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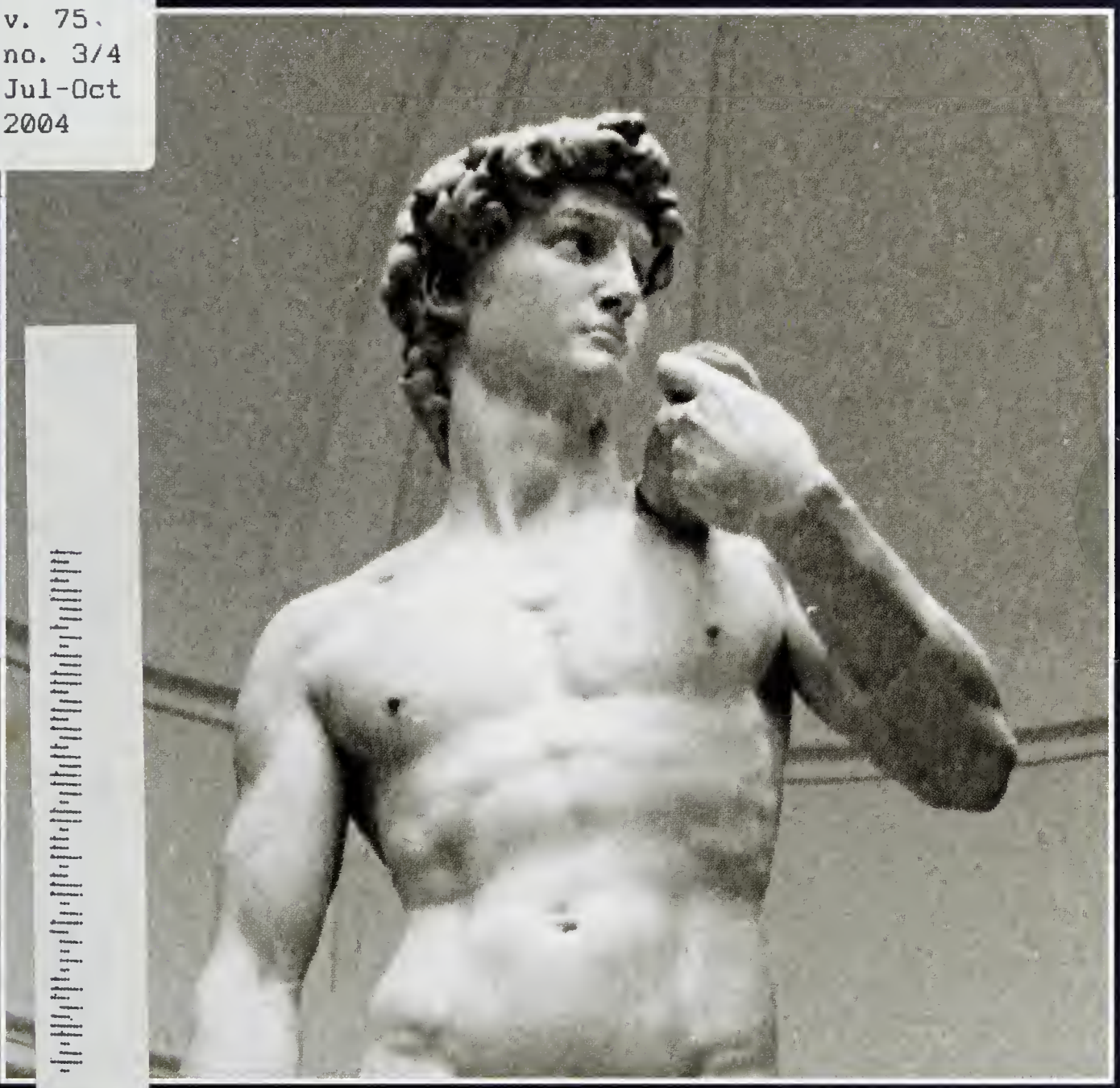

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Cover photograph:
David (1501-04) by Michelangelo Buonarroti (1475-1564) in the Galleria dell'Accademia in Florence, Italy. This image honors the Alabama Academy of Science, the inauguration of its twelfth section, Bioethics and the History & Philosophy of Science, and the many ways that the activity of the Academy reflects the spirit of the Renaissance.

Photography by Jim Bradley.

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Editor's Introduction

The spirit of the Renaissance – inquisitiveness, skepticism, confidence, exploration, celebration of life in all of its many dimensions, and the recognition and embracing of our potential as individuals and as a species – is epitomized by Michelangelo's *David* and also by the activities of the Alabama Academy of Science during its 81 year long presence. With the flowering of humankind's ability to understand and direct the laws of Nature toward its own purposes has come increased responsibility. Establishment of the new **Bioethics and History & Philosophy of Science Section (XII)** in the Academy recognizes that responsibility.

This issue of the *Journal of the Alabama Academy of Science* honors the inauguration of Section XII which met for the first time in March, 2004, at the University of Montevallo during the 81st annual meeting of the Academy.

Peter Harzem, Hudson Professor of Psychology at Auburn University, delivered the inaugural lecture, "On The Ethics Of Ethically Constraining Science," (*JAAS*, April 2004, p. 124). In it he distinguished two fundamentally different categories of issues commonly identified with "ethical" matters. The first is the subdiscipline of philosophy we call *Ethics,* and the second is comprised of so-called "ethical guidelines," sets of rules designed to regulate human activity within public or private sectors of society.

Ethics enjoys a history of scholarship stretching from the present back to Aristotle's *Nichomachean Ethics.* By contrast, the rules that regulate our daily lives are rarely rooted in philosophical scholarship. Professor Harzem argued that guidelines cloaked in the name of *Ethics* may not serve us well when they are used to limit the pursuit of new knowledge as now widely occurs in the instance of embryonic stem cell research and other areas of investigation. He encouraged "inquiry into whether constraining the pursuit of new knowledge – not only science – in the name of ethical considerations is itself *ethically* sound."

This provocative inaugural lecture was followed by nine presentations by students and faculty from four institutions. All three disciplines within the section – Bioethics, History of Science, and Philosophy of Science – were represented in the program. This made for a stimulating meeting and bodes well for the future of Section XII. Each of the papers delivered at the meeting is published as a full-length article in this issue of the *Journal of the Alabama Academy of Science.*

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PERSONHOOD AND THE HUMAN EMBRYO

A Biologist's View

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The burgeoning science and industry associated with modern biotechnologies like genetic engineering, reproductive cloning, extending human life span, human embryonic stem cell use, therapeutic cloning, and pre-implantation diagnosis raise questions about the core of our being. Do we differ qualitatively from other living creatures? What is human nature, and should it be respected and protected any more than "dog nature," "worm nature," or "fly nature?" What is a human being, and is being one the same as being a person? What is the proper use of science? These are not questions that most research biologists like me think about during a normal day in the laboratory or university classroom. Maybe that is because they are questions generally considered unanswerable using the intellectual process or technological methods of modern science. Also, the workaday thoughts of most biologists may reflect educational systems that for decades have done little to encourage cross disciplinary thinking.

Whatever the reasons for compartmentalized thinking in many disciplines, the time has come to apply interdisciplinary approaches to the problems of human nature and personhood which for centuries have been treated primarily as the property of philosophy, art, and theology. Certainly, these ways of knowing are important to a holistic understanding of our species. But the biology of our species and its origin via natural selection demand that generative thinking about human nature and personhood also incorporates information from the sciences including the multitudinous sub-disciplines within biology, psychology and anthropology.

Unfortunately, our thoroughly animal lineage has frequently been underappreciated or straight-out denied by clergy, legislators and others whose ideas and work are influential in defining for us who we are. Now the 21st century biotechnologies endow us with an unprecedented capacity for self-sculpting, it is urgent that we develop balanced, realistic, and practical approaches to discovering who we are and what we wish to become. My aim in this essay is to answer a well-defined question about the moral status of early human embryos using an interdisciplinary approach. The question is whether 5-day-old and earlier stage human embryos ought to be dignified with the status of "personhood."

I begin by presuming that the concepts of personhood, dignity and moral worth are conferred upon human beings by other human beings. I do not deny that a supernatural Creator may also do this, but I do not assume it. Defining personhood as a state or trait conferred upon us by ourselves avoids the pitfall of presuming to know which Creator is preeminent in the realm of personhood and what She/He/It had in mind when assigning it.

The ideas presented here are works in progress. They are not exhaustively described or argued to tight completion. My hope is that they will convince readers of the value of interdisciplinary approaches to difficult theoretical problems in need of solutions with real-life applications. My approach to and conclusions about personhood differ from those of most theologians in that they are undogmatic and open to criticism and correction. Also, I hope that they differ from those of most philosophers by being comprehensible to non-philosophers. Finally, I maintain that my approach to the personhood question promotes respect for the diversity of views that exist on this subject.

What I wish to say comes in six parts:

1) definitions of some key terms,
2) descriptions of three specific biotechnologies and how they raise the issue of personhood,
3) an overview of varying criteria that have been used for identifying *Homo sapiens'* uniqueness among other creatures and/or personhood for certain of its members,
4) information about a young philosopher of the Italian Renaissance, Pico della Mirandola, his view on human nature, and how this might inform 21st century views on personhood,
5) application of Pico's concept of human nature to the personhood problem raised by the above three biotechnologies, and
6) acknowledgment of some problems and unfinished business for this analysis.

1. Definitions

Definitions are important. In the majority of articles and books I have read about personhood, terms like *embryo*, *human life*, *human being*, and *person* are either not defined, used differently by different authors, or even used differently within the same work by the same author. Also, incorrect use of the term fetus by some writers has encouraged some people to mistakenly believe that embryonic stem cells are derived from tissue of aborted fetuses. Confusion can be avoided by beginning with clear definitions of these terms.

Human life I use to refer to any cell or group of cells that is alive and possesses a functioning human genome. By this definition, human cells of any type growing in a culture dish constitute human life, as would an egg, a sperm, a fertilized egg, and cells, tissues, organs, and individuals from any later stages of development. Human cells in which one or a few genes from a different species have been functionally integrated into the intact human genome also constitute human life. What proportion of an engineered genome must be human in order for the cell to qualify as human life is an interesting question but not germane to this discussion.

Human being designates an organism that belongs to the species *Homo sapiens*. By "organism" I mean a cell or group of cells with interdependent parts that can exist autonomously in its environment. This definition includes individuals we may call persons, but it may not be limited to persons. The fertilized ovum is a human being by this definition, and so too are entities at all stages of prenatal development, whether inside the womb or in a glass culture dish. All living postnatal *Homo sapiens* are human beings including those who are asleep, otherwise unconscious, comatose (with or without life support apparatus), or without memory. By contrast, a severed toe is not a human being, but the entity that lost the toe remains a human being since it constitutes an autonomous composition of interdependent parts.

Human embryo and ***fetus*** both refer to prenatal human beings. *Embryos* exist at stages of development from fertilization through the end of organ formation which is at about eight weeks. Thereafter until birth the entity is called a *fetus*, a term that also implies that the

being is beginning to look like the adult form of its type.

Finally, the term ***person*** I reserve for human beings upon which dignity has been conferred. One property of dignity is the right to continued existence. As a biologist who recognizes the continuity between all living things and the dynamic nature of species It is a bit embarrassing to restrict personhood to *Homo sapiens*. The problems with doing so have been clearly described (Kushe and Singer, 1986; Tooley, 1998), not the least being that the mental functions of most adult mammals function at higher levels than newly born humans. My defense is to say that I do not feel like a "speciesist" on the personhood issue and that it is primarily for expediency in discussing the moral status of human embryos that I have made persons a subset of human beings here.

2. Three specific biotechnologies

Recent advances in cell biology and human reproductive biology raise the questions about the criteria to be used for conferring personhood and when human beings first meet these criteria. These questions are not new. But now they need discussion and practical resolution with an urgency that matches the rate of relevant biotechnological advances. This essay addresses three specific biotechnologies that make personhood an urgent issue for early human embryos: 1) the derivation of human embryonic stem cells from 5-day old embryos, 2) therapeutic cloning, and 3) pre-implantation embryo biopsy.

Human Embryonic Stem Cells. In November, 1998, James Thomson and his co-workers at the University of Wisconsin reported having used cells from 5-day old human embryos to establish human embryonic stem cell lines that retained the ability to differentiate into several types of adult cells and tissues. The therapeutic potential of human embryonic stem cells for treatment of diseases like Type I diabetes, Parkinson's, Alzheimer's, and congestive heart failure and to repair tissue damaged by stroke, heart attack, or spinal cord injury was immediately recognized. Before such therapies can be performed though, research is needed to discover how to induce human embryonic stem cells to develop along specific pathways of differentiation to give rise to specialized cells like neurons, cardiac muscle cells, and insulin-producing pancreatic cells. Prior to 1998 most Americans had never heard of embryonic stem cells or cell lines. Since then the terms have become more familiar, yet there is still widespread confusion about their meanings. Since an understanding of the origin and basic nature of human embryonic stem cell lines is crucial for evaluating the argument I will present here, let us now consider properties of 5-day-old human embryos and how Thomson and others have created embryonic stem cell lines from them.

By five days after fertilization, the human embryo is at a stage of development called the *blastocyst*, a group of about 150 cells a bit smaller than the head of a pin. The blastocyst is a miniature, hollow ball of cells containing a small mass of nondescript cells, the *inner cell mass*, growing against the inside wall of its hollow interior. Implantation during a normal pregnancy results in the blastocyst becoming attached to the inner wall of the uterus. Ultimately, cells of the single-cell layer thick wall of the blastocyst give rise to the fetal component of the placenta, and the *inner cell mass* grows into the fetus. To obtain human embryonic stem cells, the inner cell mass is removed from a blastocyst, placed in a glass or plastic culture dish, and its cells disaggregated and grown in a nutrient-rich culture medium. Cultured in the laboratory like this, the cells can proliferate indefinitely, producing more and more cells like themselves. Such cells derived from a single blastocyst comprise an embryonic

stem cell line. Presently about 20 lines of human embryonic stem cells are available in the United States for federally funded research. A presidential decree in 2001 banned production of any additional human embryonic stem cell lines . The reasons cited were that 1) using blastocysts in this way shows or encourages disrespect for human life, and 2) enough stem cell lines were already available for research. Research funded by the private sector was not affected by this ban. Consider now how human blastocysts come to be available for human embryonic stem cell research.

At in vitro fertilization (IVF) clinics, eggs are fertilized in glass test tubes. The resulting embryos are grown to the blasotcyst stage outside the womb in preparation for their introduction into a hopeful mother's uterus for implantation. For each attempt at assisted reproduction by IVF, several more embryos than needed for one implantation procedure are produced. This is to help insure that at least three to five healthy appearing blastocysts are available for implantation (all normally do not successfully implant), and also to have available additional embryos should the first implantation attempt not result in a pregnancy. Surplus blastocysts are put into suspended animation by freezing them in liquid nitrogen. They can then be retrieved and reanimated from their frozen state if they are needed for additional attempts at implantation. Tens of thousands of unused, surplus embryos are presently in frozen storage at IVF clinics in the United States and around the world. After a period agreed upon by the clinic and its clients, surplus embryos are removed from storage and discarded. Interestingly, the 2001 ban on producing new human embryonic stem cell lines did not address the eventual fate of surplus blastocysts stored at IVF clinics.

Therapeutic cloning. In February, 2004, South Korean researchers reported the successful cloning of a human being to the blastocyst stage and from it the derivation of a line of human embryonic stem cells. The motivation for this successful experiment was to aid in development of a procedure called therapeutic cloning. The experiment involved replacing the chromosome-containing nucleus of a woman's egg cell with the chromosome-containing nucleus from a somatic (body) cell from another individual, activating the egg cell to begin undergoing DNA replication and cell division, allowing the embryo to develop to the blastocyst stage, and then using the blastocyst to derive a line of human embryonic stem cells as described above. The clinical value of this procedure is that the resulting embryonic stem cells and any cells derived from them are perfectly immunologically compatible with the individual from which the somatic cell nucleus was taken. Introduction of such cells into that individual for the treatment of disease or injury would not elicit a rejection response, so there would be no need to chemically suppress the immune system as part of the treatment. As for normal human embryonic stem cell research, therapeutic cloning requires the destruction of a human blastocyst to obtain an inner cell mass for the production of embryonic stem cells.

Pre-implantation biopsy. It is now possible to quickly test for the presence of certain disease-causing genes by biopsy of an early human embryo created *in vitro*. A single cell can be removed from a pre-implantation stage embryo for genetic testing without disrupting the future development of the embryo because of the great developmental plasticity of the cells during the early stages of embryogenesis. This procedure is called pre-implantation biopsy and is now used primarily by couples in need of assisted reproduction by IVF. This could change though if the expense of IVF were lowered so that it becomes a feasible option for couples simply wishing to exert some control over the genotype of the embryo that becomes implanted. Recently it was reported that fetal biopsy can now detect several hundred genetic diseases and other conditions that some may consider to be handicapping, like deafness and dwarfism

(Harmon, 2004). Pre-implantation biopsy makes possible a future, widespread selection and discarding of blastocysts based on genotype-a "pre-implantation eugenics." Such a practice would of course be accompanied by its own ethical issues that are not subjects of the present discussion.

Relevant to us here is the fact that all three of these biotechnologies - human embryonic stem cell production, therapeutic cloning, and pre-implantation biopsy - bring up the question, "Is the blastocyst a person?" Therefore, let us consider next what characters might warrant the conferring of personhood status upon certain human beings.

3. Criteria for human uniqueness and/or personhood

Since "person" has been defined here as a subset of *Homo sapiens*, surveying the approaches and criteria that have been used to identify what makes us different from other animals, perhaps deserving of some special dignity, is of value in the attempt to discern when a human being meets the criteria for personhood. Finding more than 30 criteria for human uniqueness mentioned by authors from diverse disciplines, I examined the list to see if it might be systematized in some way. I found that each of the putatively human-specific traits could be classified under one of three approaches primarily used to identify it: evolutionary, comparative, or pre-suppositional.

The ***evolutionary approach*** considers biological/anatomical (material) and/or behavioral (activity) traits that appear to distinguish human ancestors in the hominid line from non-hominid primates. Among the biological/anatomical traits identified by this approach are bipedalism, cranial capacity, dentition, an opposable thumb, a lowered larynx, a developed Broca's area of the brain, the presence of a frameshift mutation in the MYH 16 (myosin heavy chain type 16) gene, and the structure of the ASPM (abnormal spindle-like microcephaly) associated gene. The last two of these are especially interesting applications of molecular/cellular biological studies to problems in human evolution and offer possible explanations for *Homo sapiens'* large and complex cerebral cortex.

Hansell Stedman and his coworkers (2004) at the University of Pennsylvania have reported evidence that a muscle protein localized exclusively to the jaw muscle of primates was inactivated by a mutation occurring in the hominid line about 2.4 million years ago, just shortly before a dramatic increase in the cranial capacity of *Homo erectus* that occurred about 2 million years ago. Stedman hypothesizes that inactivation of this gene resulted in a sudden and dramatic decrease in jaw muscle mass, relieving powerful forces that had been exerted on the brain case at the muscle insertion points. With less force on the brain case, the way may have been opened for the evolution of a larger, more gracile cranium whose increased volume became filled by cerebral cortex material. This finding is of special interest since a consensus has developed that certain behavioral traits associated with humanness have as their basis a species-specific development and functioning of the cerebral cortex.

Bruce Lahn and his colleagues at the University of Chicago have reported what one journalist has proclaimed as "the gene that made us human" (Evans et al., 2003; Zorich, 2004). The ASPM (abnormal spindle-like microcephaly associated) gene, when mutated in humans, results in microcephaly, a condition characterized by an abnormally small cerebral cortex (Bond et al., 2002; 2003). The gene is also present in other primates and non-primate mammals, but in humans the specific structure of the gene seems to have been under selective pressure to produce a protein whose function results in a human sized cerebral cortex (Evans, et al., 2003). Although the specific action of the protein product of the human ASPM gene is not

fully understood, the function and locality of expression of homologous genes in developing *Drosophila* and mice has led to the suggestion that is may be involved in regulating prenatal cell division in the developing cerebral cortex (Evans et al., 2003).

Among the behavioral traits that an evolutionary approach has identified for humanness are tool use/making, fire use/building, foresight, speech, language, culture, a "killer" instinct, cooperation within social groups, religion, art, and altruism. Whether each of these is a uniquely human trait is controversial, but a discussion of those arguments is not necessary unless one of the ambiguous criteria like tool use or language is selected as a definitive marker for personhood. Since I do not do that, we can move on to the other two approaches.

The ***comparative approach*** focuses on differences between modern humans and other contemporary species. Within this approach, traits are categorized as biological, behavioral, or metaphysical.

Modern cell biology has also made a contribution here. A cellular basis for humanity's uniqueness is implied by the title of a lead article appearing in the New York Times' *Science Times*, "Humanity? Maybe It's in the Wiring" (Blakeslee, 2003). The article reports the finding by John Allman and his colleagues at the California Institute of Technology that giant, cigar-shaped neurons called spindle cells occurring primarily in the right frontoinsular cortex may be responsible for processing information used to respond to complex, socially emotional situations associated with feelings like romance, deception, and embarrassment. Humans have five to 40 times as many of these cells than do the living great apes, the only other species know to posses spindle cells (Allman, et al., 2003)

Behavioral based traits considered by some to place us apart from other contemporary animals include the ability to empathize, non-momentary interests, emotion, art, a capacity for beliefs or propositional attitudes, intentionality, an awareness that we are subjects of mental states, problem-solving ability, and a moral sense (Doran, 1989).

Due to their abstruseness, I place two human distinguishing traits in the metaphysical category. The first is ensoulment, in the sense first proposed by Aristotle. Although one now rarely sees Aristotle cited in the context of human soul acquisition, I mention his ideas here because of the great influence they had on later Christian thinking. Aristotle proposed that during early development, humans sequentially acquire three types of souls, a vegetative soul which makes us alive, a sensitive soul which allows for animal-like sentience, and a rational soul which makes us human. Aristotle believed that the rational soul appears in the fetus at about 40 days after conception. For Aristotle, who of course did not know about eggs and sperm, conception was the time at which the semen encounters menstrual blood, thereby imparting life to it. As it turns out, were this event actually to occur, its timing would not be far off from the moment of coalescence of the genomes of male and female gametes into one zygote nucleus, the marker now used by biologists for "fertilization." The second abstruse, human-defining trait is consciousness. It is difficult to find clear and concise definitions of what is meant by human consciousness, as distinct from animal consciousness. It is sometimes described as having a sense of self with an existence moving through time and an interest in the continuation of that existence (Tooley, 1983; Kuhse and Singer, 1986).

The ***presuppositional approach*** for defining human uniqueness presumes at the start that humans are deserving of dignity and that this assumption requires no justification. The questions then become: "When during development does this dignity kick in, and once conferred, can it be lost?" Presuppositional criteria for dignified humanness include theologically based ensoulment, individuation, the onset of electroencephalogram (EEG)

detected brain waves, viability, and birth.

Regarding ensoulment, it is interesting to note that in the 13th century St. Thomas Aquinas concurred with Aristotle that ensoulment occurred at 40 days of development, but only for male fetuses. Strangely, Aquinas maintained that ensoulment of females was delayed until 90 days after conception. Presently the official Vatican position is that all human embryos, from conception onward, ought to be treated as though they have been ensouled by God and possess full moral status.

Individuation is a developmental event marking the point beyond which one and only one individual can result from subsequent embryogenesis and fetal development. This event occurs at the so-called primitive streak stage of development about 14 days after fertilization, the point beyond which the embryo can no longer spontaneously split to form identical twins. Salesian priest, theologian, and philosopher, Norman M. Ford, has suggested that the embryo first be given full moral status at the primitive streak stage because of the phenomenon of individuation (Ford, 1988).

Viability is the criterion for personhood cited in the 1973 U.S. Supreme Court decision in the Roe vs. Wade case and is set at the end of the second trimester of pregnancy. Coincidentally, this is also a time marked by adult-like patterns of EEG activity (Morowitz and Trefil, 1992) and a dramatic increase in the rate of synapse formation between neurons of the cerebral cortex (Purpura, 1975; Rakic et al., 1986).

The above listing contains only some of the bewildering array of criteria that have been suggested for marks of human uniqueness or justifying special moral status for humans beings compared to other living creatures. Examining this list with the issue of personhood raised by modern biotechnologies in mind, I found it difficult to commit to any one or even a cluster of the criteria as a satisfying marker for personhood. Many are no longer considered human-specific, and others have become so controversial as to preclude reasonable hope for their consensual international acceptance. It was then that I thought of an essay that my colleagues and I have assigned for many years to our students in an interdisciplinary history course. The essay is titled *Oration on the Dignity of Man.* It was written by a 23-year old philosopher of the Italian Renaissance named Giovanni Pico. He is better known as Pico della Mirandola since his family was from the northern Italian village of Mirandola.

4. Pico della Mirandola (1463-1494)

Pico's view of human nature can be very useful to us today as humankind moves into the uncertain ethical world of 21st century biotechnology. In his *Oration*, Pico makes clear what he believes is the essence of human nature. It is our capacity for choice-making. And it is that capacity which I propose using as a basis for personhood and as a guide when faced with dilemmas and decisions about the ethical use of modern biotechnologies.

It is legitimate to ask why I choose Pico as an authority on human nature rather than one of a score of other philosophers who have written about human nature and personhood since Pico? I choose Pico primarily because his view emerges from a diligent and respectful study of virtually all of the philosophical, theological, literary, and mystical traditions of humankind knowable to him. Pico exemplifies the inclusive thinking that is needed if we are to reach a consensus about how to behave in today's biotechnological world.

How Pico came to write his famous essay is an interesting story. His intellectual passion was to understand the diverse paths humankind has taken toward wisdom and self-

understanding. As a teenager, he began arming himself with the tools needed to gain such understanding. These included a reading knowledge of Greek, Latin, Hebrew, Arabic, and Aramaic, and facility with canon law. He used these to teach himself about the pagan philosophies of ancient Greece and Rome, Neoplatonism, the writings of the Greek and Latin Church fathers, 13th and 14th century scholasticism, Averroism, the Hermetic and Orphic texts, and Jewish philosophy, theology, science, and mysticism.

His lifelong project was to identify the threads of truth coursing through each of the world's diverse traditions and to weave these into a unified synthesis of human insight and wisdom spanning two millennia and representing all of the religious and philosophical thought known to the West. His ultimate objective was to foster peace between the world's traditions by reconciling their insights, one with another.

