our knowledge, of arrogating for science a kind of omniscience that we do not in fact have. Or, to refine it a bit: "playing God" means we confuse the knowledge we do have with the wisdom to decide how to use it. Frequently lacking this wisdom, we falsely assume we possess beneficial scientific knowledge, which then leads to unforeseen consequences, such as the destruction of the ecosphere. Applied to genetic therapy, the commandment against "playing God" implies that the unpredictability of destructive effects on the human gene pool should lead to a proscription against germline intervention.

A related implication of the phrase, "playing God," is that DNA has come to function in effect as an inviolable sacred, a special province of the divine, that should be off limits to human tampering. Robert Sinsheimer, among others, suggests that when we see ourselves as the creators of life then we lose

reverence for life. It is just this lack of reverence for life, as nature has bequeathed it to us, that drives Jeremy Rifkin to attack the kind of genetic research that will lead to algeny; that is, to "the upgrading of existing organisms and the design of wholly new ones with the intent of 'perfecting' their performance." The problem with algeny is that it represents excessive human pride. "It is humanity's attempt to give metaphysical meaning to its emerging technological relationship with nature." Rifkin's message is that we ought to let nature be. In advocating this hands off policy, Rifkin does not appeal to any particular theological principles. He issues his own missionary's call: "The resacralization of nature stands before us as the great mission of the coming age."

What is the warrant for treating nature in general, or DNA specifically, as sacred and therefore morally immune from technological intervention? Ronald Cole-Turner criticizes Sinsheimer and Rifkin for making an unwarranted philosophical and theological leap from the association of DNA with life to the metaphysical proscription against technical manipulation.

1. Is DNA the essence of life? Is it any more arrogant or sacrilegious to cut DNA than to cut living tissue, as in surgery? It is hard to imagine a scientific or philosophical argument that would successfully support the metaphysical or moral uniqueness of DNA. Even DNA's capacity to replicate does not elevate this molecule to a higher metaphysical or moral level. Replication and sexual reproduction are important capacities, crucial in biology. But they are hardly the stuff of sanctity.

To raise DNA to a status of functional sacrality, says Cole-Turner, is arbitrary. Theologians in particular should avoid this pitfall. "To think of genetic material as the exclusive realm of divine grace and creativity is to reduce God to the level of restriction enzymes, viruses, and sexual reproduction. Treating DNA as matter -complicated, awe-inspiring, and elaborately coded, but matter nonetheless - is not in itself sacrilegious."

One can argue to this position on the basis of _creatio_ _ex_0 _nihilo_, creation out of nothing. All that exists has been called from nothing by the voice of God and brought into existence, and at any moment could in principle return to the nonexistence from which it came. Life, as everything else in existence, is finite, temporal, and mortal. The natural world depends upon a divine creator who transcends it. Nature is not its own author. Nor can it claim ultimacy, sanctity, or any other status rivaling God. This leads biologist Hessel Bouma III and his colleagues at the Calvin Center for Christian Scholarship to a pithy proposition: "God is the creator. Therefore, nothing that God made is god, and all that God made is good." This implies, among other things, that we should be careful when accusing physicians and scientists of "playing God." We must avoid idolatrous expectations of technology, to be sure; "but to presume that human technological intervention violates God's rule is to worship Mother Nature, not the creator. Natural processes are not sacrosanct."

Conclusion: Theological Commitments to Human Dignity

The ethical issues just described are but a small sample drawn from a longer list that would include questions regarding the social implications of defining a "defective" gene, equity of access to genetic services, gender justice, environmental impact, patenting knowledge of DNA sequences or new life forms, developing biological weapons, eugenics, and numerous others. Some of our farsighted religious leaders have entered into serious conversation with conscientious scientists so that cooperative thinking about our response and responsibility for the future can be anticipated.

It is worth noting that virtually all Roman Catholics and Protestants who take up the challenge of the new genetic knowledge seem to agree on a handful of

theological axioms. First, they affirm that God is the creator of the world and, further, that God's creative work is ongoing. Second, the human race is created in God's image. In this context, the divine image in humanity is tied to creativity. God creates. So do we. With surprising frequency, we humans are described by theologians as "co-creators" with God, making our contribution to the evolutionary process. Third, these religious documents place a high value on human dignity.

By "dignity" they mean what philosopher Immanuel Kant meant, namely, that we treat each human being as an end, not merely as a means to some further end. The United Church of Canada eloquently voices the dominant view: "In non-theological terms it [dignity] means that every human being is a person of ultimate worth, to be treated always as an end and not as a means to someone else's ends. When we acknowledge and live by that principle our relationship to all others changes." As church leaders respond responsibly to new developments in HGP, we can confidently forecast one thing: this affirmation of dignity will become decisive for thinking through the ethical implications of genetic engineering.

Yet there is more. The theology of co-creation leads Ronald Cole-Turner to a beneficent vision: "For the church, it is not enough to avoid the risks. Genetic engineering must contribute in a positive way to make the world a more just and more ecologically sustainable, and it must contribute to the health and nutrition of all humanity."

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Wisdom from the past

THE NECTARY OF A FLOWER (1) Hugh Macmillan (1892)

Objects in Nature are fitted for a new purpose by becoming unfitted for their primary purpose.

The nectary of a flower is regarded by scientific botanists as a degenerated stamen: that is, a stamen that no longer serves its original object in helping to propagate the plant and yet, strange to say, in its altered form this nectary or degenerate stamen secretes a sweet liquid which attracts bees and other insects, by whose entrance into the flower the pollen dust is scattered and carried front one blossom to another. In this way the nectary helps to fertilize the plant more effectually, and fulfills in a more admirable manner its part in the economy of the flower, than if it had retained its original form and function. It serves even higher purposes than those which belong to the plant itself; it looks to the wants of other orders of life beyond and above its own. It feeds the insect world; the bee fills its comb, and thus stores up nourishment for itself during the idle winter, from the sweet golden tears which it secretes. Nay, more: the nectary ministers ministers to the wants and luxuries of man himself - the lord of creation-and supplies one of those pleasant gratifications of the senses which God did not disdain to commend when He spoke of the Land of Promise as a land flowing with milk and honey.

Is it not thus a wonderful thought that we owe all our honey to the abortion or degeneration of an indispensable part of a flower -to the frustration of the original purpose for which that part was created? The mind must be callous indeed which does not recognise in this one of the most remarkable illustrations

of Nature's compensatory arrangements.

And is not the spiritual lesson which it teaches most instructive? God acts in the moral world as He does in the natural. His judgements are sweeter than honey and the honeycomb... out of the dead form of some rampant evil that has destroyed much good He produces abundant sweetness to satisfy the immortal cravings of our nature.

Hugh Macmillan, LL.D., F.R.S.E. is author of Bible Teachings in Nature. This article is an excerpt from _A Cyclopaedia of Nature Teachings_. (1892) Elliot Stock, London, p.p. 156-157.