The major outcome of these studies was the formulation of 900 theses (Farmer, 2003) which Pico proposed to defend in Rome during the winter of 1486-1487 against any and all philosophers, theologians, or other scholars willing to debate them. Leaving few scholarly disciplines untouched, the subjects represented by the propositions included metaphysics, moral philosophy, astrology, physics, numerology, theology, magic, epistemology, physiology, and several others. This extraordinary debate was to be held before the college of cardinals with Pope Innocent VIII presiding as judge. Although the debate never took place, the reason being another story in itself, Pico did prepare a speech to open the debate. It is that speech that we now know as the essay, *Oration on the Dignity of Man* (Pico, 1486). In Pico's *Oration* is this famous paragraph that states his view on human nature. In it God is speaking to Adam in the Garden of Eden, explaining to him how he differs from all other creatures.

> *We have given to thee, Adam, no fixed seat, no form of thy own, no gift peculiarly thine, that thou mayest feel as thine own, have as thine own, possess as thine own the seat, the form, the gifts which thou thyself shall desire. A limited nature in other creatures is confined within the laws written down by Us. In conformity with thy free judgment, in whose hands I have placed thee, thou art confined by no bounds; and thou wilt fix limits of nature for thyself...Neither heavenly nor earthly, neither mortal nor immortal have We made thee. Thou, like a judge appointed for being honorable, art the molder and maker of thyself; thou mayest sculpt thyself into whatever shape thou dost prefer. Thou canst grow downward into the lower natures which are brutes. Thou canst again grow upward from thy soul's reason into the higher natures which are divine.* (Translation by Charles Glenn Wallis)

Here is a Renaissance humanist and world philosopher promoting the notion that humans are co-creators of themselves. There is little doubt that Pico had the Christian God in mind as the other artisan in co-creation. But, in my view, whether God or natural selection is placed as the co-creator opposite humankind in its own creation is not what is important in Pico's thought. What is important is that we recognize ourselves as equal, if not major, partners in co-creation. Both the species and each individual have been endowed with a capacity for choice-making -- the former some 100,000 years ago, and the latter fairly early in life. How we use that capacity to sculpt ourselves as a species and as individuals is up to us. That is what Pico is telling us. And just what kind of choices does Pico have in mind when proposing that choice-making distinguishes us from all other creatures? I feel confident that it is not the kind of

choice a humming bird makes when it visits red flowers and not white flowers, or the "decision" of a Baltimore oriole to nest in the high branches of a Northern red oak rather than on the ground. Those are instinctual acts, "confined within the laws written down by Us," and not really choices at all. The human-specific choices attributed to Adam by Pico are moral choices derived from "thy soul's reason." These are behavioral choices we make that affect, among other things, our own and others' quality of life and the stability, integrity and beauty of the planet itself.

From Pico's view that a capacity for choice-making is at the core of human nature, I derive the following principle: *Our use of biotechnology ought to respect and protect the choice-making capacity of human beings and of humankind.* How can this principle be applied to the issue of the moral status of the human blastocyst, which is the problem at hand for each of the three biotechnologies described at the beginning of this essay?

5. Applying the Pico Principle to 21st century biotechnologies

Application of the capacity for choice-making as a criterion for personhood requires asking what attributes a human being must acquire in order to possess such a capacity. In response to that question, I suggest the following abilities as necessary components of a moral choice-making capacity: 1) gathering sensory data, 2) storing those data, 3) selectively retrieving data, 4) analyzing data to imagine outcomes for various paths of action, and 5) applying reason, emotion, and empathy to choose the desired outcome.

When does this constellation of capacities develop? One thing that can be said with certainty is that all of them do not develop at once. In fact, based on current information from the disciplines of human developmental biology and psychology, it appears that the biological hardware necessary for having at least a capacity to exercise these five abilities at some point in time is assembled during a period beginning at about five weeks after conception and extending for about 10 years into postnatal development.

Sensory neurons from the olfactory apparatus first establish synapses in the developing brain at five weeks into prenatal development (Larsen, 2001), marking initial establishment of the hardware required for gathering some sensory data. Spindle cells of the prefrontal cortex, implicated in data storage and retrieval, begin appearing at about four months into development. The proliferation of cells that form the cerebral cortex also begins at about this time, presumably under the control of ASPM gene activity. Data analysis requires communication between neurons in the cerebral cortex, and the intra-cortical synapses needed to mediate this are forming at an exponential rate between weeks 25 and 32 of prenatal development (Morowitz and Trefil, 1992). A fully functional brain requires that its nerve axons be myelinated. Myelination begins during the second trimester of prenatal development, occurs at its most rapid rate shortly after birth, and is not completed until the child is about 10 years old (Morowitz and Trefil, 1992). Awareness that one has a future is needed in order to apply foresight to the decision-making process, and that awareness is thought not to begin until about two years after birth. "Othermindedness," the capacity for empathy, occurs even later during the 3rd or 4th year after birth life.

So, if a capacity for choice-making is taken as a useful criterion for personhood, and if that capacity emerges gradually between five weeks of prenatal development and 10 years of postnatal life, what can be concluded about personhood and the moral status of the human embryo? I offer the following: 1) at the least, a nascent choice-making capacity is required for

conferring personhood on a human being, and 2) prior to five weeks of development, the embryo cannot qualify for personhood.

These conclusions may appear very minimal and of questionable value since they do not specify a beginning point for personhood; however, in the context of the three biotechnologies described earlier, they are very useful. They allow a decision to be made about the moral status of the human blastocyst and therefore about the ethical status of stem cell research, therapeutic cloning, and pre-implantation biopsy. Since not even a nascent choice-making capacity is present prior to 5 weeks of prenatal life, the use of 5-day old blastocysts in these technologies does not violate the dignity of personhood.

This is not to say that other ethical issues are unimportant. Indeed, many other ethical issues associated with these biotechnologies would remain to be resolved even if a consensus could be reached on the personhood issue. What should be the source of blastocysts for research? The source(s) of eggs for therapeutic cloning? Who should benefit the from the development of these technologies into actual clinical procedures? What will be the cost for bringing the technologies into the clinic? Can the cost be justified when millions of persons worldwide experience malnourishment and starvation and when three children die each minute from malaria, all under circumstances that could benefit from monies applied to research and other activities aimed at improving the human condition? Still, if the present analysis helps to resolve the personhood problem for early embryos, emotional and intellectual energies may be freed to devote to addressing these additional issues. Finally, although my analysis of personhood and the moral status of the human embryo are vulnerable to criticisms which space prevents me from addressing here, I will nevertheless acknowledge their existence.

6. Problems remaining to be addressed

Problems that need addressing in order to undergird the value of this analysis include: 1) the so-called "is-ought" dichotomy and the associated "naturalistic fallacy," 2) the question of free will for human activity, and 3) the pitfalls of arguing for personhood on the basis of potentiality.

The *"is-ought" dichotomy*, the formulation of which is usually credited to David Hume, asserts that it is not possible to logically derive a statement of moral obligation from an empirical observation about nature. Those who claim otherwise are often accused of a failure of logic called the *naturalistic fallacy*. The "is" of this dichotomy for the present analysis is that choice-making is identified as a species-specific marker for human nature. The "ought" is the claim that the choice-making trait should be protected, honored, and preserved. In other words, just because humans are moral choice-makers, why does it follow that this is a trait to be preserved and that beings possessing it deserve the dignity of personhood and continued existence? This question needs answering.

Obviously, placing high value on human choice-making capacity presumes the existence of *free will* for the ultimate expression of that capacity. Therefore, arguments for a strongly deterministic universe and genetic determinism must be addressed for "choice-making" to be taken seriously as a human trait that ought to be protected and preserved.

Finally, by identifying the acquisition of moral "choice-making capacity" as a developmental process occurring over more than 10 years, I leave myself open to the criticism that an argument for conferring personhood on any human beings younger than 10 years old must be an *argument from potential*. The pitfalls of an argument based on potentiality have

been described by English bioethicist, John Harris (1998), who points out the absurdities to which this argument leads. Thus, not only would the single-celled conceptus be a person, but so too the unfertilized egg which may be stimulated to develop parthenogenetically, and virtually any one of our body cells in the hands of an adept cloning biotechnician. I have not concluded when personhood ought to be conferred, only when it is not present. Yet, I admit to an unwillingness to say that a 9 year old child (or even a newly born infant) is not a person. This may mean that one or more incipient levels of personhood and their moral status may need to be defined for human beings within the 10-plus year long period of development for choice-making capacity. The same applies to the end period of life when choice-making components may be *lost* gradually over an extended period of time.

To conclude, I turn to another familiar figure of the Italian Renaissance, Michelangelo Buonarroti (1475-1564), and his masterpiece, *The David*, now standing in the Academy in Florence, Italy. In a PBS film on Florence and the Renaissance, Bill Moyers said this about *The David* and the legacy of 15th century humankind's decision to grasp control of its own fate:

> *The heroic ideal of David was the ultimate expression of Florentine optimism - their belief in the divinity of the human being. Created in the image of God, now Man was creating images of himself. Contained in the marble was the mirror of the soul. We needed only to free it as Michelangelo had liberated David from the block. But what does it bring, this gift of freedom? Certainly the ability to dream and the power to achieve. But perhaps, as Michelangelo had seen, it also leaves us standing alone - to make and face our fate.*

REFERENCES

Allman, J., A. Hakeem, N. Tetreault, and K. Semendeferi, 2003. The spindle neurons of frontoinsular cores (Area FI) are unique to humans and African apes. Program No. 725.5. *2003 Abstract Viewer/Itinerary Planner*. Washington, DC: Society for Neuroscience, 2003. Online.

Blakeslee, S., 2003. Humanity? Maybe It's in the Wiring. *Science Times*, In *The New York Times*, December 9, pp. D1,4.

Bond, J., E. Roberts, G.H. Mochida, D.J. Hampshire, S. Scott, J.M. Askham, K. Springell, M. Mahadevan, Y.J. Crow, A.F. Markham et al., 2002. ASPM is a major determinant of cerebral coritcal size. *Nature Genetics* 32: 316-320.

Bond, J., S. Scott, D.J. Hampshire, K. Springell, P. Corry, M.J. Abramowicz, G.H. Mochida, R.C. Hennekam, E.R. Maher, J.P. Fryns et al., 2003. Protein-truncating mutations in ASPM cause variable reduction in brain size. *Am. J. Hum. Genet.* 73: 1170-1177.

Doran, K., 1989. *What is a Person: The Concept and the Implications for Ethics*. Lewiston, New York: The Edwin Mellen Press.

Evans, P.D., J.R. Anderson, E.J. Vallender, S.L. Gilbert, C.M. Malcom, S. Dorus, and B.T. Lahn, 2004. Adaptive evolution of *ASPM*, a major determinant of cerebral cortical size in humans. *Human Molecular Genetics* 13: 489-494.

Farmer, S.A., 2003. *Syncretism in the West: Pico's 900 Theses (1486)*. Medieval &

Renaissance Texts & Studies, Vol. 167. Tempe, Arizona: Arizona Board of Regents for Arizona State University.

Ford, N.M., 1988. *When did I begin? Conception of the human individual in history, philosophy and science.* New York: Cambridge University Press.

Harmon, A., 2004. In new tests for fetal defects, agonizing choices for parents. *The New York Times,* June 20, CLIII (52,886): 1,19.

Harris, J., 1998. *Clones, Genes, and Immortality: Ethics and the Genetic Revolution.* Oxford: Oxford University Press.

Hwang, W.S., Y.J. Ryu, J.H. Park, *et al.*, 2004. Evidence of a pluripotent human embryonic stem cell line derived from a cloned blastocyst. *Science* 303: 1669-1674.

Kushe, H., and P. Singer, 1985. *Should the Baby Live?* Oxford: Oxford University Press.

Larsen, W.J., 2001. *Human Embryology*, 3rd ed. New York: Churchill Livingstone

Miller, P.J.W. 1998. Introduction. In C.G. Wallis, P.J.W. Miller, and D. Carmichael (Transl.), *Pico della Mirandola: On the Dignity of Man* (pp. vii-xxvii). Indianapolis: Hacket Publishing Company, Inc.

Morowitz, H. J. and J. S. Trefil, 1992. *The Facts of Life: Science and the Abortion Controversy* (pp. 105-125). New York: Oxford University Press.

Moyers, B., 1990. *The Power of the Past with Bill Moyers: Florence.* David Grubin Productions in association with WETA, Washington, D.C., Distributed by PBS Home Video, Public Broadcasting System.

Pico, Giovanni, 1486. *On the dignity of man.* In C.G. Wallis, P.J.W. Miller, and D. Carmichael (Transl.), *Pico della Mirandola: On the Dignity of Man*, Indianapolis: Hacket Publishing Company, Inc.

Purpura, D.P., 1975. Morphogenesis of the visual cortex in the preterm infant. In M.A. Brazier (Ed.), *Growth and Development of the Brain.* New York: Raven Press.

Rakic, P., J. Bourgeois, M. Eckenhoff, N. Zecevic, and P. Goldman-Rakic, 1986. Concurrent overproduction of synapses in diverse regions of the primate cerebral cortex. *Science* 232:232.

Stedman, H.H., B. W. Kozyak, A. Nelson, D. M. Thesier, L. T. Su, D. W. Low, C. R. Bridges, J. B. Shrager, N. Minugh-Purvis, and M. A. Mitchell, 2004. Myosin gene mutation correlates with anatomical changes in the human lineage. *Nature* 428: 415-418.

Thomson, J. A., J. Liskovitz-Eldor, S.S. Shapiro, M.A. Waknitz, J.J. Swiegiel, V.S. Marshall, and J.J. Jones, 1998. Embryonic stem cell lines derived from human blastocysts. *Science* 282: 1145-1147.

Tooley, M., 1983. *Abortion and Infanticide.* Oxford: Clarendon Press.

Tooley, M., 1998. Personhood. In H. Kuhse and P. Singer (Eds.), *A Companion to Bioethics* (pp. 117-126). Oxford: Blackwell Publishers Ltd.

Zorich, Z., 2004. The gene that made us human. *Discover*, March 4.

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THE FATE OF THE SCIENCES

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ABSTRACT

By and large, those who discuss the fate of the sciences divide into two camps. The first includes those convinced that the sciences will be complete once a few major problems are solved. Partisans of this camp commonly presume there are a finite number of forces, particles, or bodies in the universe. Once these are understood and explained, science will be finished. The second camp holds those who argue that the sciences will never come to an end. They have two main arguments. One is that the end of science has been proclaimed many times in the past, but science, blind to the wisdom of those claims, rose to greater heights. The second is that solving scientific problems always generates new ones. The arguments of both camps are unsatisfying because they give no reason why past scientific advances will continue or why we can expect to find no more phenomena to investigate. Lately, Stephen Hawking has joined the camp of those who believe science will never come to an end. His new position intrigues because he attempts to explain why, in principle, science can never be complete. I propose to examine and assess his view.

THE OPPOSED POSITIONS

I open with two quotations from Stephen Hawking. The first is from an address he delivered at the University of Toronto in 1998:

> In 1980 I said I thought there was a 50-50 chance of us finding a complete unified theory in the next 20 years. That is still my estimate, but the 20 years begins now. I will be back in another 20 years to tell you if we made it (Hawking, 1998, p. 2).

The second appears in a paper he apparently posted on his website early in 2004[1]:

> Some people will be very disappointed if there is not an ultimate theory that can be formulated as a finite number of principles. I used to belong to that camp, but I have changed my mind. I am now glad our search for understanding will never come to an end, and we will always have the challenge of new discovery (Hawking, 2003a, p. 5).[2]

Hawking, it seems, has been born again.[3] For decades, he was a most visible and irrepressible proponent of the views that a final theory of physics is near to hand, and, once in hand, physics would be complete. He ranked with a group of authors, each convinced that one or a handful of major problems remain in one scientific discipline or another, and the completion of that science would follow their resolution. I have not as yet happened upon an author who laid out this type of view in systematic fashion. Hence, I will reconstruct what I believe to be their mode of argument.

I will employ Hawking as an exemplar of this argument pattern, as he has addressed the matter repeatedly over a period of several decades. His treatment typically follows a standard formula. He begins by noting that there are four elemental forces: gravity, electromagnetism, the strong atomic force, and the weak atomic force. With a series of brilliant achievements, physicists have devised theories to unify three of them: electromagnetism, the strong atomic force, and the weak atomic force. Thus far, however, attempts to merge gravity with the other three have failed. Gravity must be described by Einstein's theory of relativity, which, sadly, is incompatible with quantum theory. In the past, Hawking was confident that all four forces would eventually be unified by means of a theory of everything, as he termed it. At that point, important and difficult problems would remain, but the fundamental business of physics would be finished (Hawking, 1980, 1998, & 2003b). Hawking's argument rests on a set of critically important assumptions. They are:

No other forces remain to be discovered in the future.

No additional elementary particles will appear.

No significant conceptual issues are likely to emerge which will prompt a fundamental shift in theoretical underpinnings.

Hawking and notable figures with like positions, such as Brian Greene and Steven Weinberg, are sufficiently astute to recognize that another outcome is possible, namely, that there will be no end to the procession of scientific discoveries.[4] All agree that the latter outcome is possible, but all make it clear that they incline to the first.[5] I believe an argument could be devised to support their bias toward the first possibility. The enormously expanded powers of scientific investigation, the greatly extended ability to probe deeper and further into nature, and the brilliant discoveries of the century just past all lend credence to the idea that we have found all there is to discover. Because, we see nothing beyond what has been discovered, there is good reason to believe nothing further remains. Certainly, the fact that we can see nothing else is not good evidence for the view that something remains to be found. Nonetheless, the partisans offer us no reasons beyond this to believe that there is in principle nothing further to be discovered.[6]

As it happens, several authors are undaunted by such claims. They believe that the sciences will continue indefinitely—barring loss of research funding, debasement of science through commercialization, usurpation of science by computers[7], or dismemberment by politically ascendant religious fundamentalists. Partisans of this view have offered two kindred arguments to bolster their position. First, they point out that each time in the past when science has been pronounced dead, it has not merely recovered but advanced to new heights (Beaty; Smolin, 1997). Second, they also note that, in the past once again, whenever science has contrived to solve knotty and difficult problems, new problems soon appear in their place (Maddox, 1998, pp. 370-1).[8]

These arguments are both compelling and unsatisfying. They are compelling because the history of science offers ample support for them.[9] They are unsatisfying because they provide no explanation of **why** new problems should always arise to replace old ones or **why** science should inevitably recover whenever it seems moribund.

The arguments on both sides of the issue of whether sciences will soon come to an end rest on assertions that their proponents generally agree cannot presently be demonstrated true or false. The question of which side is correct can be addressed only by saying, "We'll have to wait—centuries perhaps—and see." It may well be the case that we will simply have to be patient, but patient waiting is uncomfortable and intellectually unsatisfying.

HAWKING'S ANALOGICAL ARGUMENT

It is at this juncture that the reborn Hawking is so intriguing, as he may have found an exit from the impasse. In "Gödel and the End of Physics," he presented a fresh argument for the claim that the business of scientific inquiry will never **in principle** be completed.[10] He took inspiration from Gödel's Incompleteness Theorem, the argument that any powerful mathematical system must be incomplete because it will have theorems which cannot be proven within the system.[11] Hawking has come to the conclusion that physics is like mathematics, so it will necessarily remain incomplete—and, hence, never come to an end. If Hawking's argument is successful, it will have achieved two exceedingly important results: First, it will have shown that physics will never be completed. Second, it will have provided a most gratifying explanation of why it can never in principle reach completion.[12]

Hawking's argument has the form of what us dazed veterans of introductory logic instruction call an analogical argument, that is, an argument based on a comparison. In this instance, mathematical systems and physics are being compared. Analogical arguments have the following structure:

Two things are alike.
<u>One of them has a certain quality.</u>
Therefore, the second has the same quality.

Hawking's argument can thus be sketched as:

Mathematical systems and physics are alike.
<u>Mathematical systems have the quality of being incomplete.</u>
Therefore, physics has the quality of being incomplete.

Introductory logic instructors hasten to emphasize that the things being compared must be alike in ways relevant to the conclusion if an analogical argument is to be successful. The problem is that any two entities can be claimed alike in some fashion or another. Hence:

Mother Theresa had skin, sinews, a mouth, and a nose.
<u>Saddam Hussein has skin, sinews, a mouth, and a nose.</u>
Therefore, Mother Theresa and Saddam Hussein are alike.
<u>Mother Theresa was saintly.</u>
Therefore, Saddam Hussein is saintly as well.

Of course, Mother Theresa and Hussein are indeed alike in the ways stated, for they are alike in being human. The difficulty is that they are not at all alike in ways related to saintliness, and saintliness is the topic of the second argument in the chain. So, my second argument is unfortunately weak.

Hence, to evaluate Hawking's argument, we must inquire whether mathematical systems and physics are alike in ways relevant to the quality of being incomplete.

As I read his presentation, Hawking makes two claims to support his belief that mathematical systems and physics are relevantly alike in the matter of incompleteness. The first is to remind us that mathematics and physics have been deeply entangled since the Scientific Revolution. He says, "According to the positivist philosophy of science, a physical theory is a mathematical model. So, if there are mathematical results that can not be proved, there are physical problems that can not be predicted (Hawking, 2003, p. 5)."

I am neither a physicist nor a mathematician. However, I believe Hawking's argument would benefit from added detail. My ignorance does not prevent me from having several concerns.

First, mathematical theorems must be proven--or not--by additional mathematics and by mathematics only. Mathematics does not look outside itself for confirmation. Theories of

physics, though formulated as mathematical models, are either confirmed or not by juxtaposition with empirical data. Theories of physics must always look beyond themselves for confirmation, but mathematical theories must never do so. So, while it was a great shock to learn that mathematical systems contain theorems unprovable within them, physical theories must be proven—or not—by empirical testing (Nagel and Newman, 2001, pp. 1-6).

Second, I am left a bit puzzled by Hawking's inference, "If there are mathematical results that cannot be proved, there are physical problems that can not be predicted (Hawking, 2003, p. 5)." It is commonly understood that the physical world conforms to mathematical theories with uncanny accuracy. Nonetheless, I have always presumed that result followed from the effort to devise mathematics suitable to describe the world. Of course, we frequently hear of instances where the world is found to accord with formulations developed for strictly mathematical reasons. However, I do not believe this entitles us to the belief that mathematics and the world map one other perfectly. Nor are we entitled to the inference that there must be unpredicted physical problems because there are unproven mathematical results. Mathematics has proven an enormously useful instrument for making sense of the physical world. Many physical phenomena display relationships that are readily mapped by mathematical formulas. But, this does not entitle us to presume that physical phenomena exhibit all the qualities of mathematical relations. It may well be the case that they do, but we are entitled to hold this belief only after empirical examination confirms it, not before. Of course, investigators will insist that physics is entirely likely to stumble upon unexpected problems, but they are also prone to believe that is the result of empirical inquiry. There's little reason to attribute these surprises to a similarity with mathematical systems. It's quite possible my concerns can be readily addressed by Hawking or others. Nonetheless, I believe they need to be addressed.

Hawking has a second claim to support his belief that mathematics and physical theories are relevantly alike in the matter of incompleteness. He says, "But we are not angels who view the universe from the outside. Instead, we and our models are both part of the universe we are describing. Thus a physical theory is self referencing, like in Gödel's theorem (Hawking, 2003a, p. 6)." Hawking has a bit of background to illuminate this claim. Gödel's theorem is constructed by means of an intriguing and difficult type of statement, one that refers to itself. The ancient and common example of this sort of statement is:

> This statement is false.

You have likely noticed the difficulty it generates. If it is true, it is false, but, if it is false, it is true. As you may imagine, this has generated no end of head scratching. Nonetheless, Gödel put a statement of this type to good use. He devised a way to construct self referencing mathematical statements on the order of:

> This [insert a Gödel type statement] cannot be proven to be true within this mathematical system.

Gödel demonstrated that statements of this sort do not generate the perplexities of 'This statement is false'. In fact, they can be proven true (Hawking, 2003a, p. 5; Nagel and Newman, 2001, pp. 101-2; and Suber, pp. 4-5).

So, Hawking's claim is that physical theories are like Gödel's mathematical statements in being self referencing, since both we and our physical theories are part of the universe we wish to describe. This seems strained. It is entirely true that physical theories are part of the world they describe, but it does not thereby follow that they are self referencing in the manner of 'This statement is false'. This is because physical theories—all of them, I take it—describe the world without saying anything explicit about themselves. In addition, it is quite true that Hawking is part of the universe his theories describe. However, it is unlikely his theories tell us anything informative about him. In fact, the theories Hawking has

formulated would be completely unchanged if neither he nor any other human being existed.[13] Hence, I am unable to see the force of his claim that physical theories are like Gödel's mathematical statements in the manner of being self referencing.

So, I conclude that Hawking's analogical argument fails. Or, at the very least, far more needs be said before we are entitled to conclude it is a robust argument.

HAWKING'S SECOND ARGUMENT

However, Hawking's arguments do not end with his analogy. I believe he has a second argument quite distinct from his analogical argument. I suspect Hawking does not recognize it to be a distinct argument, but I believe it is because its force is independent of the fate of his analogical argument. Recall, he began his presentation by pointing out that the most important problem in theoretical physics at present is the attempt to reconcile quantum mechanics with relativity theory so as to unify the four main forces of nature. Many, including Hawking, have come to believe that a development of string theory, called M theory, offers the best chance for reconciling the two.

On this matter, Hawking says, "What we need is a formulation of M theory that takes account of the black hole information limit. But then our experience with supergravity and string theory, and the analogy of Gödel's theorem, suggest that even this formulation will be incomplete (Hawking, 2003, p. 6)." This conclusion is most revealing. Rather than offering a distinctive argument able to demonstrate that science cannot in principle come to an end, Hawking here relys on a version of the traditional argument employed by those who believe science will never come to an end. It is the claim that our present and future theories will meet the same fate as our past theories, which is that they will prove incomplete.

CONCLUSION

As I have acknowledged, I am neither a physicist nor a mathematician, so it is entirely possible I have missed something critically important in Hawking's arguments. Nonetheless, if my assertions are correct, Hawking has not succeeded in demonstrating that science cannot in principle come to an end. This is because his analogical argument fails. His second argument is more successful because it enjoys ample support from the history of science, but it differs only in detail from those customarily offered by those who are convinced science will never come to an end.

LITERATURE CITED

Beaty, W. "Science Is At Its End, All the Important Things Have Already Been Discovered." http://www.amasci.com/weird/end.html. Downloaded March 18, 2004.

Caltech. 2003. "Stephen Hawking: 'Gödel and the End of Physics.'" http://events.caltech.edu/events/event-861.html. Downloaded April 30, 2004.

Chang, Kenneth. 2004. (Published March 06, 2004) "In Math, Computers Don't Lie. Or Do They?" *New York Times*. p. D1.

Dyson, Freeman J. 2004a. (Published May 13, 2004) "The World on a String." *The New York Review of Books*. Vol. 51, No. 8. Pp 16-19.

_____. 2004b. (Published July 15, 2004) Letter to the editor. *The New York Review of Books*, Vol. 51, No. 12, p. 61.

Greene, Brian. 1999. *The Elegant Universe*. New York, W.W. Norton.

Feferman, Solomon. 2004. (Published July 15, 2004) Letter to the editor. *The New York Review of Books*, Vol. 51, No. 12, p. 61.

Hawking, Steven. 2003a. "Gödel and the End of Physics." http://damtp.cam.ac.uk/strtst/dirac/hawking/ . Downloaded March 03, 2004.

_____. 2003b. *The Illustrated Theory of Everything*. Beverly Hills, New Millenium Press.

_____.1980. *Is the End in sight for Theoretical Physics?* Cambridge, Cambridge University Press.

_____.1998. "A Unified Theory of Everything." http://www.math.toronto.edu/~joel/hawking/transcript.html. Downloaded March 03, 2004.

Levey, Kelli. 2003. (Published March 09, 2003) "Physicist Hawking Wows Capacity Crowd at Texas A&M." *The Bryan-College Station Eagle*. http://www.thecagle.com/region/localregional/030903hawkingspeach.htm. Downloaded March 18, 2004.

Maddox, John. 1998. *What Remains to be Discovered*. New York, The Free Press.

Nagel, Ernest and Newman, James R. 2001. (First published in 1958) *Gödel's Proof*, rev. ed. New York, New York University.

Rees, Martin. 2003. *Our Final Hour*. New York, Basic Books.

Sample, Ian. 2004. (Published February 23, 2004) "Ultimate Equation Is Pie in the Sky, Says Hawking." *The Guardian*. http://www.guardian.co.uk/uk_news/story/0,3604,1153853,00.html. Downloaded March 03, 2004.

Smolin, Lee. 1997. "The End of Horgan." Published online by The Edge. http://www.edge.org/documents/archive/edge16.html. Downloaded March 28, 2004.

Suber, Peter. "Gödel's Proof." http://www.earlham.edu/~peters/courses/logsys/g-proof.htm. Downloaded March 04, 2004.

University of Dundee. 2003. (Published January 23, 2003) "Virtual Hawking Lecture." https://secure.dundee.ac.uk/pressreleases/prjan03/hawking.html. Downloaded April 29, 2004.

University of Ulster. 2003. (Published January 23, 2003) "UU Hosts Stephen Hawking Lecture." http://www.ulst.ac.uk/news/releases/2003/687.html. Downloaded April 29, 2004.

Weinberg, Steven. 1992. *Dreams of A Final Theory*. New York, Pantheon Books.

_____. 2003. (Created July, 2003) "Viewpoints on String Theory," NOVA Science Programming on Air and Online. http://www.pbs.org/wgbh/nova/elegant/view-weinberg.html Downloaded March 01, 2004.

[1] It seems this paper was first presented as a virtual lecture delivered simultaneously to the University of Dundee, Cambridge, MIT, and the University of Ulster on January 23, 2003 (University of Dundee, 2003: University of Ulster, 2003). A bit later, on March 08, 2003, he delivered this lecture as part of the inauguration of a new institute for the study of fundamental physics, and he remained at Texas A & M for a month as part of the festivities (Levey, 2003). He presented the lecture at least once again in 2003, October 04, at Caltech (Caltech, 2003).

[2] Hawking has since published the lecture online (Sample, 2004). References here are taken from the online version.

[3] Apparently, Hawking's conversion was sudden. In a book published in 2003, he said, "I think that there is a good chance that the study of the early universe and the requirements of mathematical consistency will lead us to a complete unified theory by the end of the century—always presuming we don't blow ourselves up first (Hawking, 2003b, p. 110)." Typically, a book manuscript will appear in print a year or more after it is delivered to the publisher. Hence, it is likely that Hawking retained his faith that a final theory could be achieved until sometime in 2001 or 2002.

[4]Hawking explicitly recognizes this possibility, but passes it by with brief comment only (Hawking, 1980, pp. 25-6). Greene and Weinberg both acknowledge that science could proceed without end (Greene, 1999, pp. 373-4; Weinberg 1992, pp. 232-5).

[5] Weinberg offers what might be termed a pragmatic argument in support of his bias. He notes simply that we will never know whether a final theory can be found unless we look for it (Weinberg 2003, p. 1). This is entirely sensible, but this argument cannot, as the other arguments cannot, demonstrate that the search for a final theory must succeed.

[6] As we might expect, Weinberg has a refreshingly different argument in support of his conviction that the final theory is near to hand. Rather than looking at the world and what we understand of it, he shifts his focus to contemporary theories of physics. He believes that physical theories now seem to be converging "like arrows" on a common point—which as yet eludes us—and that the theories are becoming simpler and more elegant (Weinberg, 1992, pp. 6 & 231-2). This is an intriguing argument. However, it differs only in detail from the argument described in the text, since it is built on inferences made from the present state of scientific investigation. So, it is a new argument, but not startlingly new. And, of course, it offers no reason why these arrows of explanation should continue to converge—or why they should not be scattered in different directions by new discoveries. Moreover, even if a final theory falls to hand a few years hence, it remains possible that it could be superseded by another theory later or undone by future discoveries.

[7] Hawking mentions this possibility, and appears to take it seriously (Hawking, 1980, p. 26). He worried that physics would face this difficulty by the end of the century. Thus far, it seems to have escaped this fate. However, there is presently lively controversy in mathematics regarding the proper role of computers in working out proofs—and whether such results should enjoy the same status as old fashioned pencil and paper proofs (Chang, 2004).

[8] Brian Greene mentions this possibility and does not rule it out. He also has a quote from Edward Witten, who endorses the view (Greene, 2000, p. 373). Martin Rees has an intriguing version of this argument, which he borrowed from Isaac Asimov. He (and Asimov) believe the universe is like a fractal; that is, it's entire nature is repeated as investigators move from structure to structure, so, complexity is not reduced as researchers probe smaller dimensions. The entire complexity of the whole is reproduced on each level. Thus, science must, in a sense, begin anew with each step deeper into nature (Rees, 2003, pp. 141-2 & 151-2). Freeman Dyson offers an intriguing argument on this topic. He divides science into analytic and synthetic thinking. Analytic thinkers are reductionist. They presume all entities in the universe will be understood once their ultimate constituents are understood. Synthetic thinkers, on the other hand, believe that such things as molecules, cells, or neurons will not be understood once the ultimate constituents of matter are grasped. Synthetic thinking that does not seek to reduce them to their ultimate constituents will be required. Freeman asserts that, even if a final theory of the sort that Brian Greene or Steven Weinberg foresee should be discovered, that will be the end of analytic science only, not of synthetic. This is an important argument, but it cannot demonstrate there will be no end to science. It can demonstrate that science will not end with the end of analytic science, but it does not demonstrate there will be no end to synthetic science (Dyson, 2004, p. 19).

[9] Maddox repeatedly mentions the weight of history supporting his contention that science will not come to an end any time soon (Maddox, 1998 pp. 21 and 370-1).

[10] Hawking's arguments focus only on the fate of physics. His argument applies directly to the sciences that rely heavily on mathematics. However, he notes that chemistry and biology depend in critically important ways on physics. So, if physics must remain incomplete, they must remain incomplete as well (Hawking, 2003a, p.2). Further, to the extent that other sciences build on these three, they will remain incomplete as well.

[11] Informed commentators hasten to note that Gödel did not prove that a mathematical system must be incomplete. He proved, rather, that it must either be incomplete or inconsistent. However, Hawking sets the latter possibility aside (Hawking, 2003a, p. 5 and Suber). Nagle and Newman point out that it is possible to prove that a particular mathematical is complete, but only by using material from outside the system. (Nagel and Newman, 2001, p. 107 and n. 38).

[12] For a time, Freeman Dyson also believed Gödel's theorem shows that physical theories must be incomplete on grounds they are analogous to mathematical systems. However, he presented his argument in a brief paragraph. It appears a close kin to Hawking's, though Dyson makes no reference to Hawking's paper (Dyson, 2004a, p. 19). Several weeks after his article appeared, his position was rebutted by Solomon Feferman of Stanford University. Feferman presents two claims to support his contention that Gödel's proof cannot demonstrate that science must remain incomplete. He notes, first, that even if axiomatic systems of mathematics are incomplete and physical laws are formulated in mathematical terms, there is little reason to suppose that physical laws must be complete as well. In addition, he points out that physics does not employ all of higher mathematics, only a portion of it. Hence, once again, it matters little for physics if axiomatic systems must remain incomplete (Feferman, 2004, p. 61). With his customary grace, Dyson immediately acknowledges the force of Feferman's assertion. In a responding letter, he says, "I am grateful to Solomon Feferman for explaining why we do not need Gödel's theorem to convince us that science is inexhaustible (Dyson, 2004b, p. 61)." Dyson's concession reveals an intriguing irony. Feferman also believes science will never be complete, but not because it relies on mathematics. Basically, his argument is that each domain of science is capable of generating an infinite number of propositions, only a portion of which will be demonstrated true. Hence, science will remain incomplete even if no radically new scientific principles are discovered (Feferman, 2004, p. 61). Apparently, Dyson gratefully accepts this argument.

[13] This is because it is possible for intelligent aliens (if such exist) to devise theories equivalent to Hawking's.

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UNDERSTANDING THE ANTI-NUCLEAR MOVEMENT: WHAT THEIR SUCCESSES CAN TEACH US ABOUT OUR FAILURES

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God did not create plutonium and therefore it is evil

--Anonymous

I have a three-year-old daughter who is currently learning how to argue. She has been persuasive for a long time—threatening to throw a fit in a restaurant has always gotten her almost exactly what she's wanted—but she is now getting comfortable with using language to manipulate us. Or, as is the case rather frequently these days, not using language. See, she has figured out that giving me the silent treatment will win the fight pretty consistently, and she has gotten very good at not responding to any of the exhortations I throw her way. By not lowering herself to the discussion, she wins the argument.

For centuries, scientists adopted similar tactics and had similar success. Science and technology has always had its detractors, but the men and women doing the actual work of science paid these naysayers little mind, and they ended up being of little consequence. But the last half century has seen these neo-Luddites adopt a new strategy, one that brings to mind H.L. Mencken's description of the goal of politics as "keep[ing] the populace alarmed, and hence clamorous to be led to safety, by menacing it with an endless series of hobgoblins, all of them imaginary." This approach has been to describe a new technology as autonomous, one that, in John Street's words, "acquires an independent momentum, which...puts it beyond human control" (23). While I am not sure the average American is ready to assign this degree of freedom to any technology, I believe many of us have bought into a more limited "practical autonomy" of technology—able to negatively affect us without our consent—and this concerns us very much. It is a small step from sensing this practical autonomy to wanting to stop the technology in its tracks.

Prior to the latter half of the 20th century, technology was seen as mainly neutral. It could be used for either good or bad purposes, but, since we are good people, we will tend to use technology for good. Nuclear technologies quickly changed that view. The use of nuclear weapons to hasten the end of World War II demonstrated the heretofore unknown power (as well as far-reaching implications) possible with the splitting of the atom, and Americans soon began feeling this was a technology over which they had no control. As nuclear technology expanded to include more "peaceful" purposes, a large contingency maintained that we could not control this new manifestation of the atom any more than its predecessor. This contingency formed what has come to be known as the anti-nuclear movement, and they have

been largely successful in their goals of poisoning the nuclear well. Anything that employs the "nuclear" adjective is immediately linked to the horror of nuclear weapons, the catastrophic possibilities of a meltdown, and the permanence of radioactivity.

In their campaign against nuclear power, the anti-nuclear movement has been able to convince the American people that the nuclear energy industry possesses the practical autonomy described above, in that it will necessarily harm a helpless general public. They have done this through a series of articulations in which the entire nuclear energy industry has been inextricably linked to the twin specters of Hiroshima and Nagasaki, as well as the poisoning of our future generations. These identifications have led to a view of nuclear power that implies an agency in the technology that cannot be completely overcome by its human operators. It is my further claim that though nuclear power was one of the first technologies to be tagged "autonomous," the success of this labeling has inspired use of the term in many more arenas, including computer science, artificial intelligence, and genetics (see, for instance, Misa and van der Valk). And though the more recent technological autonomy designations have not yet been as successful as the original one (in that they have not led to the halt of progress in these fields), they continue to proliferate with little response from the scientific community. My aim in this paper is therefore twofold: 1) to discredit the identifications that led to the practical autonomy classification of nuclear power and, by implication, to condemn the entire project that seeks to assign autonomy to technology; and 2) to encourage scientists to take an active role in the debates that are now underway regarding the regulatory future of scientific research in America. I will accomplish my goals by discussing the identification of nuclear power with three specific ills—weapons, meltdowns, and radioactivity. I will show that each of the three identifications are misconstrued by the anti-nuclear movement, but they have been nonetheless successful in their endeavors because there has been very little response to their claims. No longer can we give our critics the silent treatment and still hope to win the argument.

NUCLEAR WEAPONS

The idea of any sort of nuclear technology was first presented to the American public on August 6, 1945 when a deadly mushroom cloud rose above a previously bustling Japanese town. Three days later, we were given another example of this new technology, and the words "nuclear bomb" were forever engrained on the minds of Americans. For the majority of the public, those words carried (and still carry) a very negative connotation: the capacity to kill or seriously injure thousands of fellow human beings in one fell swoop is not something to be particularly proud of. So strong is this distaste for many that any association with nuclear weapons is seen as the kiss of death. It is this guilt by association that the anti-nuclear movement has exploited so often that nuclear weapons and nuclear power hardly seem to be separate in any way. By fallaciously linking these two quite distinct applications of the radioactive nature of uranium, the anti-nuclear movement has succeeded in attaching the near-unanimous distaste for nuclear weapons to nuclear energy.

The anti-nuclear movement can hardly be blamed for initializing the identification of nuclear power with nuclear weapons, however. The Atomic Energy Commission was formed in 1939 to keep an eye on the Manhattan Project, and, throughout the 1940s and 50s, they oversaw all of the American nuclear weapons tests, from Bikini Atoll in 1946 to the Nevada tests in the late 1950s. And far from simply being a watchdog for these tests, the AEC was involved in promoting them, at one point even suggesting "atom-bomb watching for vacationers in Nevada" (Hilgartner et al 90). Thus, when the Atomic Energy Commission

finally got around to overseeing and regulating atomic *energy* in the 1950s, it is little wonder that the two separate aspects of nuclear technology were connected in the minds of many.

Though the anti-nuclear movement may not be responsible for constructing the link between nuclear power and nuclear weapons, they have certainly played a large role in strengthening that bond over the past forty years. Much of the identification here is implicit; many anti-nuclear activists do not ever make the statement that nuclear power = nuclear bombs, but the two technologies are often spoken of interchangeably, as if both pose the same hazards. For instance, a 1971 book by Frank Barnaby, titled *Man and the Atom: The Uses of Nuclear Energy*, features a picture of a mushroom cloud on the title page. And a newspaper column describing 1982 election results in the Northeast featured the following excerpt: "Eight states and the District of Columbia voted for a nuclear freeze [on weapons], but the one crucial issue on any ballot—Maine's referendum on the Yankee Power Plant—the pronukes won" (qtd. in Cohen 239-240). Even if we trace this too back to the AEC—in that discussing the history of the commission invariably leads anti-nuclear advocates to the weapons tests run by them—we cannot help but notice that little (and more often nothing) is generally done to explain to the casual reader that the radioactive fallout that drifted across the western United States in the 1950s was not—nor could it ever be—the result of nuclear power.

As damaging as this implicit identification may have been, there has been much more explicit association as well. When the anti-nuclear movement was beginning to gather steam in the early 1970s, one of their main draws was their direct identification of nuclear reactors with nuclear bombs; this was accomplished due in large part to the linking of nuclear energy fuel with nuclear weapon fuel. This appears to cause two main concerns: a country with a nuclear power plant acquiring a nuclear weapon and a terrorist group stealing fuel from a power plant to construct a weapon. Steven Del Sesto, in his history of the nuclear power controversy, describes the former as the "proliferation problem" (195). He summarized this fear of the anti-nuclear movement: "all countries with breeders [reactors that convert uranium to plutonium] will also possess plutonium, for which it is only a short step to constructing atomic bombs" (195). The first half of this statement is clearly accurate, but the misleading is done in assessing the step to constructing atomic bombs as "short." There are many non-trivial prerequisites to a nation taking this step: significant technological expertise, money, and, perhaps most importantly, desire. It is important to keep in mind that many of the countries interested in nuclear power are those in a financial situation which makes it difficult for them to import enough fossil fuels to meet their energy needs; a government in these straits would probably not have the inclination nor the ability to make weapons a priority. Nevertheless, the depiction of the "proliferation problem" is one that insinuates the expansion of nuclear power necessitates the expansion of nuclear weapons.

The concern over states with nuclear reactors acquiring nuclear weapons, however, has tended to pale in comparison with the worry generated by the thought of a terrorist organization stealing fuel from an existing plant and using it to create their own nuclear explosive. Paul Ehrlich, one of the loudest and most influential voices in the movement, proclaims in his textbook-like *Ecoscience*, "The knowledge needed to construct fission bombs...is relatively widespread and accessible"; "small, technically literate groups" could readily produce a nuclear device capable of killing "tens of thousands of people—in the worst case, hundreds of thousands" (453-454). Barry Commoner concurs, claiming that risk of theft is an inherent feature of the breeder reactor: "Regardless of how a breeder is designed, the very size of the system would increase the risk that nuclear fuel might be stolen and fashioned into bombs" (*Politics* 54). For these men, plutonium is simply a nuclear weapon that has not

been built yet, and they use this identification to instill the fear of another Hiroshima in the public with regards to nuclear power.

John Gofman and Arthur Tamplin are much more direct. Rather than relying on a feeling they hope people have about nuclear weapons, they identify plutonium directly with death. They claim that as nuclear power becomes more widespread, "plutonium will become as commonplace as heroine and even more profitable" (199). So terrible is the mere notion of plutonium to Gofman and Tamplin that they presume any reasonable person shares their opinions. Thus, only irrational people promote nuclear energy; they bluntly state that anyone advocating the expansion of nuclear power is "possessed with a death wish that encompasses all mankind" (203).

Even more frightening in the campaign to scare us away from nuclear power, though, was the information provided by Ted Taylor, former head of the Defense Department's bomb design and testing program. In 1973, he did a series of interviews with John McPhee, which were published in the *New Yorker*, and later compiled as a book. In the interviews, Taylor expressed his concern over the relative ease with which a terrorist organization could construct a nuclear bomb. *The Wall Street Journal* quoted him as saying, "I've been worried about how easy it is to build one ever since I built my first one"; he then recommended the World Book Encyclopedia as a particularly good source for bomb-making instructions (qtd. in Gofman and Tamplin 200). Taylor later published a book of his own, in which he further elaborated on the simplicity of the task: "a few persons, possibly even one person working alone, who possesses about 10 kilograms of plutonium and a substantial amount of chemical high explosive could, within several weeks, design and build a crude fission bomb" (qtd in Cohen 242). Further, these persons would only need to be "reasonably inventive and adept at using laboratory equipment...[and need only] understand some of the essential concepts and procedures that are described in widely distributed technical publications" (ibid).

While the Taylor interviews had at least one positive effect—the tightening of nuclear plant safeguards—they also added fuel to the fire of paranoia concerning the likelihood of terrorist acquisition of nuclear weapons. Nuclear power plants were portrayed as natural targets for any terrorist group with a physics textbook, and the public was led to believe that more reactors would lead directly to more renegades with H-bombs. There is considerable evidence, however, that suggests the issue is more complicated than Taylor, Gofman, and Tamplin make it seem. For instance, Taylor's "crude fission bomb" would almost certainly be one of the old gun-triggered weapons, a design that at best is capable of no more than about 15 kilotons of explosive power. This is clearly not nothing, but it is a far cry from the 10,000 kilotons of yield in the modern fusion weapons, the design for which requires the construction of a fission device within the fusion bomb. Taylor, of course, does not split these hairs, but Bernard Cohen does, and he found at least three snags in the claim that nuclear power plants are do-it-yourself bomb kits for terrorists. First, building a nuclear bomb is simply going to be beyond the abilities of all but the most extensively trained, and the professionals with this training do not tend to belong to terrorist organizations. Not even the average scientist could likely accomplish the task; Cohen, with a PhD in nuclear physics, argues that the design and construction of a nuclear weapon would require

> people capable of carrying out complex physics and engineering computations, handling hazardous materials, arranging electronically of a hundred or so triggers to fire simultaneously within much less than a millionth of a second, accurately shaping explosive charges, attaching them precisely and connecting triggers to them (245).

But even if Osama bin Laden were able to lure a group of professionals with this expertise into his troupe, they would run into the second hurdle Cohen articulates: the inadequacy of nuclear

reactor fuel for the task. A terrorist organization interested in building a bomb would not be likely to steal their plutonium from a power plant simply because much higher grade fuel (which would make a much more reliable explosion) is available at research reactors, which are nearly as common as power reactors. Despite this, the anti-nuclear crowd has raised very little resistance to the "proliferation" of nuclear research reactors.

Cohen's final argument against the terrorist theft of plutonium and acquisition of a nuclear weapon is probably the greatest: there are much easier methods by which their goals can be accomplished. According to most experts, a terrorist-designed nuclear explosive would not even be able to match the 15-20 kiloton yields of Fat Man and Little Boy, hovering instead around .3 kilotons. This would produce an explosion capable of destroying a very large building, but not much more. The most populated buildings in the country house no more than around 50,000 people at one time, so we can estimate that these terrorists can hope to kill approximately 50,000 Americans in return for all the effort they have put into this project (Cohen 245). Yet it seems abundantly clear that there are much easier ways for terrorists to kill far more people. Sadly, the destruction of the World Trade Center provided some solid evidence for this portion of Cohen's hypothesis, and there are many other possibilities Cohen describes: "Dynamite the structural supports in a sports stadium so as to drop the upper tier down on top of the lower tier; this should kill nearly all the people in both tiers...Blast open a large dam; there are situations where this could kill over 200,000 people" (245-246). It simply does not make much sense to fixate on the possibility of a terrorist nuclear attack when they would seem so much more likely to wreak other, more destructive, kinds of havoc. More generally, identifying nuclear energy fuel with nuclear weapon fuel does not paint an accurate picture of the realities of either technology.

An even more direct tactic employed by the anti-nuclear movement is linking the reactor core with a nuclear bomb. This idea has somehow perpetuated itself, despite the general reluctance to make the actual claim in print. This fear is the one of the chief causes for the Not In My BackYard (NIMBY) syndrome, which has plagued the nuclear energy industry since its inception. And this attitude still exists; a couple years ago, I took a tour of the Penn State nuclear reactor with a small group of PhD candidates, and a serious concern for many of them was the chance of the core exploding into a mushroom cloud. They were not placated until two engineers at the facility explained that a nuclear power plant could undergo a nuclear explosion only if someone actually carries a nuclear bomb into the plant. As Dr. Ben Bolch and Dr. Harold Lyons explain, "A nuclear bomb requires a very high percentage of uranium 235, far higher than the maximum of 3 percent found in a nuclear power plant. In addition, a bomb must be triggered by a special explosive device not found in a nuclear power plant" (qtd in Bast et al 106). Even Paul Ehrlich is forced to admit "it is physically impossible for...any thermal neutron reactor to blow up like a nuclear bomb," (*Ecoscience* 444). The public's perception of a nuclear reactor as either producing fuel for a bomb or as a bomb itself is based on the emotional appeals of the anti-nuclear movement rather than the logical realities of the physics involved.

The identification of nuclear power with nuclear weapons has done much to further the idea of the former as an autonomous technology. Nuclear weapons burst on the scene with very little foreknowledge on the part of the public, and they continue to be seen as something beyond our control. The power of a small handful of world leaders to drastically affect everyone in the world puts most of us in a very uncomfortable position. Add to that the thought that terrorists could seize a nuclear power facility with the intention of constructing their own nuclear weapons, and the control exercised by the public is reduced even further. Thus, the extent to which the anti-nuclear movement has succeeded in tying energy to

weapons has largely been the extent to which they have succeeded in portraying nuclear power as an autonomous technology.

MELTDOWN

The second identification that has led to the public's view of the nuclear power industry as "practically autonomous" is that which has linked normal reactor operations with the inevitability of a meltdown. The goal of this section of the paper is not to claim that no one should be worried about reactor safety; everything possible needs to be done to ensure that no lives are lost due to nuclear reactor accidents. Rather, my goal here is to establish the context so skillfully removed by the anti-nuclear crowd. By ignoring the middle term in the standard risk-analysis equation—Risk = Probability x Consequences—they have amplified the worry surrounding nuclear power plants to a level that causes public paralysis. An analogous situation is when someone becomes so afraid of airplane accidents that they refuse to fly. Most of us likely know such a person—my aunt is one, for instance. I think very highly of my aunt, but I realize that in this particular area, she is not thinking rationally; her chances of being injured in a plane accident are quite small, especially when compared to the chances of being injured in other forms of transportation.

The situation with nuclear power is similar. It is *possible* that a nuclear plant will have an accident killing or injuring a small portion of the general public, but the harm done the public by a nuclear reactors, including the most liberal estimates of accidents, is much, much smaller than that caused by the other main forms of electricity generation currently employed. In fact, the most-publicized study of the risks involved in nuclear power (WASH-1400, commonly called the Rasmussen Report, conducted by a nuclear engineering professor at MIT in 1974) estimates "the likelihood of reactor accidents is much smaller than that of non-nuclear accidents having similar consequences...the chance of mass destruction from an atomic reactor accident was as unlikely as that of a meteor striking an urban area" (qtd in Hilgartner et al 125-126). The study also estimates that the chance of any one person being injured as a result of a nuclear power accident are approximately one in five billion, far less than the chances any one person has of, for instance, contracting lung cancer due to the pollution caused by the sulfur dioxide released into the atmosphere by coal-burning power plants[1] (Ehrlich, *Ecoscience* 445-447, Cohen 29-34).

Needless to say, the figures reported by Rasmussen caused an appreciable amount of controversy within the anti-nuclear movement. Paul Ehrlich discounted the accuracy of the study simply because, in his opinion, the "tiny probabilities" were too small to be taken seriously (*Ecoscience* 446). Not that Ehrlich was terribly interested in the probabilities, anyway. Ehrlich states as much in his own book just three pages earlier when discussing reactor hazards. After briefly noting that probability ought to be considered, he refuses to do just that, stating he is "[d]eferring the question of probability for a moment" (443). He then proceeds to paint a picture of an accident in which the reactor "crack[s] open like an egg," causing the deaths of 133,000 people and tens of billions of dollars in property damage, never mentioning that the most likely way for this to happen in an American reactor is for a fully loaded jumbo jet to crash into the plant *during* a complete meltdown (444-445, Sims 103). When Ehrlich finally gets around to mentioning the probability, he only does so to dismiss the widely accepted findings in the Rasmussen Report. By avoiding probability and focusing on consequences, the anti-nuclear movement is able to identify nuclear reactors with unthinkable tragedies, thereby striking an unreasonable amount of fear in the American people.

As could have been predicted, the accident at the Three Mile Island power plant on March 28, 1979 added ammunition to this pathetic identification. The anti-nuclear movement immediately adopted a "See, I Told You So" stance concerning their doomsday predictions. Even people not normally associated with the movement got into the act; Walter Cronkite began his news report of that evening with a grave sounding, "The world has never known a day quite like today" (qtd. in Sims 26). This is true in the sense that you cannot step in the same river twice, but Cronkite's implication—that we had just been a part of a full-fledged nuclear disaster—set the tone for the attitude to be adopted by a vast majority of the American people concerning the event. The best place to start is probably with a brief recap of the actual event; there are many such factual accountings, and this one is taken from Gordon Sims' *The Anti-Nuclear Game*. Three Mile Island is a pressurized light-water reactor, and, sometime in the early morning hours of March 28, 1979, a valve in the cooling system failed to close, allowing the water surrounding the core to slowly drain away. The operators misread their equipment and, believing nothing was out of the ordinary, did nothing to prevent the drain. Eventually the temperature of the core rose to the point at which the fuel began to melt, but soon thereafter, the problem was detected and an auxiliary valve was closed. Even so, the core was hot enough that a partial meltdown occurred, and the fuel began escaping the core of the reactor. The fuel did not, however, escape the containment of the reactor (3 feet thick concrete walls reinforced by steel rods) and no significant amount of radiation was released into the environment (a small amount of radioactive gas was vented, but this was judged to be a small enough amount as to be harmless). The accident caused neither death nor injury to a single person in the surrounding area; in fact, the Kemeny Commission appointed by President Carter to investigate the accident determined that "the major adverse health effect of Three Mile Island was the stress caused by the fear of radiation" (qtd. in Sims 63).

If anything is to be concluded from the accident at Three Mile Island, it would seem to be that the safety procedures and containment structures are quite sufficient to protect the health of the public, even in the event of a serious mishap. This is not the identification the anti-nuclear movement made. Jerome Price reports that "the 1979 accident at the Three Mile Island ingrained in public consciousness the fear that a catastrophic accident could release large amounts of lethal radioactivity into the atmosphere" (68). Barry Commoner, in his book *The Politics of Energy*, gives what seems to be an objective, factual account of the accident. He begins with the precise date and time of the initial malfunction as well as an accurate description of the problem. But Commoner quickly begins writing fiction, recounting several instances of what "might" or "could" have happened. "Under these circumstances...the reactor could, in theory, melt its fuel rods....the gas might contain enough oxygen to cause an explosion" (47). By the end of his description of the accident, Commoner seems confused as to what actually happened; his concluding statement is "the normally benign and easily controlled process of producing steam to drive an electric generator turned into a trigger for a radioactive catastrophe" (48).

Despite their factual inaccuracies, Price, Commoner, and others clearly convinced the majority of Americans that " [o]ne of the most important lessons of the accident...is that even after some twenty years of commercial use, conventional nuclear power remains an immature technology, subject to poorly understood and potentially catastrophic events" (Commoner, *Politics* 53). Even though no harm was caused anyone, John Campbell reports that the "percentage of people who objected to building plants nearby grew to a point where they outnumbered those who did not object by a two-to-one margin, a dramatic reversal of the attitudes found just before the accident" (5). The media's interpretation of the incident at Three Mile Island did more than just alter some opinions about the future of nuclear power; it

actually altered the future. In Campbell's *Collapse of an Industry*, he cites "political forces" at the grass-roots level as being responsible for much of the policy shift which occurred in the late 1970s and early 1980s. The anti-nuclear movement, which reached its peak after the Three Mile Island accident, was in large part responsible for "the public worr[y] about the dangerous nature of the technology and distrust [for] those responsible for its development" (Campbell 7). In short, by identifying the Three Mile Island accident with a major catastrophe and convincing America that many more meltdowns were sure to follow, the anti-nuclear movement was well on its way to instilling the American people with the belief that the nuclear power industry had practical autonomy, and the only way to regain control was to stop the entire industry.

RADIATION

The final misconception propagated by the anti-nuclear movement is that which morphs the nuclear energy industry into the manufacturers of an uncontrollable, unending poison: radioactive waste. This is probably the claim about which the activists garner the most emotion because the victims in this case are the unborn future generations, and therein lies the identification: the nuclear power industry are the murderers of your posterity.

It would be a difficult task to select the most vociferous critic of radioactive waste, but the award might, in the end, go to Franklin Gage, spokesman for the Citizens Association for the Safe Energy and the Citizens Committee for the Protection of the Environment. In 1972, he argued that "it is morally outrageous for one generation of humans to create a radioactive legacy which irreversibly mortgages the future of the next 50 generations in exchange for a very small amount of expensive, unreliable electric power today" (qtd in Del Sesto 195). Barry Commoner is likewise gravely concerned about the "useless waste that must be scrupulously contained for many thousands of years as its intense radioactivity slowly decays" (*Poverty* 88). Gofman and Tamplin are also intent on sounding the alarm as loudly as possible: "Manufacture of plutonium-239 and its widespread use in nuclear electric power may represent man's most immoral act" (61).

As noted in the previous section, I do not intend to claim that we should not be quite careful with the use of nuclear power; I do intend to claim, however, that the use of context-free statements like Gofman and Tamplin's lead the public into erroneous identifications. For instance, it is certainly the case that the by-products of nuclear energy, namely, radioactive wastes, have the potential for causing serious harm to innocent civilians. But this is certainly also the case in regards to the by-products of coal or oil energy as well. In fact, in most respects, the waste produced by nuclear power is preferable to that produced by burning coal because nuclear wastes are containable. Dixy Lee Ray has compared a coal-burning and nuclear plant of similar output and observed some interesting things:

> The coal plant produces carbon dioxide at a rate of...7 million tons per year; the nuclear plant produces none. The coal plant produces sulfur oxides at a rate of...120,000 tons per year; the nuclear plant produces none. The coal plant produces nitrogen oxides [at the rate of] 20,000 tons per year; the nuclear plant produces none...[Overall], solid waste is produced in a coal-burning plant at a rate of...750,000 tons per year; the annual spent fuel from a nuclear power plant is about 50 tons. (196-197)

Even Paul Ehrlich has admitted that "a future generation of nuclear reactors" ought to be considered as a cleaner alternative to the combustion of fossil fuels (*Population* 222).

What, then, has led to the identification of nuclear wastes as "the most lethal...substances on the face of the earth" (Donovan Timmers, qtd. in Sims 144-145)? There seem to be two main features of nuclear waste which are despised by the anti-nuclear movement: toxicity and permanence. Both of these aspects lead to the characterization of nuclear power as practically autonomous; as Gage reminded us, the by-product of these plants will be giving us and our children cancer, and there is nothing anyone can do about it. It is certainly true that if we hold spent nuclear fuel in our hands, we have an excellent chance of getting some sort of cancer, but this, as with many of the other consequences touted by the anti-nuclear movement, will not "just happen" to anyone. We are in control of the storage, reprocessing, and disposal of these wastes, and we can ensure that they will be harmless to the general public.

Radiation is a naturally occurring side effect of living in this particular universe. It originates from several sources, but the two largest are radioactive metal deposits in the earth's crust and cosmic radiation bombarding us from space. Radiation exposure in humans is measured in millirems, and each person on the planet receives approximately 200 millirems of natural radiation per year. Other, man-made, sources include X-rays (78 millirems per year), brick buildings (7 millirems per year), and sleeping in the same bed as another person (4 millirems per year). Nuclear power plants, as well they should be, are federally regulated to monitor and control the radiation they release. Current standards dictate that the "most exposed" person—a person living next door to the nuclear plant who gets all their drinking water from the outlet at the reactor and whose food is all grown at the reactor fence—must receive no more than 5 millirems per year,[2] but most do much better than that, contributing only 2-3 millirems per year to the "most exposed" person (Sims 34-41).

Even if the anti-nuclear movement concedes that the radiation exposure from a reactor is negligible (as Paul Ehrlich does), there is still much ado about the potential hazards of nuclear waste. But the radiation from nuclear wastes to which we are currently exposed (or would be if all our electricity were generated with nuclear energy) is negligible compared to what we receive naturally. A typical nuclear power plant produces about 35 tons of high-level waster per year, but 99.5% of that waste is uranium and plutonium that can be extracted and re-used. This leaves 1.5 tons of material that must be disposed of per plant per year, and this is simply not a difficult task. Bernard Cohen has described a procedure involving the encasement of the waste in glass blocks, placing the blocks in thick steel containers, and burying the containers in granite reserves (178-180). These types of containers have been tested and are expected to last at least 500 years before corroding through. At this point, the nuclear waste can potentially get into the groundwater, but 99.9995 % of the radioactive materials have decayed into stable elements, and the net effect of all the nuclear waste we produce will be much less than the natural deposits of uranium and thorium (Sims 138).

The natural question to ask at this point is if we have acceptable methods of disposal, why is there all the controversy? This is precisely where the anti-nuclear movement comes in; by identifying nuclear waste with certain cancer and death for the next billion years, they have convinced the public that there is no such thing as safe disposal. Many members of the anti-nuclear movement equate any radioactive waste with moral reprehensibility; by invoking "the children" and claiming that the continued production of nuclear waste will spell certain death for them, the anti-nuclear movement has again produced a persuasive pathetic appeal. Sadly, this tactic has simply forced nuclear plants to continue storing the waste, rather than safely disposing of it (Bast et al 108-109).

CONCLUSION

It is easy to understand how any non-human entity seen to have "practical autonomy" would be undesirable to have around. No one wants to believe there exists a part of their lives with regard to which the arrow of influence only points one way, particularly if the potential or probable effects are harmful. It is precisely this image with which the anti-nuclear movement has convinced the American public to view the nuclear energy industry. But this charge of practical autonomy rests on the identification of nuclear power with three negative side-effects: nuclear weapons, meltdowns, and radiation sickness. Yet these identifications depend on pathos rather than logos, despite the latter's superior track record in predicting the future. I claim we must understand the scientific logic behind the technology in order to judge its usefulness; if this is done in the case of nuclear power, the charge of practical autonomy collapses.

But concerns over autonomous technology have not remained confined to nuclear power. Though nuclear technologies were the first to be so classified, they promise not to be the last. Similar fears are being expressed with regard to computer science, and the growing fields of artificial intelligence, genetic engineering, and cloning are beginning to receive a version of the criticism. It is in these younger fields where the lessons learned from the downfall of nuclear power must be applied. If the scientists and engineers who are most directly involved with the technologies do not speak up in defense of their work, much of the promise and potential in these fields may be lost.

Many scientists are not crazy about engaging in political exchanges. This is a perfectly reasonable point of view, especially given the political climate in this country in which debate is little more than partisan shouting back and forth. Unfortunately, more and more scientific research is coming under the purview of governmental oversight, and if scientists do not make a case in favor of their work, those making the case against it will be the only voices in the argument. This can lead to governmental scrutiny, regulation, and, in some cases, prohibition. My plea is that research scientists understand the need for them to enter these political debates. The work must be promoted and defended, or it will almost certainly be defeated.

Notes

[1] A 1985 study conducted by a Harvard research group concluded that approximately 100,000 Americans die each year as a direct result of air pollution, and, since coal-burning plants are responsible for 64% of the sulfur dioxide and 27% of all particulates, Cohen claims "it is reasonable to estimate that [coal-burning plants are] causing 30,000…deaths per year" (34).

[2] This leads to an interesting juxtaposition: Grand Central Station is constructed of granite with a high enough uranium content that people living next door to it would receive an average of 7 millirems per year. Thus, if it were a nuclear power plant, it would have to be closed; since it is a popular train station, nobody seems to mind.

WORKS CITED

Baden, John A., ed. *Environmental Gore: A Constructive Response to* Earth in the Balance. Lanham, MD: National Book Network, 1994.

Barnaby, Frank. *Man and the Atom: The Uses of Nuclear Power*. New York: Funk and Wagnalls, 1971.

Bast, Joseph L., Peter J. Hill, and Richard C. Rue. *Eco-Sanity: A Common-Sense Guide to Environmentalism*. Lanham, MD: Madison Books, 1994.

Burke, Kenneth. *A Rhetoric of Motives*. CA ed. Berkeley: University of California Press, 1969.

Campbell, John L. *Collapse of an Industry: Nuclear Power and the Contradictions of U.S. Policy*. Ithaca, NY: Cornell University Press, 1988.

Cohen, Bernard L. *The Nuclear Energy Option: An Alternative for the 90s*. New York: Plenum Press, 1990.

Commoner, Barry. *Making Peace with the Planet*. New York: Pantheon Books, 1990.

---. *The Politics of Energy*. New York: Alfred A. Knopf, 1979.

---. *The Poverty of Power*. New York: Alfred A. Knopf, 1976.

Del Sesto, Steven L. *Science, Politics, and Controversy: Civilian Nuclear Power in theUnited States 1946-1974*. Boulder, CO: Westview Press, 1979.

Duffy,. Robert J. *Nuclear Politics in America: A History and Theory of Government Regulation*. Lawrence, KS: University Press of Kansas, 1997.

Ehrlich, Paul R. and Anne H. Ehrlich. *Betrayal of Science and Reason: How Anti-Environmental Rhetoric Threatens Our Future*. Washington D.C.; Island Press, 1996.

---. *The Population Explosion*. New York: Simon and Schuster, 1990.

Ehrlich, Paul R., Anne H. Ehrlich, and John P. Holdren. *Ecoscience: Population,Resources, Environment*. San Francisco: W.H. Freeman and Company, 1977.

Gofman, John W. and Arthur R. Tamplin. *Poisoned Power: The Case Against Nuclear Power Plants*. Emmaus, PA: Rodale Press, 1971.

Hilgartner, Stephen, Richard C. Bell, and Rory O'Connor. *Nukespeak: Nuclear Language,Visions, and Mindset*. San Francisco: Sierra Club Books, 1982.

Metzger, H. Peter. *The Atomic Establishment*. New York: Simon and Schuster, 1972.

Misa, T. "How Machines Make History: And How Historians (and Others) Help Them To Do So." *Science, Technology and Human Values* 13 (1988): 317-329.

Price, Jerome. *The Antinuclear Movement*. Rev. ed. Boston: Twayne Publishers, 1990.

Sims, Gordon. *The Anti-Nuclear Game*. Ottawa: University of Ottawa Press, 1990.

Street, John. *Politics and Technology*. New York: Guilford Press, 1992.

van der Valk, A.C. "Cloning as a Test Case for Autonomous Technology." *Techne: Journal for the Society of Philosophy and Technology* 3.1 (1997). 10 Jan. 2004. <http://scholar.lib.vt.edu/ ejournals/SPT/v3n1/vandervalk.html>.

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DUDE, ONLY GROWNUPS DIE: BIOETHICAL CONSIDERATIONS OF *IN LOCO PARENTIS* ON COLLEGE CAMPUSES

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ABSTRACT

One of the many structures of our society shattered in the late 1960s was the matter of "in loco parentis" on many college campuses. The college could no longer act as parent to the student, a change brought about by claims of adult hood, personal freedom, and several summers of love. Regardless of how effective these old strictures may have been, the willingness of college students to assume responsibility for their personal, communal, or supervisory behavior has never been impressive as the current proliferation of cautionary websites attests. The current dangers of dwelling in densely populated areas such as dorms and apartment complexes have not been higher since the rampages of tuberculosis at the birth of the industrial revolution.

Behaviors of concern include but certainly are not limited to drug use, excessive exposure to UV light, alcohol use, violence and trauma, sex, eating disorders, and increasingly, prospective prophylactic vaccination. Looking back from a seat of wisdom and education, I assert that three of these behaviors, sex, alcohol use, and vaccination, are matters of legitimate concern for the University. The University must develop a policy for each of the behaviors that best fits the relationship established with its students.

Much of the successful action and outcome of both public health and veterinary medicine is cloaked in invisibility. We as a society no longer confront epidemic diphtheria, polio, measles, or mumps. Our society is essentially free of tetanus, human rabies[1], and even most fatal food poisonings. Our society, bless its heart, has turned self-gratification not only into a lifestyle, but also a contestable right to the extent that "..people claim the right to risk significant unnecessary injury (driving without seatbelts or motorcycling without helmets) even though the cost of injury is borne by our society." This is a society that views public health as "..coercive, biased, and dangerous..." (Smith, 2003) and become noncompliant when confronted with a policy that "..forces

alteration of behavior, causes personal inconvenience, financial loss, or risk of any dimension such as with childhood vaccination." Indeed, in the face of the order to vaccinate 500,000 front line healthcare workers against smallpox, workers switched from being health providers and became consumers or constituents by refusing the vaccine on the basis of health considerations. Ultimately, about 35,000 (7%) health care workers were vaccinated.

This perfectly reflects the interaction of the real fear of terrorism and bioterrorism, and the challenge to the current interventionist status of public health policy.

"The choice," write Bayer and Colgrove (2002), " is the extent to which we are willing to limit liberty to face threats of uncertain but potentially catastrophic dimensions." "In the shadow of 11 September, the conflict over rights and dangers would resurface, shattering the illusion that public health and civil liberties can exist in a conflict-free relationship."

Onto this collage of differing goals and inclinations, I project the state of public health initiatives on college campuses today. Students, freed of parental stricture, abundant with money, energy, and hormones, each eager to carve or enlarge a social niche, confront an array of life threatening situations equal to or exceeding the Litany of Deaths accompanying the Yom Kippur service. Unlike biblical times, as with most modern fatalities, those things that kill college students are, in some sense, easily preventible. And yet, intervention is still controversial.

Today I address three of the many, nay, myriad, health problems that confront our students, and attempt to find the grail of successful, invisible intervention. I'm sure many of you will revisit fond memories as I look back and prescribe for our students what I, at times, refused to do for myself.

I first become very conscious of student drinking when I stopped in at parties at the professional veterinary fraternities, parties run by students I knew to be hard working, responsible, and older than most of our undergraduates. After I realized that I drove home sober and wondering if I would read about any of my students in Sunday's paper, I finally stopped going to parties. Regardless of how one defines or views drinking among college students, no one can deny that a lot of it goes on:

A 1995 national survey found that almost half of the college students who were questioned had consumed 4 or 5 drinks at a single sitting in the previous 2 weeks, almost 40% of the women and 50% of the men engaged in this behavior. For members of the Greek system, 86% of men and 80% of women engaged in this behavior (NIAAA, 1995, SAMSHA, 1998).

The "trickle down" effects include hangover and more severe forms of alcohol poisoning or intoxication, destruction of property, assault, insult, missed classes, traffic hazards, and unsafe sex. Non-drinkers suffer through providing care to drunks, having their studies interrupted, or having unwanted sexual advances or date rape.

The motivation for excess and binge drinking is complex and is related to age of first drink, home environment, campus location and tone, and peer interaction. However, immediate factors such as membership in a Greek organization, valuing parties and athletics, and erroneous perceptions of what a dominant male friend is consuming largely define who's drinking how much (Bartholow, Sher & Krull, 2003). The Greek connection has stark consequences in relation to hazing and initiation rituals as noted by the 65,500 hits on Google searching "college hazing" and its alcohol associations and dealing with unfavorable to fatal outcomes as well as suggestions for

controlling and outlawing hazing.

Binge drinking is highly situational[2] although women in sororities have usually moderated their intake sharply by their later years in college, and fraternity men drink far less on graduation or on leaving the fraternity environment (Bartholow, Sher, & Krull, 2003). As is so often the case with educators and parents, we find ourselves in frustration mumbling,"If only s(he) can make it through this stage....." Indeed, James Martin, President of Auburn University, once said, "Now, if we can only make it through fall quarter without any more students killing themselves..."

Even in the absence of fatalities, college drinking calls loudly for some sort of intervention. Even those of us unsettled by the idea of curtailing the immediate "fun" of another must see the need to intervene if only to protect those not sharing the inebriated state. How then to relegate alcohol consumption to something reasonable?

In some areas like Australia, influxes of students from non-drinking cultures such as those of Islamic or Asian origin have had some influence on consumption (Cohen, 2004), but that's nothing to rely on. Wechsler *et al* (2002) found that states with "extensive" laws regulating age and access to alcohol including limiting the volume of liquor to be sold, what might be termed an "unhappy hour," had more success in curtailing underage drinking among college students.

Educators are coming to the conclusion that education programs for alcohol and drugs, including the much touted and very widespread "DARE" simply do not work. One such campaign focused on "Social Norms," the notion "..that if students realize they have been overestimating how much others drink, they will drink less themselves." Students, now aware of who drinks how much, continue to consume as before, again, in part based on how much the " big guy" drinks. Information from the National Institute for Alcohol Abuse and Alcoholism advocates the use of Behavioral Interventions including the Alcohol Skills Training Program which teaches students to monitor drinking using cognitive skills (Campo, 2003). Perhaps most effective, and most costly, is one-on-one intervention, a sit-down session with the heavy drinker to provide feedback of behavior while the student was drinking. Unfortunately, this *ex post facto* method may come too late for students, nor are all students in need of intervention likely to come to the attention of counselors.

My conclusion about control of excess drinking among college students?

Even though we have not found a perfect system for alcohol education, we as faculty must persist in supporting systems that are somehow enlightened and enlightening in order for the student to gain mastery over impulse. To ignore the problem would be to condone failure among that half of our students who drink.

On to sex.

For those of us who can remember that far back, sex was far more enticing than booze, and booze was most often what we could get. All that we could get. Sex has had its up and downs in the history of college[3]. In the mid-1980s, AIDS caused an era of hygienic prudery to settle over the "fairest village" all the way from Hollywood. As that fear faded with advances in testing, AZT, and a decline in cases due to the efforts of the gay community, other sexually transmitted diseases popped up their little heads, and those of greatest concern became not those with clinical signs for which antibiotics and antivirals were available, but silent infections with life long consequences which made *Chlamydia trachomatis,* genital chlamydia, the most widely distributed venereal

disease in the US (The next three on the list are gonorrhea, genital warts, and genital herpes, all bad actors.[Egenes, 2000]) So widespread is C trachomatis that guidelines suggest diagnostic testing of college age women who have two or more sexual partners per year, even in the absence of a presenting complaint (CDC, 1993). Untreated, indeed, undetected, infection can lead to irreversible occlusion of the fallopian tubes and sterility.

Yet antiviral agents and antibiotics have made sex "safer" and students indulge in a great variety of sexual patterns which begs many questions. First the numbers (from Eisenberg, 2001):

- 71% of college students have or have had sex, predominantly in a serially monogamous fashion.
- A quarter of sexually active students did not use barrier protection, and about half always used condoms[4].
- However, men who had two or more recent sexual escapades reported less frequent and less consistent use of rubbers.
- The indomitable spirit of youth permits 68% of those who had unprotected sex, including oral sex, to announce that each was not at risk for STD.
- Yet a fact that cannot be ignored is the shocking increase in HIV infection black men of college age: 54% of new AIDS cases are in blacks, and up to 30% of black urban homosexual males are HIV positive.
- Incidentally 40% of college students are or will be tattooed or pierced, each event an opportunity to contract hepatitis B, which can also be transmitted sexually and by sharing toothbrushes or razors.

Next, sex among college students is also developing what might be called its softer side: recognition of the "partner" aspects of "sex partner." Thus "no" is widely accepted as indicating cessation of further activity. Eight percent of men admit to having forced themselves on a woman; the number is a small but still unacceptable. Despite this apparent sweep of sensitivity, about 30% of women report having been coerced into having sex, as have 11 % of men[5]. Relationship development is still a Venus-Mars contention, but the repercussions of a one-night stand can be campus-wide (Davidson, 1998).

Sex is an arena in which *Primarum Non Nocere* must be applied multi-dimensionally: prevention of disease, enhancement of dignity, enlarging the human spirit. That's a lot to ask of a University, yet clearly, the University is confronted with permutations of 11,000 couples. How deeply should the University insert itself into the lives of these young people? How severe are the competing interests of the University Health services, dormlife services, and faculty? Unlike the outcomes of alcohol, the difficulties of sex relations on campus are likely to be kept under the covers. Yet because of the profound effects on both health and psyche, leaving sex to students is clearly the worst answer to a very complicated series of questions. Our only ethical stance is educational intervention for all our new students with some sort of "booster" or "enforcement of ideas" present throughout the College experience.

I come to the last topic for complicating life on campus[6]: Control of infectious disease. As an infectious disease guy, I am a great proponent of preventive medicine. Vaccination is the ounce

of prevention that saves a half pound of cure: For every dollar spent on vaccination, eight treatment dollars are saved[7]. But vaccination can be a tough sell. Absent the ravages of measles, diphtheria, and tetanus, parents have to be convinced that the literal one in a million chance of a severe vaccine reaction is worth the risk to protect their children. But the agents against which we vaccinate are harbored in the human soul, or at least, the oral cavity, among other places. Childhood vaccinations last throughout a life time for the most part, and thus, vaccines against mumps, measles, rubella, chickenpox, hepatitis A and B, and tetanus are forgotten with age, although recent recommendations are moving to booster vaccination against measles and diphtheria.

More controversial, or perhaps, simply more dynamic, is vaccination against influenza. Only recently thought to be a vaccine needed by those over 50, recent recommendations reflect concern about a highly dynamic virus that may be entering a new pandemic cycle and a more highly purified vaccine with far lower incidence of side effects. This year, the recommended age of vaccine dropped into early childhood, and a nasal modified live vaccine entered the market. Coincident with early onset of the influenza season in 2003 was an apparent increase in the deaths of young children infected by influenza. This is in keeping with the ever changing character of the disease: although typically a disease of the aged, the Spanish influenza of 1918-1919 caused death in many young people, age 18 to 28. Hence the need for concern about vaccination of college age individuals (Crosby, 1999).

With infection rates approaching 100% and clinical disease in 10 to 30% of infected individuals, mass vaccination is an efficient strategy that, in theory, works in the best interests of institution and individual. Yet memories of 1976 National Immunization Program and accompanying epidemic of Guillan Barre Syndrome may disincline some people to participate (Garrett, 1994). In this environment of strident public health policies, what are the consequences of failure to participate in such a program of preventive medicine?

The crisis attendant the next mass vaccination for influenza is speculative, but a more subtle, insidious, and ultimately less dangerous pathogen stalks the campus. Meningeococcal meningitis is caused by one of the 5 serotypes of *Neisseria meningiditis* and can cause rapid fatal infection. Of about 14 million students in college, about 125 will develop clinical signs and up to 15 will die; another 20 will suffer deafness, limb loss, or central nervous damage (CDC, 2000). The US vaccine is 85% effective against the 4 serotypes included in the vaccine; the serotypes not included causes 25 to 40% of reported cases.

This is the focus of the quandary: to insist that students be vaccinated at a cost of $70 for a rare disease, or to provide information, and let the student make the choice, or to be prepared for mass emergency vaccination clinics on campus in the face of the rare outbreak with attendant tragic stories, grief stricken parents, and the glare of the media (Alexander, 2004). Although the CDC and some college health associations support vaccination, colleges have been slow to insist on vaccination, in part because of the burden of the paper trail that verifies vaccinal compliance for each student. In reaction to the lobbying of parents of students afflicted by bacterial meningitis, many state legislatures have forced colleges to require or administer vaccine against meningococcal meningitis (Farrell, 2004). The CDC determined through cost benefit analysis that national funding of vaccination was unlikely to be cost effective. This may be the clearest instance of conflict and

tension between institutional intervention and demands of the individual. Yet the demands from individuals are likely to be made after a student has become sick, and rarely present themselves in advance of clinical disease. [8]

In light of conflicting reports, vaccination against meningococcal meningitis boils down to a personal decision and highlights again the complete democracy of infectious disease: every citizen venturing into the marketplace will have a chance to participate.

Three major health issues for college students, no clear cut answers for any of them. Sounds like a pretty good bioethics paper to me.

Let me close: Clark Lundell and I asked our Human Odyssey Course, "Who benefitted from advances in western medicine?" seeking the answer that only people in the West got full benefit. When one of the students stated that "Everyone" benefitted, we very socratically asked "Everyone?"

"Well," said the student, "We will, but not old guys like you."

I think one of our stated goals at the University should be to see that our kids live long enough to be old guys like us.

Footonotes

1. A report in MMWR, Jul 04, (Morbidity & Mortality Weekly Reports) of the CDC notes a cluster of 3 human cases of rabies following organ transplant from a donor without nervous signs. A bad rabies year in the US sees 6 human deaths with many years having no human deaths due to rabies.
2. If 4 years of "hitting the sauce" can be referred to as a "situation".
3. But nobody cares.
4. During the sexual revolution, I looked in vain for the recruiting office, and by the time I signed up, AIDS had cast a thin pall over mouth-to-mouth kissing, one-night stands, bare sex. I remember a time when Auburn was safe from AIDS because no one here, or even in Alabama, had it. That lasted until someone reminded me that every student had a car and knew how to get to Atlanta.
5. Who decided to call 'em condoms? Whatever happened to prophylactics, prophies, safeties, rubbers, party hats, sheaths, french caps, sheep skins, and so on?
6. Mercifully.
7. This is an average. Diseases from which uncomplicated recovery is the case have modest cost benefits such as $1:$4.7 for chicken pox or $1:$6.2 for diphtheria, tetanus, pertussis. For diseases causing permanent impairment, the savings in dollars per vaccination cost often exceeds $20.
8. As of the second week of February, 2005, the CDC advocated vaccination of college students for bacterial meningitis as a broad general recommendation to spare individual families the grief of losing a child to death or permanent injury.

REFERENCES

Alexander, Beth. Good Policies on Student Vaccination Can Inoculate Colleges against Risk. Chronicle Review, Chronicle of Higher Education. 5 Mar 2004.

Bartholow, Bruce D. Changes in Heavy Drinking over the Third Decade of Life as a Function of Collegiate Fraternity and Sorority Involvement: A Prospective, Multilevel Analysis, Health Psychology. 2003.

Bayer, Ronald, Colgrove, James. Public Health vs Civil Liberties. Science. 297: 1811, 2002.

Campo, Shelly. Are Social Norms Campaigns Really Magic Bullets? Assessing the Effects of Students' Misperceptions on Drinking Behavior. Health Communication, 2003.

CDC. Meningococcal Disease and College Students. MMWR. 49(RR-07) 11-20, 2000.

CDC. Recommendations for the Prevention and Management of *Chlamydia trachomatis* infections, MMWR, 42: (No. RR-12) 6 Aug 1993.

Cohen, David, Drier Education. Chronicle of Higher Education, 2004.

Crosby, Alfred W. America's Forgotten Pandemic: The Influenza of 1918. Cambridge University Press, 1999.

Davidson, Joy. Carnal Knowledge: 10 Things Most College Students Already Know about Sex...and 10 Things They Should Know. Men's Fitness, Sep, 1998.

Egenes, Andy. Four Major STDs Plague College Campuses Nationwide. Daily Egyptian 85: (no 131), 14 Apr 2000.

Eisenberg, M. Differences in Sexual Risk Behaviors between College Students with Same-Sex and Opposite-Sex Experience: Results from a National Survey. Archives of Sexual Behavior, 30: 575-89. 2001.

Farrell, Elizabeth F. More States are Encouraging Vaccine fo Students, Despite Ojbjections from Some Campus Health Officials. Chronicle of Higher Education. 20 Feb 2004.

Garrett, Laurie. "All in Good Haste" in *The Coming Plague*, Farrar, Strauss, Giroux 1994.

NIAAA (National Institute for Alcohol Abuse and Alcoholism). College Students and Drinking. No. 29 PH 357, July 1995.

SAMSHA. Binge Drinking in Adolescents and College Students. www.health.org/govpubs/rpo995/ 1998.

Smith, Jane S. The Personal Predicament of Public Health. The Chronicle Review, Chronicle of Higher Education, 27 June 2003.

Wechsler, H, Lee, JE, Nelson, TF, Kuo, M. Underage College Students' Drinking Behavior, Access to Alcohol, and the Influence of Deterrence Policies: Findings from the Harvard School of Public Health College Alcohol Study. Journal of American College Health 50: 223-236, 2002.

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HUMAN NATURE AND THE CREATION OF NEW VALUES

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The concept of human nature, having fallen on hard times during the modern period, has become a focus of contemporary interest. This renewed interest centers around the new genetics, especially the real possibility of genetically transforming our species. Asking ourselves what kind of transhumans we might become compels us to consider what traditional values we would wish or be able to preserve. What part of our human nature should remain in a posthuman future? Is it even possible to significantly change human nature without abandoning human values? If not, should we even consider tampering with our genetic legacy? Such questions recall the Copernican conflict between science and religion, with the battle now being waged not over an astronomical center of motion but over the ultimate source of values. Do values descend from spirit, reason or imagination or do they ascend from the ground of human nature?

Given their modern antagonistic history, both science and religion seem ill suited to resolve the moral controversies a posthuman future raises. Religion's commitment to preserving traditional values makes its relation to scientific advance problematic. Religion initially attempted to suppress the New Science and thereafter fought a rearguard action against a science triumphant. To be sure, a rapprochement between science and religion finds growing support today. Nevertheless, where scientific developments threaten traditional values, religion's instinctive response is to react defensively rather than proactively embrace change. Arguably, religion plays its positive cultural role vis-à-vis science precisely by acting as a brake shoe on the juggernaut of scientific advance. Science's relentless quest for knowledge and ruthless self-criticism launch it into a state of permanent revolution in regard to its own models. Given technology's power to transform society, scientific advance virtually guarantees constant moral and social upheaval. Science seems ill suited to tackle questions of value, because its practice undermines values even while being indifferent to them. In regard to the fact/value dichotomy that it helped to establish, science situates itself on the side of objective facts. Today, postmodernists, sociologists of knowledge, and philosophers of science have exposed science's claim to value-free objectivity as naive. Most scientists, however, continue to see themselves as empiricists and seem uncomfortable making moral or speculative claims that go beyond the facts. At the same time, many scientists have joined the chorus of those who recognize that, regardless of the fact/value dichotomy's ultimate validity, the scientific enterprise has major ethical, legal and social implications that must be addressed and cannot be ignored prior to conducting research. Science, then, lacks expertise in regard to the values it undermines, while religion reacts defensively to changes that threaten them.

This impasse in regard to values reflects the fact/value dichotomy, but also suggests the means of resolution. The interdisciplinary field of bioethics arose in large part to address the ethical, legal and social implications of biotechnological advances. The example of bioethics suggests a paradigm for understanding philosophy's cultural role today; namely, as a

mediator between science and human values that will somehow bridge the fact/value dichotomy. Yet this mediating role is not that of a value regulator who preserves traditional values; nor would the juggernaut of science submit ultimately to such regulation. Instead, following Nietzsche on this point, I maintain that modern science necessitates the creation of new human values, and that this cultural role belongs neither to science nor to religion[i], but to philosophy. Since I also maintain that the relation between values and human nature is an intimate one, a specifically philosophic reassessment of the concept of human nature is in order.

Let me begin this reassessment with an historical sketch of the concept of human nature. As indicated at the outset, the concept of human nature fell on hard times and suffered philosophic neglect during the modern period. This modern fall from grace contrasts with the prestige it enjoyed in the tradition stretching from classical antiquity through the Middle Ages and into the beginning of modernity. The traditional view of human nature owes most to Aristotle's psychology, the general study of the psyche or soul. This psychology in turn rested on Aristotle's hylomorphism, the view that all natural objects consist of a unity of matter and form. Form informs, that is, organizes matter and constitutes the essence of a thing that distinguishes it from other things. A formal essence, then, is simply that which makes something what it is, in other words, what we usually refer to as its nature. Living beings have a special kind of formal essence or nature called a psyche or soul that both organizes their bodies and animates them in characteristic ways we refer to as activities. Body and soul comprise an indissoluble unity for a living being; their dissolution defines death for Aristotle, the end of all activity as such. Activities are internal self-activated processes or actions of an organism which are either reversible or which the organism retains a potentiality to repeat. In other words, they are regular functions of the organism. Classes of living beings share functions, while others are specific to the organism in question. Thus, for Aristotle, nutrition and growth are functions common to all living things, sensation and motion are common to animals, and intellectual functions are specific to humans. Since a special function implies a special kind of soul, human psychology or the study of human nature entails the study of the differentiating character of the human soul, namely, intellect or mind. Thus, human nature consists of a body and a soul, which shares certain features with other organisms and contains a specifically human intellect or mind.

Aristotle sometimes equates nature with the soul or essence alone, at other times, with the combination of body and soul. These alternatives do not, however, imply Aristotelian ambivalence. Rather, they reflect for Aristotle, first, the unity of body and soul in reality, despite our ability distinguish them in abstraction, and, second, the soul's logical priority over the body in regard to the functions any species exhibits.

To appreciate Aristotle's view of human nature, these last two points need to be spelled out in more detail. Aristotle denies that any personal soul survives death, though he concedes that if anything survives, it would be the pure intellect, an impersonal mind that he likens to an activating light. Medieval thinkers, of course, parted company with Aristotle on this point, arguing that the personal soul survives death. More importantly for our discussion, Aristotle's integrated soul-body dualism sharply contrasts with the mind/body dichotomy Descartes later made famous. Descartes completely identifies his self with his mind or intellect, which happens to inhabit a body that is no part of self, a mere biological machine. Descartes' problem, famously caricatured by Gilbert Ryle as the problem of the ghost in the machine, concerns how a spiritual, immaterial mind can interact with a mechanical body. Descartes cleverly dodged this problem by positing the mysterious pineal gland as the site of the interaction, a pseudo-explanation that leaves unexplained how mind can affect matter. Scientists eventually overcame Descartes' problem by eliminating its source, namely, the

mind/body dichotomy, in favor of a reductionist identification of mind with the functions of a material structure; namely, the brain.

This structure-function model returns us, but with important differences, to the functionalism involved in Aristotle's psychology. While the ancient and modern views agree that organisms develop structures to perform certain functions, they disagree on the causality of how these structures come about. For Aristotle, function is prior to structure. To see this point, it is necessary to recognize that the essence or nature activates both its functions and its development. With respect to development, Aristotle speaks of the activating essence as inner principle or entelechy, literally a final end or purpose within. It is the potentiality the acorn contains within it to realize an oak tree. At the level of ontogeny, this entelechy looks like a naïve view of the genome in the sense of being a form or blueprint along with the instructions for self-organizing growth. The sticking point here for evolutionary biology is Aristotle's view that for the species as a whole structure develops for the sake of the function or purpose defined by the organism's nature. In other words, we have feet because we need to walk. For evolutionary biology, the structure is prior to the function at the level of phylogeny, having developed through the mechanism of Darwinian evolution. That is, random mutation caused a change in structure that allowed for a new or slightly different functioning that enabled the organism to better survive or adapt to its environment. To summarize, for Aristotle, we ultimately have feet because we need to walk, while for evolutionary biology, we can walk, because evolving feet enabled us to adapt and survive.[ii]

The reader may be forgiven for having failed to see the ethical significance of what is tantamount to asking in earnest whether the chicken or the egg came first. That significance only comes into view by considering the relation of Aristotle's human psychology to his ethics. As we have seen, the essence or nature of a thing determines what makes it what it is as well as its final end or purpose, but it also defines what would make something an excellent instance of its species. If I know what a hammer's nature is, I also know what its purpose is, and in what an excellent hammer consists. I would know that it should have a balanced, easily grasped handle, not have a head made of glass, but of iron, etc. Knowing what something *is*, also tells me something about what *should* be done to make it a *good* or *excellent* instance of its kind. The point to notice here is the absence of a fact/value dichotomy, ontological facts do imply moral oughts.[iii]

Let me conclude this section by emphasizing several features of the traditional theory of human nature. First, it exhibits a body/soul unity that integrates the biological and the ethical that contrasts sharply with mind/body and fact/value dichotomies. We can now understand why Nietzsche says that psychology was once "the queen of the sciences."[iv] What he means is that pre-modern psychology or the theory of human nature was the highest natural science. He may also have implied that this queen was the proper consort and complement to the human science of politics, for Aristotle, a master science that embraced the good both for the individual and the state. At any rate, the traditional theory of human nature easily integrated the biological and the practical-cultural dimensions of human life.

We have already alluded to several modern changes that resulted in the fall from grace of the pre-modern concept of human nature: Descartes' mind/body dichotomy, Hume's fact/value dichotomy, and the reductionist view of the mind as brain function. The rejection of teleology and the Darwinist denial of the fixity of species were parts of a wider repudiation of eternal, immaterial essences. The human essence vacated the realm of biology and took up residence in culture. For example, Marx maintained that human nature results from social conditioning; hence, transforming social conditions implies a transformation of human nature. If biological, instinctive conditioning is weak or absent in man, then the unlimited possibilities

of social transformation imply a limitless malleability of human nature. Comparative anthropology's descriptions of the wide variety of cultures and cultural practices have reinforced this Marxian emphasis on nurture over nature. In his work, *Human Natures*, the biologist Paul Ehrlich has drawn out the implication of combining great cultural variability with the idea that culture determines human nature. Namely, it is more appropriate to speak of human natures in the plural rather than a single human nature rooted in biological determinism. As the cognitive scientist, Steven Pinker, sees it, modern thought displays a progressive effort to deny any influence of the biological substratum of human nature on human behavior.

It is not surprising, then, that the concept of human nature underwent devaluation during the modern period. The last people to talk unabashedly about biological determinism were eugenicists; to talk in some quarters today about biological nature decisively influencing human behavior is to invite reproach. Yet, despite the risk of reproach, the idea of human nature is returning to the table of serious intellectual discussion on at least three fronts. The first is cognitive science and neuroscience, where a rapid advance in knowledge of brain structure and function increasingly suggests that not all brain functioning results from social conditioning. The second centers around a number of allied fields associated with genetics such as evolutionary and behavioral genetics, sociobiology, genetic engineering and transhumanism, the view of those who advocate a radical transformation and overcoming of the human race through genetic engineering. These two fronts are pushing the nature/nurture away from the extreme nurture position, which had gradually developed during modernity. They are pushing toward a balanced view that sees human behavior as the result of a complex interaction of both nature and nurture, while admitting that some individual behaviors or characteristics are determined more decisively by either nature or nature. I am sympathetic to this interactive view and generally to the work being done in these fields, even where I do not agree with some of their reigning explanatory models.

Two conservatives members of the President's Bioethics Council, Leon Kass and the political scientist, Francis Fukuyama represent the third front. In the remarks that follow, I will focus on Fukuyama's views in *Our Posthuman Future*. Basically, Fukuyama worries that, although biotechnology holds great promise, it also threatens to destroy us. To avoid destruction, he proposes regulating biotechnology, which, to be successful, requires a standard of what is essential to human nature, and he finds that standard in Aristotle's account of human nature. He correctly points out that an Aristotelian account of human nature does not stand or fall on the ontological question of the eternity of essences but rather on the existence of something that falls within a typical statistical range. He also refutes Ehrlich's conclusion that cultural variability implies the lack of a single human nature. Variability often only illustrates the range of the typical. Languages, for example, exhibit a high degree of variability, yet every human culture has a language. What is natural or typical for human beings, then, is to have a language, not to have a language with such and such features; the latter represents the variability within human nature, not a nature that differs with respect to humanness. Fukuyama also shows that those who dismiss the idea of human nature usually introduce their version of it unannounced through the back door, and that it turns out to include background assumptions shared by other modern thinkers. Fukuyama is most illuminating when showing how human nature historically has grounded our cherished notions of political rights. If, as Fukuyama rightly argues, the struggle for political recognition is a prime impetus of social change, then the question of human nature is decisive is central for politics. Fukuyama is rightly concerned that undermining the idea of a common humanity or tampering with the genome will confuse the underlying basis on which human rights and human equality are based. Whether in the end human nature must ground ethical and political values, Fukuyama is certainly correct in main-

taining that it historically has. Consequently, I think his concerns about undermining the basis of rights have to be taken seriously at a practical, political level, even if one rejects on scientific grounds the Aristotelian theory of human nature he espouses.

I do not take issue with Fukuyama's view of human nature as grounding either ethics or politics. I would suggest that what remains exemplary in the Aristotelian approach is the bridging of the gap between the biological and the ethical-political. I do, however, reject Fukuyama's view that Aristotelian theory can serve as a basis for regulating science. Fukuyama's regulatory attempt to rein in science, while well intended, is wrong-headed in strategy and may prove no more successful than religion in applying a temporary brake to scientific research. The problem with this strategy is that the vision commanding the future is the wish to impose reins moored in the past. Fukuyama's presupposition is that, since Aristotle mainly got it right about human nature, the scientific gaps in his knowledge can be filled in. In my view, the absence of an evolutionary dimension fatally flaws Aristotelianism. This evolutionary deficiency pertains not only to his thinking about living beings, but also to his concept of human nature. This concept itself is not something static, but is something like a dynamically evolving theoretical model.

This completes the historical sketch of our philosophic reassessment of the concept of human nature. The main conclusion of that sketch for what follows is that the concept of human nature enjoyed a prestige in the pre-modern period that it lost in modernity. Philosophy cannot recapture the status it enjoyed in antiquity as the principal cultural spokesperson for the true. That mantle has passed to science. Nor can the prestige of Aristotelianism be resurrected to regulate the present. Nor should philosophy serve as a handmaid of religion or science as it did in the Medieval and modern periods respectively. Rather, philosophy's proper role in a scientific age is to serve as a mediator between science and the ethical-political realm by creating new values. In what follows, I will simply lay out what I see as three distinct levels of the concept of human nature and indicate how the project of creating values arises out of the third level.

The first level involved in the concept of human nature is the biological substratum. Here would be included not only human physiology and neuroscience, but the understanding of biological life in general, since human life shares in general features of all life. That understanding necessarily entails an understanding of how life evolves. Though the evolution of species is unproblematic for all but creationists, considerable debate rages over the mechanism of evolution. Though orthodox Darwinism explains most of the facts of evolution through the gradualist mechanism of random mutation and natural selection, I have never found this mechanism entirely convincing. Lynn Margulis has shown that symbiosis is a non-Darwinian process that is crucial for understanding the origin the basic phyla of life. Geological tempo and evolutionary tempo differ; life does not appear to evolve gradually but in fits and starts as Gould's theory of punctuated equilibrium suggests. My main reservation, though, is that the Darwinian picture of evolution is too passive, making the organism active only in the sense of engendering errors. I find more convincing John Campbell's autopoetic view of life that sees the gene as the organ of evolution. That is, the gene is structure whose function is precisely to evolve new structures. Some such view seems at least necessary to explain why punctuated evolution suddenly occurs. In this autopoetic view, the organism is like a writer, natural selection like an editor. The question becomes, what and why life is writing. Let me propose a tentative answer to this question by defining life as improvised proliferation. By using the term, improvised, I mean to suggest an analogy with jazz. Life proliferates variations on themes that evolve in the sense of becoming organically becoming more complex, but they do not exhibit a pre-scribed *telos*; the purpose is free play for its own sake. Natural selection prunes this pro-

liferation, but does not otherwise decisively influence it; that is, development has its own immanent, autopoetic logic.

Regardless of how evolution works, life evolves up to a certain point in the case of human beings to where the synergy of evolved features—upright posture, opposed thumb, hand-eye coordination, speech, etc.—creates a sudden explosion of adaptive power. From this point onward, the main locus of adaptation shifts from evolution to culture. Though evolutionary change may proceed at the same rate, it is eclipsed by the speed of cultural variation and adaptation. The proliferation of cultural variations constitutes the second level of the concept of human nature. The variations may be considered the working out of the inherent possibilities made possible by the synergy of those evolved features. From the standpoint of these various cultural possibilities, Ehrlich seems justified in speaking of human natures. On the other hand, the proliferation of these variations does not significantly change the biological substratum of evolved features.

The third level of the concept of human nature is what I call the consciously autopoetic to distinguish it from the unconsciously autopoetic character of all life. Pico della Mirandola expressed this autopoetic thought in writing that the nature of human nature is to make our nature. In that sense, the transhumanist project of re-engineering our genetic substratum seems like a self-conscious reenactment of what life unconsciously is. There are at least two problems with this project. First, we should be cautious about changing our substratum before we have sufficiently understood it and before we have worked out and optimized its inherent possibilities. Second, it presupposes that one has the wisdom or the expertise to successfully program what we are to become. The absence of sufficient knowledge of our current biological substratum and the realization of its inherent possibilities makes the possession of that wisdom and expertise unlikely. In the absence of such wisdom, one would have to take seriously the concerns Fukuyama raises in regard to the potential to undermine and confuse the historical basis of our political rights.

Given the autopoetic character of life and the consciously autopoetic character of humanity, our understanding of who and what we are must perforce ground our ethical and political values. Notice that in the last sentence that the ground of human values has shifted from human nature to "our understanding" of human nature. Our understanding of human nature, of ourselves, changes historically and culturally even when the substratum remains constant. Moreover, our understanding of that substratum changes as our scientific understanding of it deepens. In short, the concept of human nature is an evolving, developing concept, and we seem to be in a period when it is evolving very rapidly. This is the reason why I believe the Fukuyaman project is doomed.

What is needed is not a regulative ideal of human nature, but a scientific model of human nature. Such a model would not serve as a regulative standard but, rather, like all scientific models, as a hypothesis. The only problem with this picture is that if science is a juggernaut that disrupts values, then a juggernaut attacking the concept of human nature, the ground of values, could prove disastrous. Philosophy is needed to create new values precisely because of the disruptive potential of the new genetics and the new model of human nature. To do so, philosophy's creation of values must imaginatively transcend the factual basis of science without, however, contradicting that basis. Nietzsche liked to style himself dynamite and proclaim that all creation is destruction. I think the danger in our age is not one of smug, bourgeois complacency but of radical moral upheaval in our values. Given that fact, Nietzschean aggressive posturing in regard to the creation of new values would be counterproductive. Ironically, the strategy to be recommended would be that secretly practiced by all great reli-

gious innovators who managed to innovate while insisting that their innovations merely continued the tradition.

Bibliography

Aristotle. *De Anima*. In Richard McKeon, ed., *Introduction to Aristotle*, 153-245. Chicago: The University of Chicago Press. 1973.

Arnhart, Larry. *Darwinian Natural Right: The Biological Ethics of Human Nature*. Albany: State University of New York Press. 1998.

Campbell, John H. "The New Gene and Its Evolution." In K.S.W. Campbell and M.F. Day, eds., *Rates of Evolution*, 283-309. New York: Allen and Unwin. 1987.

Descartes, René. *Meditations on First Philosophy*. Laurence J. Lafleur, transl. Indianopolis: The Bobbs-Merrill Company, Inc. 1960.

Ehrlich, Paul R. *Human Natures: Genes, Cultures, and the Human Prospect*. New York: Penguin Books. 2000.

Fukuyama, Francis. *Our Posthuman Future*. New York: Farrar, Straus and Giroux. 2002.

Gould, Stephen Jay. *The Structure of Evolutionary Theory*. Cambridge: The Belknap Press of Harvard University Press. 2002

Margulis, Lynn. *Symbiotic Planet: A New Look At Evolution*. Amherst: Basic Books. 1998.

MacIntyre, Alasdair. *After Virtue*. Notre Dame: University of Notre Dame Press. 1981.

Nietzsche, Friedrich. *Beyond Good and Evil*. In Walter Kaufmann, transl. and ed., *Basic Writings of Nietzsche*, 179-435. New York: The Modern Library. 1992.

Pico della Mirandola, Giovanni. *On the Dignity of Man*. Indianapolis: The Bobbs-Merrill Company, Inc. 1965.

Pinker, Steven. *The Blank Slate: The Modern Denial of Human Nature*. New York: Viking. 2002.

Ryle, Gilbert. "Descartes' Myth." In *The Philosophy of Mind: Classical Problems, Contemporary Issues*, Brian Beakley and Peter Ludlow, eds, 23-31. Cambridge: The MIT Press. 1992. From *The Concept of Mind*. New York: Harper Collins Publishers, 1949.

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[i] My admittedly stereotypical characterization of religion better applies to the average religious person than it does to religious intellectuals or to scientists who are religious. Nevertheless, to the extent religion posits eternal values, science's inherently value-disrupting tendencies must continually force religion into the unpalatable alternatives of either compromising its presuppositions or resisting scientific innovation. Perennial values exist, but we are not in a position to determine rationally or scientifically whether eternal values exists.

[ii] Arnhart persuasively argues, first, that modern biology's account of ontogeny closely resembles the immanent teleology of Aristotle and, second, that Aristotle's account of human nature does not depend ultimately on an eternal, essentialist account of human nature. Regarding phylogeny, Arnhart notes that Aristotle emphasizes the adaptation of species to their environments, whereas Darwinism explains how the adaptation evolves. In my view, the absence of an evolutionary understanding of how species emerges colors Aristotle's ethical naturalism in crucial ways. We *know* significantly more today about how life functions, how it emerges and how the brain functions. Here, the maxim applies, that sufficient quantitative increases eventually result in qualitative differences. So, even if human nature in fact has changed only negligibly in a biological sense in the course of human history, and even if various cultures are only variations on the one theme of a universal human nature, it remains true that our *knowledge* of human nature has changed. As I suggest, the conceptions of human nature developing on this ever-growing knowledge base have profound mythico-religious, political-ideological, and philosophic implications for the human prospect.

[iii]MacIntyre argues that the divorce of fact and value and the general disappearance of the connection between morality and human nature led to the failure of the Enlightenment project of grounding morality on a new footing. Although he utilizes Nietzsche's critique of the Enlightenment, he rejects the Nietzsche's doctrines of overman and will to power as viable alternatives to that failure (MacIntyre, 1981). However, he does not see that Nietzsche's creation of new values is less a creation *ex nihilo* than an experimental reinterpretation of human nature that offers a hyperbolic version of MacIntyre's own alternative, a kind of historicized Aristotelianism.

[iv]More precisely, Nietzsche holds that psychology, the science of human nature, must "be recognized again as the queen of the sciences, for whose service and preparation the other sciences exist. For psychology is now again the path to the fundamental problems." (Nietzsche, 1992, p. 222, (Section 23 of *Beyond Good and Evil*).

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POTENTIAL BARRIERS TO INFORMED CONSENT

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INTRODUCTION

Every health care provider and every researcher knows that securing informed consent from patients and potential study participants is a critical requirement before treatment or research activities may commence. The three necessary elements for informed consent are: facts about the nature and risks of the proposed therapy or trial; the capacity to process and understand the information; and the freedom from coercion to make a reasoned choice. Although these criteria are well known, there are potential barriers to these three elements that may interfere with successful achievement of truly informed consent. The purpose of this paper is to discuss some of the barriers that may impede the exercise of informed consent. The discussion will begin with a review of the concept and history of informed consent and conclude with an analysis of the potential barriers to informed consent.

THE CONSENT PROCESS

Consent as a process protects an individual's exercise of self-determination, the freedom to make choices about important issues that affect one's life. (Buchanan and Brock, 1990) Giving consent to health care and to research participation is a result of the right to decide what will happen to one's body. The right to consent is based upon the ethical principle of autonomy, which holds respect for the uniqueness of each individual. Health care professionals show respect for individuals by honoring a patient's choice of therapies, including the option of refusing all treatment. In societies where there is little respect for individuals, including slaves, women, minorities, and even children, these groups of persons exercise little autonomy and might not have the opportunity to consent before being subjected to treatment or experimentation. (Burkhardt, 1998) The Nazi experiments on "undesirables" during WWII are examples of a lack of respect for these human subjects and the subsequent abuse of their self-determination. (The Doctors Trial)

CONSENT AND THE LAW

Society has long identified that certain types of touching without consent can be unlawful. In law, battery is defined as "intentional and wrongful physical contact with a person without his or her consent" (Black, 1991, p. 104) and it is either a tort (a civil act) or a crime. Despite their defense that they were conducting scientific research, the Nazis were found guilty of criminal acts against humanity and war crimes because they performed their

harmful experiments on unwilling and non-consenting victims. Medical professionals who act upon patients without their informed consent may either be guilty of criminal battery or be liable for the tort of malpractice.

EMERGENCE OF "INFORMED" CONSENT

In 1947, a document entitled, "Permissible Medical Experiments," was submitted to the Nuremberg tribunal by two American doctors who had assisted the prosecution against the Nazis who had conducted the experiments. (Nuremberg Code explanation) The first precept of this document states, "The voluntary consent of the human subject is absolutely essential." (The Nuremberg Code excerpt) Forty-two years earlier in the US, a state appeals court had reaffirmed a person's "right to inviolability of his person (in finding that a physician), however skillful or eminent ... (could not operate) on him without his consent or knowledge."(Pratt v. Davis, 1905, p.166) The physician, Dr. Pratt, had performed a hysterectomy to cure Mrs. Davis of her epilepsy, and had deliberately deceived her as to the nature of the treatment because he wanted her cooperation. Dr. Pratt essentially stated that, by seeking his care, Mrs. Davis had consented to anything he deemed proper therapy. (Katz, 1984) Both the Nuremberg document and the Davis decision distinctly reconfirmed the need for consent before any medical or research action could be initiated towards a person. Neither Mrs. Davis nor the victims of the Nazi experiments ever agreed to the operations to which they were subjected.

Although the law of battery is very old, the doctrine of *informed* consent is a relatively new legal concept and it has evolved primarily in the context of medical procedures. Only recently has the law recognized that a person needs information about a proposed procedure to give reasonable consent to that procedure. The doctrine of *informed* consent protects the individual's right not only to consent to being "touched," but also to *know* precisely what that contact will entail (pros and cons, potential harms and benefits) *before* giving consent to this contact.(Katz, 1984) In 1972, the landmark case of Canterbury v. Spence established the physician's *duty* to adequately disclose information that would allow a patient to make an informed decision about treatment options, including the option to refuse any or all treatment. The court found that "the very purpose of the disclosure rule is to protect the patient against consequences which, if known, he would have avoided by foregoing the treatment."(Canterbury v. Spence, 1972, p. 787)

The physicians who had written the Nuremberg document in 1947 had not used the term, "informed consent." However, this early document has all the critical elements for informed consent; these elements are included in a paragraph that explains the first precept, "voluntary consent," in words that mirror findings in later informed consent cases. (The Nuremberg Code excerpt) Articulated specifically, informed consent is comprised of a free, uncoerced choice, made by a person who is legally and cognitively capable of processing facts about the options surrounding that choice *and* who has sufficient information about the options to make a rational, reasonable decision. True informed consent does not exist if any one of the critical elements of voluntariness, competence, and knowledge is missing. Lack of any consent, as with the Nazi experiments, or consent achieved through fraud or deceit, as in the case of Pratt v. Davis, are obvious examples of lack of voluntariness.

THE ELEMENT OF COMPETENCE

In another landmark case, Schloendorff v. Society of New York Hospital, the court found that "every human being of adult years and sound mind has a right to determine what shall be done with his own body." (1914, p.129) There is a legal presumption that an *adult* is of sound mind, unless proven otherwise. This presumption gives rise to two important corollaries: 1) a child, by definition, is not an adult and therefore is not *legally* (as opposed to cognitively) competent to give informed consent; and 2) unless there is an established reason to prove incompetence (i.e., lack of consciousness, clearly identified brain malfunction, etc.), an adult should be afforded decision-making rights. Merely because an adult does not agree with medically recommended treatment does not indicate a lack of competence.

The legal and ethical aspects of surrogate decision making for children and legally incompetent adults are complex and beyond the scope of this paper. However, a few generalizations are appropriate here. First, parents are the primary surrogate decision makers for children for both treatment and research purposes. (Meyer v Nebraska, 1923; Pierce v Society of Sisters, 1925; Wisconsin v Yoder, 1972) Secondly, incompetent adults are generally excluded from participation in research, and treatment decisions for them are based on a determination of the individual's best interests. (Buchanan and Brock, 1990)

THE ELEMENT OF INFORMATION

When a patient suffers as a result of inadequate information about his personal medical status and/or his treatment options, the doctor *might* be liable for the tort of malpractice, a type of negligence. When the court established that physicians have a *duty* to inform patients, informed consent expanded from merely the law of battery into the law of negligence. Touching a patient without consent could be battery. Touching a patient without adequately explaining what the nature of the touch is, could be malpractice: the physician has failed in performing his or her duty to the patient.

There are three legal standards for disclosure of information to a patient. There is the professional standard, which focuses on the customary information disclosed by the "reasonable" medical practitioner in similar circumstances. (Katz, 1984, p. 70) In order to determine adequacy of disclosure, the jury judges the information given to the patient against testimony from medical professionals about what is the "usual" information given. Secondly, there is the objective standard, articulated in Canterbury v. Spence, which essentially specifies that a risk should be revealed if a "reasonable person" would consider it when deciding about a proposed therapy: this issue becomes a jury decision about what is "reasonable."(p. 787) And finally, there is the subjective *causation* standard, which has very little legal acceptance in courts or legislatures. This approach asks the jury to decide if this specific patient would have avoided this treatment that led to an injury sustained by the patient during the therapy, had he or she known the potential risk of this treatment. (Annas, et al, 1990)

The US Code of Federal Regulations (45CFR46) provides for the protection of human subjects and regulates research conducted at any institution under federal jurisdiction or federal regulation. Section 46.116 provides that no investigator may conduct research on human subjects without obtaining a legal informed consent and specifies the requirements for this informed consent. Many of these specifications center around the information that must be disclosed to potential participants; this information is comprised primarily of *any* risks and benefits of the research. Section 46.102(i) defines that the important concept of minimal risk includes those situations when "the probability and magnitude of harm or discomfort

anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests." Whenever a study could involve more than minimal risk, not only do all participants need a clear understanding of all of the dangers, but the researcher must have additional safeguards and remedies in place to appropriately deal with those risks. The guidelines further provide for the establishment of Institutional Review Boards (IRBs) that monitor all research proposals and appraise the potential risks. The guidelines give the IRBs explicit authority to evaluate the adequacy of the disclosure that the investigator intends to give to study participants. An IRB may require additional explanations be given to potential participants "when in the IRB's judgment the information would meaningfully add to the protection of the rights and welfare of subjects."(Section 46.109 b)

POTENTIAL BARRIERS TO INFORMED CONSENT

There are obvious barriers to the achievement of informed consent when the criteria are not met. Coercion under gunpoint prevents free choice, for example. But there are other, more subtle obstacles that can negatively influence the exercise of true informed consent. For example, can a patient make a truly free choice if the alternatives are limited because insurance will not pay for a particular therapy, as in the movie, John Q? If potential therapies are limited by policy decisions, as in stem cell research, or by the lack of resources, as in the unavailability of a bed in a special care unit, not all options may be open to each patient equally. An argument could be made that issues of availability of resources really are in the purview of the principle of justice rather than that of autonomy. Nevertheless, policies determined by insurance companies, legislatures, and administrators influence available therapies as well as research protocols that might produce benefits to individuals. An example of the latter could be a procedure that has been shown to produce positive outcomes for a specific condition, but is still classified as "experimental." Some insurance companies will not approve payment for therapies that are classified as experimental, even if the doctor recommends it and the patient wants it.

Another potential barrier to informed consent deals with the question, "When does influence become coercion?" Patients might not feel free to go against their doctor's recommendation for fear of either offending or angering someone upon whom they depend for care. Or perhaps a person agrees to participate in a study because the recruiter is someone the subject feels has a position of power, such as when a boss asks subordinates to cooperate in a survey. Certain groups of people may be classified as vulnerable populations because of a power differential; prisoners are a group specifically identified as vulnerable to undue influence on their freedom of choice for research purposes.

One of the most powerful, potential barriers to informed consent is the fact that professionals control the flow of information, in both what is revealed as well as how it is revealed. With good intentions, physicians, in particular, have been prone to act without adequately informing patients about the nature of the treatment. Medicine has long had an ethic that encouraged physicians to meet what they deemed were the best interests of their patients, and to protect their patients from information that laymen might find frightening, even if true. Many professionals were of the opinion that lay people were unable to make decisions about medical treatments, but instead should place complete confidence and reliance in their doctors. The 1847 Code of Ethics (American Medical Association) stated incontrovertibly, "The obedience of a patient to the prescriptions of his physician should be prompt and implicit." The Code also adjured physicians to take great care in what they said to

patients, avoiding "all things which have a tendency to discourage the patient and to depress his spirits." Doctors socialized into practicing paternalism towards their patients might deem certain information as unnecessary or even too risky in and of itself to disclose. When doctors honestly believe that they know the best interests of their patients better than the patients themselves, paternalism can influence the information presented for informed consent. In jurisdictions that employ the professional disclosure standard for informing patients and where paternalism is "customary medical practice," significant barriers to true informed consent could thus evolve.

The control of the manner in which information is presented by professionals can also influence informed consent. Studies have shown that the *way* scientific facts are presented to lay people can influence the inferences drawn by juries and other non-professionals.(Koehler, 2001; Girotto and Gonzalez, 2001) The exactly same factual information can be interpreted to different meanings when the facts are presented in terms of frequencies versus probabilities in various contexts. The significance of this statement is that the astute scientist or doctor (or lawyer) can present information in such a way as to lead the listener to come to the conclusion that the speaker desires, without withholding any facts.

There is another potential barrier to informed consent, particularly for research participants, related to disclosure of information: conflict of interests for researchers. The source of funding for a research study might influence how and what a researcher tells prospective participants. Even if financial concerns do not directly affect an investigator, the pressure of academic life which requires publications or the altruistic desire to improve life through scientific discovery can motivate a researcher to recruit subjects to get the data collected.(Korn, 2000) The unfortunate death of gene-therapy subject, Jesse Gelsinger, has led to concerns about the adequacy of his informed consent and the urgency to find a cure for his disease.(Beh, 2002; Stolberg,1999)

CONCLUSION AND SUMMARY

Professionals have a legal as well as an ethical duty to secure truly informed consent from patients and research subjects. It is incumbent upon professionals to recognize potential barriers to the achievement of informed consent, particularly regarding the aspect of information giving. If patients or research participants do not have sufficient information to be self-determining, then we as professionals have failed in our fiduciary duty to them.

LITERATURE AND LEGAL MATERIALS CITED

American Medical Association. (1847). Code of Ethics. Reprinted in J. Katz. (1984) The Silent World of Doctor and Patient New York: The Free Press. Appendix A

Annas G., Law S., Rosenblatt R., Wing K. (1990) American Health Law Boston: Little, Brown & Co.

Beh, H. (2002) The role of Institutional Review Boards in protecting human subjects: Are we really ready to fix a broken system? Law and Psychology Review 26 (Spring) 1-47

Black, H. (1991) Black's Law Dictionary St Paul: West Publishing Co.

Buchanan, A. & Brock, D. (1990) Deciding for Others: The Ethics of Surrogate Decision Making New York: Cambridge University Press.

Burkhardt, M and Nathaniel, A (1998) Ethics & Issues in Contemporary Nursing. Albany, NY: Delmar

Canterbery v. Spence, 464 F. 2d 772 (D.C. Cir. 1972)

Code of Federal Regulations. (rev. Oct 1, 2003) 45 CFR 46. Subpart A. Basic HHS Policy for Protection of Human Research Subjects

Girotto, V. & Gonzalez, M. (2001). Solving probabilistic and statistical problems: A matter of information structure and question form. Cognition 78 247-276.

Katz, J. (1984) The Silent World of Doctor and Patient New York: The Free Press.

Koehler, J. (2001) When are people persuaded by DNA match statistics? Law and Human Behavior 25 (5) 493-513.

Korn. D. (2000) Conflicts of interest in biomedical research. JAMA 284 (17). 2234-6.

Pratt v. Davis, 118 Ill. App. 161 (1905)

Schloendorff v. Society of New York Hospital, 211 N.Y. 125, 129 (1914)

Stolberg, S. (1999) The biotech death of Jesse Gelsinger. The New York Times (Nov. 28) Section 6, p 137

United States Holocaust Memorial Museum. Online Exhibitions: The Doctors Trial: *www.ushmm.org/research/doctors/index.html*

United States Holocaust Memorial Museum. Online Exhibitions: Nuremberg Code explanation. *www.ushmm.org/research/doctors/code_expl.htm*

United States Holocaust Memorial Museum Online Exhibitions: Nuremberg Code excerpt. *www.ushmm.org/research/doctors/Nuremberg_Code.htm*

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HISTORY OF THE DIVISION OF FERTILIZER AND SOIL CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY

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ABSTRACT

The Division of Fertilizer Chemistry, one of the five original divisions of the American Chemical Society, was organized in 1908. Frank Berton Carpenter, chief chemist of Virginia-Carolina Chemical Company, became its first chairman. The new Division was initially interested mostly in better sampling techniques and analytical methods but later expanded its programs to include fertilizer manufacturing technology, soil chemistry, and other aspects of the fertilizer industry. The name was changed to the Division of Fertilizer and Soil Chemistry in 1952. The Division successfully pioneered the use of a two-way telephone setup in 1981 to teleconference its technical sessions to the National Fertilizer Development Center, Tennessee Valley Authority (TVA), Muscle Shoals, Alabama. Many researchers from Muscle Shoals presented papers and served as officers from 1940 to 1997. Travis P. Hignett, of TVA, received the Division's first Merit Award in 1980. The Division dissolved and merged with the Division of Agrochemicals in 2000 because of major changes in the fertilizer industry, TVA's abolishment of its fertilizer research program, and dwindling membership. During its 91 years, the Division provided a forum in which problems could be discussed and new developments shared with other researchers.

By the early 1900s many advances and improvements had been made in the fertilizer industry. The importance of chemical control was recognized by the industry and fertilizer chemistry had become a separate branch of the chemical profession. Consequently, the Division of Fertilizer Chemistry was authorized as one of the American Chemical Society's original five divisions when the Society inaugurated its division system in 1908.[1]

Frank Berton Carpenter, B. H. Hite, and John E. Breckenridge were elected chairman, vice chairman, and secretary, respectively, of the newly created division on December 21, 1908, during a general American Chemical Society (ACS) convention held in Baltimore.[2] Nine papers were presented at that meeting and in addition Mr. Carpenter gave an address entitled "The Fertilizer Industry--An Historical Sketch" which was subsequently published in a journal of the period called The American Fertilizer.[3] The new chairman was 44 years old and a graduate of Massachusetts College. His experience in fertilizer chemistry included 18 years in the Massachusetts and North Carolina state experiment stations and four years as chief chemist of Virginia--Carolina Chemical Corporation, located in Richmond, Virginia.[4] Carpenter was a leader in the Division for many years and again served as chairman from 1919 to 1927. After his second term, he was succeeded by Egbert Watson Magruder, of F. S. Royster Guano Company, who held the chairmanship for twelve years, until 1939. Herman Bernard Siems, of Swift & Company, then served as chairman from 1940 to 1946. Because of the long terms of most of the early leaders, only five men served as chairman during the

Division's first 37 years and all of them were industrial chemists.[5] Beginning in 1951, the term of office was limited to one year until the 1990s.

By the end of its first year, the Division had 100 members including several state chemists and directors as well as chemists from numerous fertilizer companies. Meetings were held each year but the attendance was usually small and few papers were presented. In 1916, for example, only three members were present at the spring meeting because industrial chemists could not be away from their laboratories during the busy fertilizer shipping season.[6] After that time, the Division met only during the fall meetings of the Society, except on special occasions such as the ACS centennial meeting in 1976 and the Third Chemical Congress of North America held in Canada in 1988.

The early meetings were devoted chiefly to problems of sampling and analytical procedures that were of particular concern to fertilizer manufacturers. During that period, the Division collaborated with the Association of Official Agricultural Chemists for several years to develop standard methods which eventually eliminated the major problems in that area.[7]

To stimulate interest in the meetings of the Division and to ensure larger attendance, one or more symposia were held at each meeting after 1917 to focus attention on some prominent phase of fertilizer or soil chemistry. The first symposium was entitled "The Sampling of Fertilizers." Later symposia were occasionally held jointly with other Divisions of the Society. In addition, at least one session at each meeting was always devoted to general papers which were not appropriate for the symposia.

The Division of Fertilizer Chemistry was led by officers from the fertilizer industry during its first 40 years, as mentioned above, but several scientists from the United States Department of Agriculture and the Tennessee Valley Authority later served as chairmen. Furthermore, three professors from Iowa State University were elected to that position in the 1960s and 1970s (David R. Boylan, George Burnet, and Maurice A. Lawson).

The organization of the Division has been somewhat informal in character through the years. There were no formal membership requirements until about 1970 and no divisional dues were assessed. The Division claimed to have over 1500 members during the 1960s. When the payment of dues became a requirement for membership, the number of members dropped sharply, and the Division had only 300 to 400 members during the 1980s. This made it one of the smallest divisions in the Society. A demographic report for 1983 listed 289 male and 15 female members. Twenty-nine percent held a doctor's degree, 20 % had a master's degree, and 48 % had a bachelor's degree.

Between 1929 and 1999, over 1500 papers were presented at Division meetings. At the annual programs, the number of papers ranged from 8 to 54 with an average of about 29 (Figure 1). Approximately 50 % of the papers were presented by industrial representatives, 16 % came from state laboratories and universities, 22 % from the Tennessee Valley Authority, and 11 % from the U. S. Department of Agriculture and other federal agencies during the period 1940 to 1994. The first papers from TVA were presented in 1940 and the agency remained a consistent contributor until 1994.[8] Between 1960 and 1996, ten TVA chemical engineers and one research chemist served as chairmen of the Division (Table 1). A complete list of chairmen from 1909 to 2000 is given in Table 2.

TVA carried out fertilizer research and development for about 60 years at the old U. S. Nitrate Plant No. 2 at Muscle Shoals. When the U. S. Congress established TVA in 1933, the new agency was given the idle nitrate plants and laboratories at Muscle Shoals (built by the U. S. Army during World War 1) and instructed to use them for fertilizer research in peacetime and for the production of munitions in wartime.

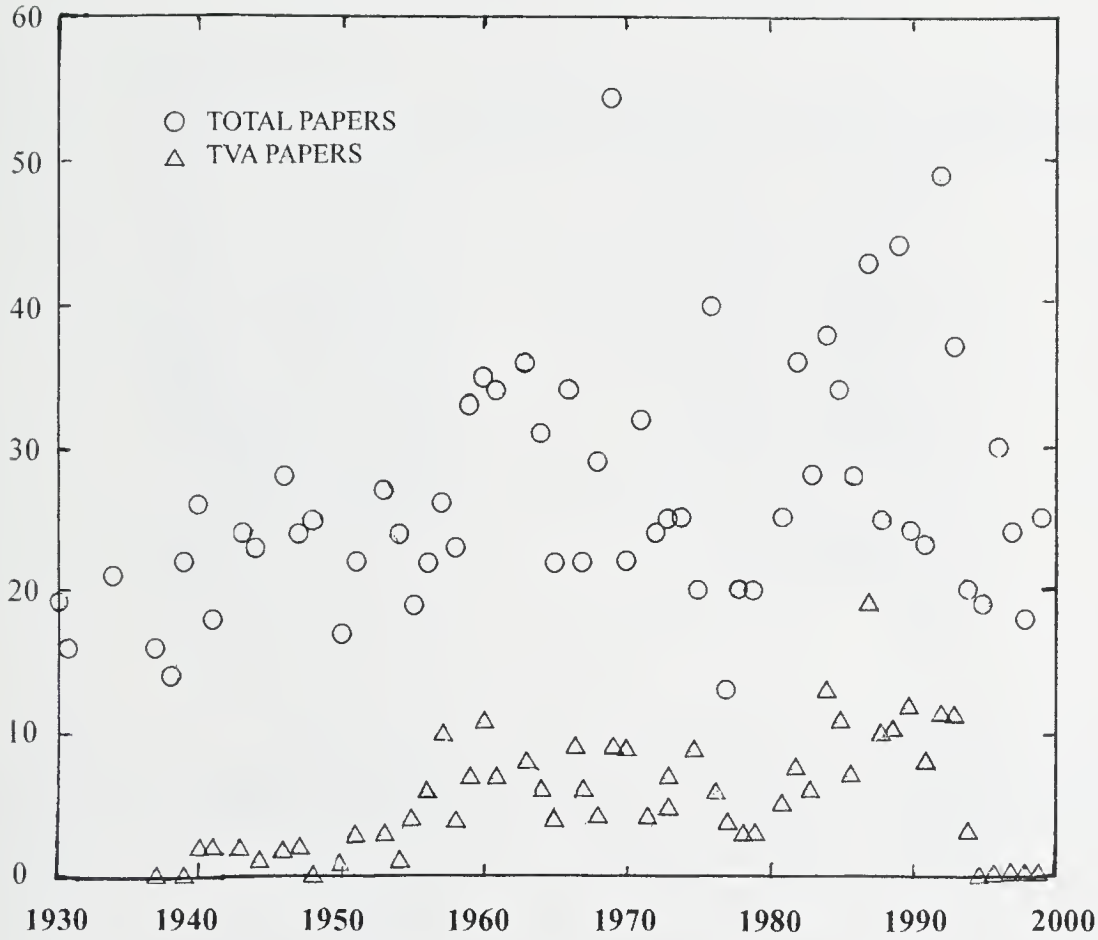

Figure 1. Papers presented between 1029 and 1999.

Table 1. Division of Fertilizer and Soil Chemistry Chairmen From Alabama

Year	Chairman	Title
1960	Travis P. Hignett, TVA	Chemical Engineer
1966	Alvin B. Phillips, TVA	Chemical Engineer
1969	Archie V. Slack, TVA	Chemical Engineer
1973	Charles H. Davis, TVA	Chemical Engineer
1975	John G. Getsinger, TVA	Chemical Engineer
1978	Zachary T. Wakefield, TVA	Research Chemist
1981	John M. Stinson, TVA	Chemical Engineer
1985	Horace C. Mann, Jr., TVA	Chemical Engineer
1988	Hubert L. Balay, TVA	Chemical Engineer
1991	David G. Salladay, TVA	Chemical Engineer
1996-1997	Carl A. Cole, TVA	Chemical Engineer
1998-1999	A. Michael Huey Applied Chemical Technology Florence, Alabama	Chemical Engineer

Table 2. ACS Division of Fertilizer and Soil Chemistry Chairmen 1909--2000

Year	Chairman
1909-1910	Frank B. Carpenter
1911-1913	Paul Rudnick
1913-1918	John E. Breckenridge
1919-1927	Frank B. Carpenter
1928-1939	Egbert W. Magruder
1940-1946	Herman B. Siems
1947	Charles A. Butt
1948-1949	Jackson B. Hester
1950-1951	Vincent Sauchelli
1952	Samuel F. Thornton
1953	Arnon L. Mehring
1954	J. D. Romaine
1955	G. H. Serviss
1956	Grover L. Bridger
1957	Stacy B. Randle
1958	K. G. Clark
1959	M. D. Sanders
1960	Travis P. Hignett
1961	John O. Hardesty
1962	Lawrence B. Hein
1963	David R. Boylan
1964	W. J. Tucker
1965	William J. Hanna
1966	Alvin B. Phillips
1967	Charles E. Waters
1968	F. J. L. Miller
1969	Archie V. Slack
1970	George Burnet
1971	Richard L. Gilbert
1972	D. W. Bixby
1973	Charles H. Davis
1974	John T. Hays
1975	John G. Getsinger
1976	Maurice A. Larson
1977	Franklin A. Retzke
1978	Zachary T. Wakefield
1979	Kenneth L. Park
1980	John B. Sardisco
1981	John M. Stinson
1982	Donald P. Day
1983	Herb C. MacKinnon
1984	Larry W. Bierman

(Table 2 continued)

1985	Horace C. Mann, Jr.
1986	Charles W. Weston
1987	John D. Jernigan
1988	Hubert L. Balay
1989	Mabry M. Handley
1990	Joe Novotny
1991	David G. Salladay
1992-1993	William E. Fair
1994-1995	R. J. Timmons
1996-1997	Carl A. Cole
1998-1999	A. Michael Huey
2000	Eric J. Lohry

Many of the Division papers were later published in the chemical literature, particularly in Industrial and Engineering Chemistry and the Journal of Agricultural and Food Chemistry. Unfortunately, the Division did not preserve its early records or collect copies of the papers that were presented. As a result, it is often difficult or even impossible to obtain a copy of an unpublished paper presented before 1976. For example, papers on the history of the Division were presented in 1958 by Walter MacIntire and again in 1974 by G. L. Bridger but the manuscripts are unavailable today. From 1978 to about 1994, copies of all papers were collected and filed in TVA's Technical Library at Muscle Shoals along with the Division's other records. In recent years, the collection of papers was given to the International Fertilizer Development Center, Muscle Shoals, Alabama.

Social activities of the Division over the years included a luncheon featuring a prominent speaker and recognition of past chairmen, a breakfast for officers and speakers, and a mixer for members and guests held in the Division's hospitality suite. The luncheon was discontinued in 1978 and the speakers breakfast was begun at that time.

The name of the Division of Fertilizer Chemistry was changed to the Division of Fertilizer and Soil Chemistry in 1952 because it was recognized that fertilizer chemistry in its broader aspects goes far beyond the reactions within fertilizer mixtures. The chemistry of the soil, the chemical content and physical characteristics of food, feed, and fiber are all closely related to and affected by the use of fertilizer. Because fertilizer chemistry and agronomy go hand-in-hand, it was felt desirable to increase the role of agronomists and soil scientists in the Division.

In 1978 the Division established a Merit Award of $1000 and a suitable plaque to honor certain living individuals for their outstanding contributions to fertilizer science and technology. The first award was made in 1980 to Travis P. Hignett, retired director of chemical development at TVA and then a consultant for the International Fertilizer Development Center. During his career at TVA, which began in 1938, Hignett personally suggested, guided, and patented several key fertilizer processes. A native of Iowa, Hignett received his A. B. degree in chemistry from Drake University and worked briefly for the Fixed Nitrogen Research Laboratory of the U. S. Department of Agriculture before joining TVA. In

1960, he became the first TVA scientist to serve as chairman of the Division of Fertilizer and Soil Chemistry.[9]

The second Merit Award was presented to Francis T. Nielsson in 1983. Mr. Nielsson, a 1935 graduate of Syracuse University, had more than 40 years of experience in production supervision, research and development, and technical consulting in the field of fertilizer materials, products, equipment, and process design. He invented the well-known TVA continuous ammoniator-granulator and received several other fertilizer-related patents. He worked for TVA from 1938 to 1943 and again from 1947 to 1953. Nielsson retired in 1982 as the senior consulting engineer for New Wales Chemicals, Inc., a subsidiary of International Minerals Corporation.

In 1987, David R. Boylan, dean of the college of engineering and director of engineering research at Iowa State University, received the third Merit Award. Dr. Boylan was recognized for his program in fertilizer technology at Iowa State which produced many notable achievements and trained numerous graduates who also distinguished themselves in this field. He received his B. S. and Ph. D. degrees in chemical engineering from the University of Kansas and Iowa State University, respectively, and he served as chairman of the Division of Fertilizer and Soil Chemistry in 1983.

From 1981 to 1987 the Division used a two-way telephone network to transmit its national meetings to Muscle Shoals, Alabama. It was the first division to do this. The idea of teleconferencing was proposed by Dan Norman, a TVA analytical chemist and past chairman of the Wilson Section of the ACS. He was assisted by Darrell A. Russel, also of TVA, with TVA providing the telephone service and meeting facilities at Muscle Shoals. The Alabamians were not only able to hear what was being said at the meetings but could also ask questions of the speakers and make comments on the presentations. Duplicate slides were delivered to Muscle Shoals in advance so that the Alabama group could see the illustrations along with their colleagues at the national meeting.[10]

Most of the Alabamians were employees of TVA's National Fertilizer Development Center. Others came from the International Fertilizer Development Center and from commercial fertilizer plants in the Muscle Shoals area. Seventy-four people attended the 1981 sessions in Muscle Shoals and the total cost of the teleconference was estimated to be less than the cost to send one person to New York for the meeting.[11] The teleconference was very successful for several years but it was discontinued after 1987 because of decreasing attendance at Muscle Shoals. Meanwhile, other ACS groups became interested in the technique, and teleconferencing began to be used fairly extensively for courses and meetings.

In the 1990's, the Division was faced with decreasing membership and difficulty in finding people willing to serve as officers and committee chairmen. Furthermore, program chairmen were forced to actively seek out speakers to contribute papers to the annual meetings. This decline was due primarily to the loss of support from TVA and major changes occurring in the fertilizer industry.

Consequently, the members of the Division of Fertilizer and Soil Chemistry voted in 1999 to merge with the much larger Division of Agrochemicals as a Subdivision. That Division had similar programs and activities and it welcomed the fertilizer people "with open arms." In August 2000, the final meeting of the Division of Fertilizer and Soil Chemistry was held in Washington, D.C. It featured a symposium on environmental issues entitled "Fertilizers Under Siege." Now, in 2004, the Subdivision is rebuilding its membership and developing strong programs for future ACS meetings. Joint symposia are being organized with other Divisions which will bring new ideas to the Subdivision.

In conclusion, it is apparent that the Division of Fertilizer and Soil Chemistry

contributed much to the tremendous progress that was made in the agrochemical industry during its 91-year lifetime. The Division achieved this by providing a forum in which problems could be discussed and new developments shared with other fertilizer and soil specialists. As predicted by Frank Carpenter in his inaugural address back in 1909, the Division's programs and activities have indeed led to a better appreciation of the value of fertilizers and to a better understanding of their function.

LITERATURE CITED

1. "Division of Fertilizer Chemists," Journal of Industrial and Engineering Chemistry 1, 130 (1909); F. S. Lodge, "Fertilizer Chemistry," Industrial and Engineering Chemistry 43, 311-314 (1951); Charles A. Browne and Mary E. Weeks, A History of the American Chemical Society (Washington, D. C.: 1952), 269-270.

2. "Division of Fertilizer Chemistry," Journal of the American Chemical Society 31, 25-26 (1909); "Division of Fertilizer Chemists," Journal of Industrial and Engineering Chemistry 2, 70-72 (1910).

3. F. B. Carpenter, "The Fertilizer Industry--An Historical Sketch," American Fertilizer 30, 5-9 (April 1909).

4. J. M. Cattell and J. Cattell, American Men of Science (Fifth Edition, 1933), 178-179; Wyndham D. Miles and Robert F. Gould, American Chemists and Chemical Engineers, Vol. 2, (Guilford, CT: 1994), 40.

5. See Commercial Fertilizer 24, 33 (#6, July 1922) for portraits of Carpenter and Magruder and The Fertilizer Review 18, 12 (#4, October-November-December 1943) for Siems' portrait.

6. F. S. Lodge, "Division of Fertilizer Chemistry of the American Chemical Society," Industrial and Engineering Chemistry, News Edition, 17, 228-230 (April 10, 1939).

7. "Outline of the Work Being Carried on by the Fertilizer Division of the American Chemical Society," Commercial Fertilizer 3, 30L-30M (August 1911); "Determination of Nitrogen in Commercial Ammoniates of High Nitrogen Content," Journal of Industrial and Engineering Chemistry 3, 691-699 (1911).

8. Abstracts of Meetings, 1938-2000 (American Chemical Society, Washington, D.C.).

9. "Awards," Chemical and Engineering News 56, 46 (Aug. 18, 1980).

10. "Telephone Link Brings ACS Fertilizer Sessions to Muscle Shoals Audience," Chemical and Engineering News 59, 61 (Sept. 7, 1981).

11. "Teleconference--New York to Muscle Shoals," NFDC News (Tennessee Valley Authority: December 1981), 7.

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ENGLISH STUDIES AND BIOTECHNOLOGY: APPLICATIONS OF LANGUAGE THEORY TO GENETIC RESEARCH

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With the publication of the 2000 and 2003 genome "drafts," the Human Genome Project (HGP) was propelled onto the world stage as a major advancement in biological research, garnering hyperbolic praise from major world leaders like President Bill Clinton who proclaimed, "we are learning the language in which God created life" ("Remarks, 2000). President Clinton's words echo a long history of comparison between the genome and some form of text: terms such as "code," "language," and "book" abound. As Lily Kay chronicles in *Who Wrote the Book of Life? A History of the Genetic Code* (2000), such metaphors have been around roughly since Watson and Crick's discovery of the double helix. Furthermore, these characterizations carry more than a metaphorical understanding; they create the epistemological framework within which much genetic research is pursued. Matt Ridley explains, "The idea of the genome as a book in not, strictly speaking, even a metaphor. It is literally true" (1999, p. 7). This textual "metaphor" is more than simply a way of explaining the genome to non-scientists; it has become an increasingly influential paradigm for understanding the genome, guiding research agendas and knowledge formation within biological and biotechnological sciences.

The textual metaphor is demonstrated rather simplisticly in Figure 1, a graphic representation of the genome produced by the U.S. Department of Energy as part of its educational materials about the HGP (2003). The graphic illustrates the genome's location within cells and its role in protein production. In this model, information is transferred—rather directly—from the genome to proteins; one-directional arrows represent the place where this process of translation happens. Viewed through the lens of English studies, those arrows also represent the space where "meaning-making" happens, where the text becomes active through reading, then the reading produces some sort of new phenomenon. In the case of traditional texts like books, this "meaning-making" occurs when readers read and comprehend a text. Within cells, "meaning-making" happens when the genome is read and proteins are produced.

Viewing the genome through this lens raises a series of unanswered questions. Figure 1 obscures a major component of the "genome-as-book" paradigm because it does not explain *how* the genome is read and comprehended: who or what "reads" it? How is it comprehended? How is it enacted? Figure 1 replaces the reader with a series of arrows on a black background, rendering invisible both the process of translation leading to proteins and the agent who

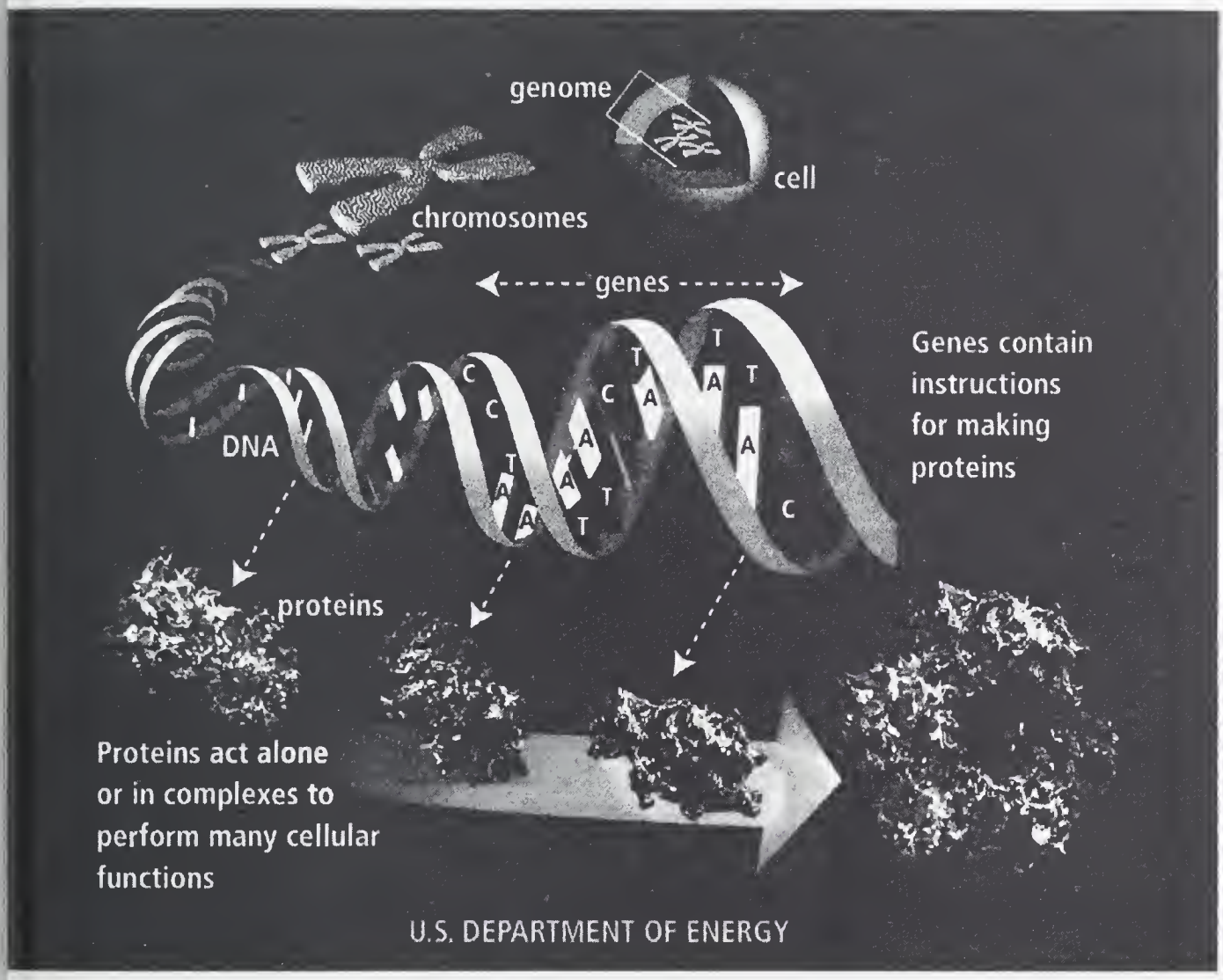

Figure 1. From Genes to Proteins
Source: U.S. Department of Energy, Office of Science. (2004, October 27).

performs this translation. Emerging biological fields like proteomics are researching questions about the interactivity of the genome with other cellular components, particularly in the process of protein production, attempting to locate the processes by which proteins are expressed. English studies has been theorizing and researching the interaction between texts and readers for much of the 20th century and can contribute multiple perspectives on this process, including metaphorical models of reading and comprehension practices.

Furthermore, the graphic states that "Genes contain instructions for making proteins," echoing another assumption within much 20th century biological research (Kay, 2000; Doyle,

1997) by implying a one-to-one correlation between genomic information and protein production. In this paradigm, genes contain all the necessary information to produce proteins, without any intervention from other biological components, environmental factors, or epigenetic concerns. Many biologists and ethicists have criticized this model of genomic functionality as overly deterministic because in its extreme, such a model implies that living beings are solely the makeup of their genetic structure. Much of this determinism results from a view of texts themselves as overly deterministic. Most late 20th century theories within English studies assert a less positivistic role for language: the comprehension of texts is highly influenced by factors such as cultural and social conditions, historical time period, and readers' own assumptions and expectations. Reading and comprehension is situated among many complex factors surrounding the text and the reader, a concept aptly applied to the genome-as-text metaphor. Expanded models of textuality may allow scientists to re-envision the genome not as a deterministic instruction book, but rather as a fluid set of guidelines for the construction of life which are enacted according to an ever changing cellular ecology.

Figure 1's confusing oversimplification of genomic functionality represents just one of many places where biotechnological research and English studies overlap. Because of the genome's persistent connection to textuality through metaphors like "genome-as-book," biotechnology is a subject of inquiry appropriate to English studies. Furthermore, the graphic highlights the need for education about the genome and its ensuing biotechnological applications among the general public, a term often referred to as "genetic literacy" (McInerney, 2002). The teaching of literacy has traditionally been a major preoccupation of English departments, and its scholars can contribute greatly to this conversation.

The following two discussions demonstrate that such inquiry is fact mandated in the face of biotechnology's growing influence on science, economics, and culture. The first will connect the incommensurability of metaphor in philosophical and social applications of biotechnology, particularly those based in genetic research. The second will apply principles of visual rhetoric and literary-rhetorical interpretation to describe the complexity of the genome's textual components. Both discussions highlight the use of literary and rhetorical concepts like figurative language, discursive paradigm, textual design, and ethical persuasion by genetic scientists and scholars. Most importantly, they explore ways that the fields of biology and English studies are poised to create a useful and stimulating collaboration, leading to increased genetic literacy, broader scientific advancement, and more efficacious public policy.

INCOMMENSURABILITY AND THE NEED FOR A COMMON LANGUAGE IN THE PUBLIC POLICY DEBATE ABOUT BIOTECHNOLOGY

Discussions about the human genome are characterized by a rich use of metaphoric language—the "book of life" metaphor has been used to describe the human genome since long before it was decoded. It would seem logical, then, that the same type of rich, consistent metaphor would be used to describe other genome-related technologies. This, however, is not the case. The field of genetic engineering, particularly stem cell research, human germline engineering, and cloning, is characterized by a sparse and inconsistent use of metaphor. Furthermore, there are two distinctive discourse communities writing about the myriad of ethical and public policy issues surrounding genetic engineering, creating a sense of incommensurability. Scientists and ethicists have failed to create what Thomas Kuhn, famous author of *The Structure of Scientific Revolutions*, calls a "shared lexical taxonomy" (Kuhn, 1997, p. 3). Thus, it will be the job of scientists, rhetoricians, and teachers to frame a plan for

genetic literacy that resolves this metaphoric ambiguity and creates a public language with which to debate the issues surrounding the paradigm shift that is occurring in science and in society because of the advances in biotechnology.

Two Discourse Paradigms

There are many publications that deal with the ethical and social issues related to biotechnological advances such as cloning. Yet, there seem to be two distinctive discourse communities that are writing the majority of these documents—what could be broadly characterized as scientists and philosophers. In addition, the preponderance of the writing is academically based; in English studies, the term "lexical taxonomy" is used to describe this phenomenon.

A lexical taxonomy is the system of language and the conceptual framework of any given discourse community—maybe we could even describe it as the set of jargon we use that makes us a member of our own discipline community. Lexical taxonomies are, of course, an integral part of specialization. Therefore, they are quite useful within the context of each discipline. They provide a way that members of each community can have a conversation about specialized issues that are many times irrelevant to those outside of their specific community. However, this is not the case when dealing with biotechnology. Not only do the scientists and philosophers need to understand each other, but what they are doing needs to be understandable by others—particularly society and public policymakers.

Scientists who work with the ethics of genetic engineering are incredibly concerned that the process of the science be understood (Shostak, 2000; McLaren, 2001). Because of this concern, the writing is detail-oriented, and a non-scientific reader can become overwhelmed by the amount and complexity of the information presented. For example, Stanley Shostak, an Associate Professor of Biological Sciences at the University of Pittsburgh, defines cloning in this way:

> In the final analysis, a mammalian clone begins as a nuclear/cytoplasmic chimera, sharing its nuclear genes with the organism donating the original nucleus, but is otherwise unique, and certainly not a member of a population of identical twins (2002, p. 167).

While it is certainly accurate, this kind of detail is usually unnecessary in a public policy debate on genetic engineering, and the lexicon used will most likely alienate a large portion of non-scientific readers.

On the other hand, philosophers, as well as ethicists and theologians, are writing using a lexical taxonomy that also has the potential to alienate readers. Cynthia S. W. Crysdale, in her 2002 address to the Canadian Theological Society, talked about boundary crossing and reproductive cloning. One of her major points is as follows:

> ...the boundary of creaturehood must never be forgotten. The aspiration of the human spirit must be allowed to thrive, and any roles, identities, or boundaries that prejudicially hamper such eros need to be challenged. But aspiration is not attainment, and we forget our finitude to our peril. Any boundary crossing that pretends omnipotence is doomed to end with dominance and, no matter how well intentioned, violence (2002, p. 397).

Many of these terms are discipline-specific and rely on knowledge of abstract principles and concepts. Additionally, many secular ethical discussions are based in academic concepts not familiar to the general reader. Glenn McGee, in a short essay written for *Engineering the Human Germline*, states:

> Elsewhere I argue that theories of "genetic progress" and dystopian analyses of genetic downfall are almost always predicated on a Luddite refusal to analyze the distinctions between technology and nature with rigor and care (2000, p. 100).

Terms such as "dystopian analyses" and "Luddite refusal" create a disconnect for the reader just as profound as that produced by intensely scientific language or intensely theological language. All three of these examples display language that is wholly unrealistic in the public policy arena because society and the policymakers elected by those in society are non-specialist readers.

In addition, discussions of public policy related to controversial biotechnologies lack the metaphorical framework present in the scientific descriptions of the human genome. Timothy D. Giles (2001), in an article titled "The Missing Metaphor," concludes that there is no central metaphor in articles about cloning. His research supports our own findings—references to "playing God" (Stock, 2002, p. 131) and defining cloning as making a "facsimile" (Shostak, 2002, p. 11) were the most common. The problem with these metaphors is that they do little in the way of explanation. "Playing God" explains nothing concrete about the process of cloning, but rather is a judgment, and to say that cloning creates a "facsimile" is inaccurate because it fails to take into account the many environmental factors that influence the manifestation of genotype. Stem cell metaphors were equally as sparse, and were usually computer metaphors—"reprogramming faulty genes" (McLaren, 2001, p. 131) is one example. The computer metaphors used for stem cell research are more accurate, but the sparse and inconsistent use of such metaphoric language makes it almost irrelevant. John Campbell and Gregory Stock envision human germline engineering in term of docking sites for "cassettes" that can be plugged in and played (2000, p. 15). The concept of "cassettes" (or even CDs) as a metaphor for how scientists will insert new genes into the human germline is promising, but the idea of germline engineering is so new, it is too early to tell if the metaphor and the science will ultimately be compatible or if this metaphorical concept will create the necessary conceptual framework for further advancement.

Paradigm Shifts and Incommensurability

The presence of different lexical taxonomies and the sparse, inconsistent use of metaphoric language in discussions about genetic engineering create a sense of incommensurability, which results from the lack of a shared lexical taxonomy.

Thomas Kuhn wrote *The Structure of Scientific Revolutions* in 1962 to explain the history of science, and the central theme of that book was to explain the continual advancement of scientific knowledge in terms of what he called paradigm shifts. As scientists discover not only how to "read" the human genome but also how to manipulate it through assisted reproductive technologies, human germline engineering, the use of stem cells to treat disease, and cloning, two paradigm shifts are occurring simultaneously. First of all, the field of science is rapidly creating new sub-disciplines to accommodate these advances, and every level of biology is adjusting to the new information being discovered. Therefore, the biological sciences are experiencing a traditional Kuhnian paradigm shift (Strohman, 1997). In addition, however, the global society is experiencing a paradigm shift in order to redefine the boundaries of what it means to be human.

Incommensurability is a common feature of paradigm shifts, according to Maurice Charland (2003), because as change occurs, the existing systems of communication become confused and irrelevant. Incommensurability, as defined by Kuhn, is "a sort of untranslatability, localized to one or another area in which lexical taxonomies differ" (1997, p. 233). And although Kuhn addresses incommensurability from a historical perspective, the

concept applies very well to the competing discourses described earlier. He asserts, "If different speech communities have taxonomies that differ...then members of one of them can...make statements that, though fully meaningful within that speech community, cannot in principle be articulated by members of the other" (1997, p. 233). Therefore, it is imperative that these speech communities develop the means to communicate now because incommensurability creates misunderstanding.

Incommensurability, Public Policy, And The Shared Lexical Taxonomy

With each new advance, incommensurability is also an issue because the science of biotechnology has societal and public policy implications beyond the simple issues of the science itself. Regardless of an author's ethical position on the issues related to cloning and stem cell research, there is little debate over where the science itself is headed. For example, Francis Fukuyama (2002) and Gregory Stock (2002), two well-known representatives of both sides of the debate, do not disagree that we will have the capabilities to modify the human germline or clone ourselves. Therefore, what we are left with is not a debate about science, but about what we are going to do with the science. Ultimately, we as a global society are going to have wrestle with issues of use and regulation of use, in addition to adjusting our answer to the question: What does it mean to be human?

Consequently, these questions are not necessarily best addressed by the scientists who do the research, but by rhetoricians who will remedy the existing incommensurability by becoming translators to society and to public policymakers who are wrestling with the implications of a massive paradigm shift resulting from advances in biotechnology. According to Kuhn, "[s]hared taxonomic categories...are prerequisite to unproblematic communication...." (1997, p. 233). Given the public policy implications of genetic engineering, it is imperative that we find a common language, a shared lexical taxonomy, with which to engage in the debate.

The Genetic Literacy Plan: A Proposal For The Future

Finally, it will be the job of scientists, rhetoricians, and teachers to frame a plan for genetic literacy to remedy the apparent incommensurability in the debate about genetic engineering. The following are some key components to this literacy agenda.

First, although scientists approaching the ethical issues related to genetic engineering are often too academic and detail-oriented, they still have an obviously important role to play in creating genetic literacy. Scientists have traditionally shied away from involvement in ethical issues, arguing that what they do is somehow objective or neutral. And some may even feel that the objection to their work raised by ethicists is too heavily based on systems of thought that are not empirical. But it is unrealistic to believe that what biotechnologists do inside a lab is somehow outside of the public realm, especially since what happens inside the lab involves issues so integral to our view of ourselves as humans.

"Among nonscientists, there is a widespread feeling that it doesn't pay to be too curious about such matters, that science is something of a closed community, not readily penetrated" (Brown, 2003, p. 1). Therefore, it is important to begin genetic literacy with an emphasis on the science, because accurate understanding of the science is necessary before we can engage in a meaningful debate on the ethical issues involved. To begin to overcome these boundaries, scientists need to first of all be aware that their research in this area has societal implications, and then they need to develop working relationships with the ethicists and rhetoricians who write for the general public about their work.

Rhetoricians will act as translators not only for the science, but for the complex philosophical issues raised by biotechnology advances. And rhetoricians are uniquely qualified to do this. First of all, in English studies, rhetoricians and technical writers are often

asked to write about issues on which they are not subject matter experts. Their expertise is communication through language, and their job, then, is to make specific and often complex subject matter understandable to whatever audience they are addressing. Therefore, they are specially trained to act as translators of complex information. Secondly, rhetoricians are also trained to approach individual situations in the context of current society and culture. By realistically culturally contextualizing each situation, they avoid the rigid definition of absolute truth that dominates many ethical discussions on genetic engineering. Lastly, the debate itself needs to be divided into manageable categories. For instance, instead of just talking about cloning, we should differentiate between therapeutic cloning and cloning to create "designer babies;" instead of just talking about stem cell research, we should differentiate between embryonic stem cell research and somatic stem cell research. By discussing these issues individually, rhetoricians will move away from a universal, "all or nothing" view of genetic engineering and into a realistic discourse about the science and its possible implications for society and public policy.

Third, teachers will be necessary in creating genetic literacy because it is their job to educate the next generation about the realities of the science and the ethical issues involved. In addition to traditional science education, which focuses on science as a solitary field and is taught through rote memorization, teachers should begin to contextualize advances. As Theodore Brown recognizes:

> The way in which science is taught in school has a lot of to do with students' understanding not only of the content of science but of how science compares with other forms of knowledge. It helps to shape their comprehension of science as a social and intellectual endeavor within the larger framework of modern society (2003, p. 2).

Fortunately, this work has begun at all levels. The U.S. Department of Energy sponsors a web site about the Human Genome Project (2003), and a major section of this site is devoted to education. And in addition to an approach that singles out science education, teachers and instructors in other disciplines can play a key role in biotechnology education by creating interdisciplinary curriculums that allow students to become familiar with the science and ethical issues of biotechnology. Ultimately, the goal of better education about biotechnology is for the students to develop into active, educated citizens and participants in the public policy debate over the implications of genetic engineering advances.

A shared lexical taxonomy is necessary for a literacy agenda to be successful, and one component of this is the common, consistent, accurate use of metaphor. Although traditionally defined as "a form of trope, the use of a word or phrase in a figurative sense" (Brown, 2003, p. 15), Peter Trudinger and Norman Habel echo the assertions of Theodore Brown, the author of *Making Truth: Metaphor in Science*, by expanding that definition to include not only metaphoric use, but function. They write:

> A metaphor is a powerful device. It joins together elements that are not customarily combined and in doing so invites the reader to reenvision their understanding of those elements (2003-2004, p. 6).

Metaphor, then, is more than just a literary device. It is a tool of communication, contextualization, and even conceptualization. In a simplistic way, metaphor provides a framework for understanding. It relates an unfamiliar concept to a familiar concept. The human genome as the "book of life" is an excellent example of this. Books are a familiar concept, and by talking about the complexities of DNA in terms of a book, it becomes accessible to non-scientists. Also, metaphor is "one of the primary conduits through which ideas are communicated within scientific communities as well as across boundaries separating

disciplines" (Lewis, 1999, p. 112). Crossing boundaries between disciplines is necessary to creating genetic literacy. Therefore, metaphor is an indispensable tool for communicating to non-specialists and for communicating across specialization boundaries. Finally, metaphor development is an essential tool in creating genetic literacy not only because it is a tool for communication and contextualization, but because the effective use of metaphor can provide the framework for scientists and scholars in other disciplines to develop new theories and ideas.

Biotechnology presents unique issues both scientifically and philosophically. Currently, the issues are primarily addressed at an academic level, and the type of language used in academic discourse is quite often not useful in public policy debates. However, the creation of a shared lexical taxonomy will provide society and policymakers with a language they can understand and give them the information they need to debate the issues surrounding biotechnology. Therefore, scientists, teachers, and rhetoricians need a plan to promote genetic literacy. Fields such as English studies have an integral role to play in this proposed plan because English studies scholars can provide research into the epistemological approaches to figurative language. The ultimate goal is to make sure that those who either approve of or object to biotechnology advances are doing so based on accurate information.

CREATING DNA LITERACY: ENGLISH STUDIES AND THE HUMAN GENOME PROJECT

As the previous section illustrates, scientists and society must develop genetic literacy in order to make accurate public policy decisions about biotechnological advancements. Furthermore, DNA literacy must be considered as an integral addition to Ms. Childs' discussion. The HGP has begun to address DNA literacy; however, before diseases caused by genetic defects and disorders can be cured (a priority of the HGP), the human genome must be read and understood. Scientists must recognize the context in which certain genes work and apply meaning to the medical advancements like stem cell research, human cloning, and in-vitro fertilization which are a few of the overall expectations of the project. In turn, our society must become DNA literate to fully understand these implications and advancements so that our decisions are based upon the best possible information produced by the HGP. The skill of reading and understanding genomics will allow policy makers, scholars, and educators, as non-scientists, to participate in conversations that were once left only to geneticists and biologists.

DNA literacy will create a more informed, more confident society, members of which are able to enter the public policy debates surrounding the double helix. We cannot access this knowledge until we develop a translation of the science for the non-scientific world. This translation can be achieved with the application of English studies to the HGP, even though the two areas appear to be polar opposites. English studies scholars and rhetoricians will aid in the creation of DNA literacy by introducing theoretical examples of metaphor, language, and contextuality to the conversation. When applied to the HGP, these examples will translate DNA and genetic processes for non-scientists, as well as provide a shared lexical taxonomy for scientists and public policy makers.

Genetic Language

The application of metaphors of language and English studies to the human genome has been common throughout time. Deciphering these metaphors necessitates an understanding of the "genetic language" that Stephanie Suhr (2001) explains Vadim A. Ratner introduced in his genetic work (p. 53). By studying the linguistic properties of genetics,

Ratner began the analogy that has overwhelmed the genetic world. Suhr (2001) writes that "Ratner defined 'genetic language' as a language of polynucleotides from a language of polypetides. This division he compared with the dichotomy between spoken and written language" (p. 53). This "genetic language" is an integral component of DNA literacy because it allows scientists and others involved in the genomic field, as well as nonscientific community members, to visualize DNA, proteins, and amino acids as active, tangible texts other than allusive microscopic cells.

Matt Ridley (1999) introduces the human genome as an autobiographical text that can be read. This metaphor – "reading the book of life" – is familiar to the scientific world, but Ridley expands the literary device in great detail. He prefaces his argument by saying:

> A book is a piece of digital information, written in linear, one-dimensional and one-directional form and defined by a code that transliterates a small alphabet of signs into a large lexicon of meanings through the order of their groupings. So is a genome. The only complication is that all English books read from left to right, whereas some parts of the genome read from left to right, and some from right to left, though never both at the same time. (Ridley 1999, pp. 6-7)

Ridley's statement establishes the validity of the metaphor of the genome as a book; in addition to this metaphor, he continues to apply literary devices to science by using traditional English grammar and syntax styles. Ridley deconstructs the human genome in the following way:

- There are twenty-three chapters, called CHROMOSOMES.
- Each chapter contains several thousand stories, called GENES.
- Each story is made up of paragraphs, called EXONS, which are interrupted by advertisements called INTRONS.
- Each paragraph is made up of words, called CODONS.
- Each word is written in letters called BASES. (Ridley, 1999, p. 6)

Using, Ridley's deconstruction of the human genome, scientists, biotechnology experts, and others interested in genomics can envision a literary model that explains the composition of the human genome. Such a model adds another tool for the project of genetic literacy, one that creates a flexible framework around which English studies can supply literary, textual, and cultural theories.

As new advancements occur each day in genetics, biotechnology, and the human genome, scientists can apply aspects of English studies to their work; these applications begin simply within the genome when mRNA "reads" DNA and creates a copy (transcription). This process produces amino acids and proteins when, as Hawley and Mori (1999) state, "the rules by which the base sequence of the mRNA molecule is translated into the primary amino acid sequence of a protein are referred to as the *genetic code*" (p. 31). The authors continue to explain that translation occurs as ribosomes read the three letter codons formed by mRNA nucleotides (Hawley and Mori, 1999, p. 32). After studying the transcription process, scientists are able to read the codons, like the ribosomes, and recognize the amino acids and proteins that form our genes. However, their work is not finished. Like an English major reading T.S. Eliot's *The Wasteland*, scientists must understand individual words, paragraphs, and stories before they can decipher the meaning of each chromosome or chapter. Then, again like the English major, they must combine these parts to understand the whole, even though some sections may appear insignificant or incomprehensible.

Contextualization

As literary scholars and experts have known for centuries, content and context are equally important to any text; this importance is relative to the work of the HGP because scientists have recognized that a "word" or three base combination is significant not only in orthography but also in context with other codons in the DNA paragraph. Hawley and Mori (1999) explain how codons represent messages for other amino acids in their explanation of translation, which usually begins at the first *start codon* (AUG) encountered by the ribosome, connecting the corresponding amino acid to that codon; the ribosome continues to read the mRNA until it meets a *stop codon* (UAA, UGA, or UAG), called that because these codons do not represent amino acids and signal the ribosome to stop reading (p. 32). As *start* and *stop codons* are recognized throughout a DNA sequence, their placement (or context) becomes necessarily important because of their signals. In other words, when the two codon types are read relatively close to each other, this signals to scientists that the gene is small compared to other longer genes that may be found on larger chromosomes such as Chromosome 1.

The placement of codons creates contextuality within a portion of DNA, depending on the words that surround them to create their own meanings. Often, the contextuality of such words depends upon the effect of mutation on a gene. Genetic defects are caused when RNA fails to replicate the correct structure of DNA for a new cell. Simply put, a failure to accurately typeset the bases (A, G, T, and C) into codons, or three-letter genetic words, onto the page of the double helix creates a misreading – a "typo" or error that, until now, remained unfixable. However, scientists believe that these errors can be remedied through the process of genetic editing. Although, "by imagining genetics as 'mere' code, this metaphor cut loose a series of 'editing' metaphors that imagined change in our fundamental material being as a process little more demanding than a type-over," the application of editing – which English studies scholars have used for centuries – creates a metaphor for genetic mutations that may, shortly into the future, be a reality (Condit, 2001, p. 14).

As English scholars recognize contextual details within literary texts, we understand that surrounding words, paragraphs, and scenes affect each other. Mutations, read in the context of surrounding codons, are known to create genetic defects. In the instance of Huntington's disease, the codons are contextualized by the number of repetitions which determine who will be afflicted with this disease. The number of CAG codons within Chromosome 4 determines a person's fate; "[i]f the 'word' is repeated thirty-five times or fewer, you will be fine. Most of us have about ten to fifteen repeats. If the 'word' is repeated thirty-nine times or more, you will in mid-life slowly start to lose your balance, grow steadily more incapable of looking after yourself, and die prematurely" (Ridley, 1999, p. 55). In the human genome, contextual details matter in a way similar to how English studies scholars understand correlations between scenes and words. If the chapters of *Wuthering Heights* were rearranged or Edgar Allen Poe had not repeated the word "knocking" in his poem, *The Raven*, literary scholarship would have followed a different path. If the CAG codons were read in a different order or the extra words were not included in the reading, Huntington's disease would not affect hundreds of thousands each year.

White Space

Literary and rhetorical metaphors continue to surface in the science of the genome. The discovery of "junk DNA" – what Ridley (1999) describes as "a jumble of repetitive or random sequences that is rarely or never transcribed" – has introduced yet another example of how English studies can be applied to the human genome (p. 9). These areas are no longer considered to be "junk:" "[g]enes comprise only about 2% of the human genome; the

remainder consists of noncoding regions, whose functions may include providing chromosomal structural integrity and regulating where, when, and in what quantity proteins are made" (*The Science*). These noncoding regions can be considered to be as integral to the text of the genome as the white space surrounding poetry or technical documents.

In creative writing, authors carefully place their text on the page, paying close attention to the shape of the type on the blank page; the space left untouched by text is referred to as white space. Authors utilize this space as a cue for their readers: a small amount of text surrounded by a large white space might signify the importance of the lines; a large amount of text with very little white space might signify the urgency of the scene – the author may use few line breaks in this instance to resemble stream-of-consciousness thinking. Technical writers apply the same theories to their work by "chunking" their text (grouping similar items in bulleted lists or under subheadings). White space surrounds this "chunked" text and allows the reader's eye to recognize sections within an entire document.

When applied to the reading of the human genome, this theory of white space provides an answer to why "junk DNA" appears in a sequence. These seemingly incoherent sequences of bases provide a context for the reader to understand the words or codons that they surround. In English studies, white space is a persuasive rhetorical tool that provides cues for the reader. Charles Kostelnick (1988) addresses the use of white space as visual rhetoric when writing, "Inter-textual structuring – headings, vertical spacing, graphic cues – has rhetorical consequences, surfacing certain aspects of the message while embedding others" (p. 42). If scientists begin to consider "junk DNA" as white space, then they may be able to understand the context of the messages presented by the text of codons, exons, and introns. Scientists have already begun to realize the importance of this white space. W. Wayt Gibbs (2003) discusses junk DNA, saying, "Though long ago written off as irrelevant because they yield no proteins, many of these sections have been preserved mostly intact through millions of years of evolution. That suggests they d[o] something indispensable" (Gibbs, 2003). White space, according to Gibbs (2003), is a necessary component of the genome, and it also may be the most important part because, as he states, "some scientists now suspect that much of what makes one person, and one species, different from the next are variations in the gems hidden within our "junk" DNA" (Gibbs, 2003). Individuality may be created in the white space, much like how the structure of a poem's text defines how it looks on the page and is seen by the reader.

Annotation

This significance leads to another influence of English studies: annotation. The footnotes in a student's *Norton Anthology of English Literature* lead her to a better understanding of a text. Reading James Joyce's *Ulysses* appears nearly impossible without a book-length compilation of notes, explaining the author's cryptic references or the background and historical contexts that Joyce does not address when he writes about characters such as Stephen Dedalus and Molly Bloom. The annotation of the human genome is as necessary for scientists as such literary footnotes are for English majors. By annotating the sequences of the human genome, scientists are able to understand its structure and the functions of the genes in each chromosome (Shoemaker et al, 2001, 925). This is extremely important to scientists' work because they will use annotations to understand the context and meaning of other DNA sequence: "[p]ost-genome biology and medicine will increasingly rely on complete and accurate catalogues of human genes, mRNAs and proteins" (Shoemaker et al, 2001, 925). Similar to the work of literary scholars, scientists are now editing their drafts of the human genome to contain notes and references to other work being done in the field.

The involvement of the humanities, particularly English studies, within scientific discussions will increase our understanding of genetics, as well as other sciences; we must develop an integrated education system that connects science and humanities, and "'[t]he only hope lies in trying to introduce a scholarly, interpretative approach to the teaching of science such as is now available in other departments of a university where the works of man are the subject of instruction" (Prior, 1962, p. 109). The humanities departments will be necessary components of this education because their theoretical approaches can aid in the translation of the science for the non-scientific public. DNA literacy will be created as we apply such scholarly pursuits as English studies to scientists' explanations of advancements in genetics. English departments provide an ideal location for discussions about DNA literacy because department members are instructed in theoretical and rhetorical constructs which can be applied to the double helix as well as the expectations, implications, and results of genetic research and the HGP.

DNA literacy will also increase the advancements made by geneticists and other scientists, thereby improving the education of society when such advancements enter into public discourse communities. The application of English studies to the human genome provides many examples of how "reading" DNA text parallels that of printed texts, and illustrates that DNA literacy, mirroring the work of English Studies scholars, will soon develop. This literacy will provide scientists with a better understanding of the genome because of the tools – such as contextualization, metaphoric language, and visual rhetoric – that English scholars have been applying to their work for many years. These theoretical applications will create a shared lexical taxonomy for scientists, presenting them with a way to describe the human genome and engage in conversations regarding DNA and genetic advancements. More importantly, when applied to the HGP, English studies will provide a theoretical, yet accessible, approach to the science for society, including public policymakers who debate the ethical and political issues surrounding the genetic field. The polar opposites of science and English studies will combine to create a DNA literacy which is beneficial for all those involved in the conversation.

Johannes Borgstein (1998) summarizes these necessary applications of English studies by saying, "The expression of the genetic code may thus be viewed as a language with almost limitless possibilities of expression within the framework of a fixed grammar [...] and a structured grammar." With his anticipation of the power of a genetic language, Borgstein also inadvertently anticipates that DNA literacy will provide the tools for interpretation that scientists will then apply to their high expectations for the HGP, including the elimination of diseases and disorders. Scholars of English studies have been engaged in conversations for years about textuality, literacy, and other rhetorical and literary devices. By applying the already established work by such scholars to the HGP and biotechnology, scientists will enter into a conversation that provides a rhetorical and scientific framework for the future.

LITERATURE CITED

Borgstein, J. (1998). The poetry of genetics: or reading a genetic sequence – a literary model for cellular mechanisms. *Lancet*, 351, 1353-5. Retrieved January 14, 2004, from Academic Search Elite database.

Brown, T. (2003). *Making Truth: Metaphor in Science.* Urbana: University of Illinois Press.

Charland, M. (2003). The Incommensurability Thesis and the Status of Knowledge. *Philosophy and Rhetoric,* 36, 248-263.

Condit, C. M. (2001). Rhetorical formations of genetics in science and society. *Rhetoric Review*, 20, 12-7. Retrieved January 14, 2004, from Academic Search Elite database.

Crysdale, C.S.W. (2002, Fall). Crossing Boundaries: Virtue or Vice for the Twenty-First Century. *Cross Currents*, 385-399.

Doyle, R. On Beyond Living : Rhetorical Transformations of the Life Sciences. Stanford, CA: Stanford UP, 1997.

Fukuyama, F. (2002). *Our Posthuman Future : Consequences of the Biotechnology Revolution*. New York: Farrar Straus & Giroux.

Gibbs, W. W. (2003, November). The unseen genome: gems among the junk. *Scientific American*, 289.5, 46-54. Retrieved December 10, 2003, from Academic Search Elite database.

Giles, T. D. The Missing Metaphor. *Journal of Technical Writing and Communication,* 31, 373-389.

Hawley, R. S. and C. A. Mori. (1999) *The human genome: a user's guide.* San Diego: Harcourt Academic Press.

Kay, L. E. Who Wrote the Book of Life? : A History of the Genetic Code. Stanford, CA: Stanford UP, 2000.

Kostelnick, C. (1988, Summer). A systematic approach to visual language in business communication. *Journal of Business Communication*, 25.3, 29-48. Retrieved March 7, 2004, from ERIC database.

Kuhn, T. (1997). The Road Since *Structure*. In A. Tauber (Ed.), *Science and the Quest for Reality* (pp. 231-145). New York: New York University Press.

Lewis, J. (1999, Autumn). The Performance of a Lifetime: A Metaphor for the Phenotype. *Perspectives in Biology and Medicine,* 43, 112-120.

McGee, G. (2001). Parental Choices. In G. Stock and J. Campbell (Eds.), *Engineering the Human Germline* (pp. 99-101). New York: Oxford University Press.

McInerney, J.D. (2002, June). Education in a genomic world. *Journal of Medicine & Philosophy*, 27.3, 369-390. Retrieved March 9, 2005, from Academic Search Elite database.

McLaren, A. (2001). Ethical and Social Considerations of Stem Cell Research. *Nature,* 414, 129-131.

Prior, M. E. (1962). *Science and the humanities*. Evanston, Illinois: Northwestern University Press.

"Remarks by the President, Prime Minister Tony Blair of England (Via Satellite), Dr. Francis Collins, Director of the National Human Genome Research Institute, and Dr. Craig Venter, President and Chief Scientific Officer, Celera Genomics Corporation, on the Completion of the First Survey of the Entire Human Genome Project." White House Office of the Press Secretary. June 26, 2000. April 2, 2004. <http://www.ostp.gov/html/00628_2.html>.

Ridley, M. (1999). *Genome: the autobigraphy of a species in 23 chapters*. New York: HarperCollins Publishers.

Shoemaker, D.D., et al. (2001, February 15). Experimental annotation of the human genome using microarray technology. *Nature*, 409.6822, 922-7. Retrieved March 7, 2004, from Academic Search Elite database.

Shostak, S. (2002). *Becoming Immortal: Combining Cloning and Stem-Cell Therapy*. Albany: State University Press of New York.

Stock, G. (2002). *Redesigning Humans : Our Inevitable Genetic Future*. Boston: Houghton Mifflin.

Stock, G. & Campbell, J. (Eds.). (2000). *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes We Pass to Our Children*. New York: Oxford University Press.

Strohman, R. (1997, March). The coming Kuhnian revolution in biology. *Nature Biotechnology,* 15, 194-200.

Suhr, S. (2001). Is the notion of language transferable to the genes? In M. Dörries (Ed.), *Experimenting in tongues.* (pp. 49-75). Stanford, California: Stanford University Press.

Trudinger, P. & Habel, N. (2003-2004). Let the Earth Rejoice--with Us! *Call to Worship,* 37, 5-8.

U.S. Department of Energy, Office of Science. (2004, October 27). The science behind the human genome project. Retrieved February 17, 2005, from the World Wide Web: http://www.ornl.gov/sci/techresrources/Human_Genome/project/info.shtml

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EUTHANASIA JURISPRUDENCE AND PHYSICIAN-ASSISTED SUICIDE
What Did *Glucksberg* Teach Us?

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While few in number, my claims in this paper move from the modest to the questionable. The focus of this paper is primarily on the theory of law as it surrounds the doctor's role in hastening the death of those who are terminally ill and wish to die. The author of this paper contends that the euthanasia jurisprudence emerging from the twin physician-assisted suicide cases originating in the Second and Ninth Circuit Courts is radical, less than honestly conceived or possibly confused, and based on a little-noticed strategy of "judicial dodge ball" this author refers to as "narrow focusing." Until the legal landscape is cleared, it will be impossible to forge a stable, realistic and coherent public policy that permits death with dignity for many. To set the stage for the main argument, some general observations about the context out of which euthanasia jurisprudence emerges are in order. The first five points are obvious; the ones that follow are not as obvious.

First, it is impossible to escape the need for settled public policy in the area of law involving the physician's or health practitioner's role in managing terminally ill patients and providing assistance in decisions involving dying and ultimately death. Given that almost all of medicine is practiced in institutional settings, individuals are expected, first and foremost, to obey the law—public law. And we have learned that the courts and state legislatures are not likely to tolerate loose cannons (whether kind and compassionate like Dr. Timothy Quill or distant and dispassionate like Dr. Jack Kevorkian) unilaterally making determinations of death and then hastening its arrival through physician-assisted suicide or voluntary, active euthanasia.

(Parenthetically, we might note for the umpteenth time that while Dr. Jack Kevorkian put a face on the euthanasia debate, it was not one legislators and judges liked despite some public sympathy for the cause he represented (recall the Thanatron—the assisted-suicide device—and "Deathmobile," Kevorkian's version of an EMT assisted suicide vehicle). Eventually, of course, an understandably unsympathetic judge jailed him. But Kevorkian's approach was rejected by the media for the wrong reasons: he was perceived as a morbid, homicidal, and celebrity-status-seeking physician and press coverage, more often than not, displayed and discussed the darker side of his demeanor. Hindsight and an impartial perspective tell us that his approach was most objectionable because it afforded only minimal procedural protections for vulnerable populations confronting and making decisions during the dying process. We need, he argued in word and deed, not just a *public* policy, but a *changed* policy.)

Second, there are a number of methods we could select as "exit strategies" to assist the terminally ill who wish to hasten the arrival of death to avoid unremitting pain or assaults on their personal dignity during the dying process (loss of mobility, autonomy, and control of bodily functions; wasting away, unrelenting and "uncontrollable" pain, personality change,

psychiatric disability, memory loss, sensory impairment, etc.), or the drawn-out debilitation associated with many chronic degenerative diseases. Third, these exit strategies vary from culture to culture, nation to nation. An uncontroversial corollary of that claim is that the aim of public policy ought to be to find a morally appropriate match between cultures and the physician's role in managing dying patients and in implementing death practices. For reasons having to do with recent history and culture, in Germany the exit strategy for those who do not wish to "die naturally" (whatever that means) is non-physician-assisted suicide through the German Society for Humane Dying. In Holland, the chosen method for coping with voluntary death by one who is terminally ill is active, voluntary euthanasia administered by a trained physician with whom a dying patient usually has a close, personal relationship. And in the U. S., the procurement of death, provided again that one is terminally ill, is achieved through passive, voluntary euthanasia in all but one state.[1]

Fourth, euthanasia jurisprudence and public law affect the contours of decision-making in matters relating to death and dying. In this country, both jurisprudence and public law in this area have been exceedingly slow to develop, being sometimes out of step with one another and with developments in medical technology. For example, the Patient Self-Determination Act requiring healthcare agencies to instruct individuals about their rights to refuse care was not enacted into public law until 1990:[2] This was roughly thirty years after the introduction of medical technologies that made cardiopulmonary resuscitation, renal dialysis, and mechanical ventilation possible, and, in the absence of whole brain or brain-stem death, prolonged existence in a persistently vegetative state. And it took landmark cases in medical law (*In Re: Karen Ann Quinlan, Nancy Cruzan v. Missouri*, to mention only the most obvious ones) to awaken states to the need for changes in the law. It took litigation to capture poignantly the cruelty of state-mandated existence in a persistent vegetative state made possible by medical technology. Now we know that the times of being caught in the limbo of a persistently vegetative state can range from a few short months to as much as 37 years.

Some observers have commented that we stay too busy celebrating the miraculous benefits provided by every modern medical technology while too little time is spent on examining the impact of these technologies on the law or on medical decision-making. Yet those impacts are significant. Technological change without corresponding legal change may narrow rather than widen the medical choices available to actively or passively end life. Until the *Cruzan* decision, established law (in Missouri at least and in many other states) would not allow withdrawing life support once begun. Given the technology involved before *Cruzan,* simple refusal of life-support was insufficient to trigger the process of ending one's physical existence. And battles are still being fought in hospitals, hospice centers, and nursing homes in states where forces other than compassion and respect for persons drive healthcare decision-making—and the focus of those battles is chiefly over who has the right to decide for patients how they will die.

The introduction of technology without compensating legal changes complicates matters for those who wish to determine the "time and manner" of their deaths. It also creates problems for those who want simply to accept a "natural" end to their "physical existence." But eventually the legal environment catches up. At this point, changes in "accepted practice standards" might further complicate matters, even absent the introduction of new or innovative technology. Since 1990, hospitals (at the time of admission for inpatient services), nursing facilities (at the time of an individual's admission as a resident), home health care service providers (when an individual comes under the care of such a provider), hospice programs (at the time of patient enrollment), and health maintenance organizations (at the time of inclusion of a person in the plan's policies) must have policies in place to inform patients of their rights

to refuse medical care. Such institutions must also document in patient records the existence of completed forms attesting to this fact. The law, known as the Patient Self-Determination Act captured the same rights Nancy Cruzan's family had to spend seven years in litigation to obtain: the right to refuse medical care. Of course, the character of the death and dying debate has, for all practical purposes, moved beyond the debate over the right to refuse care.

Another manifestation of a public law lag in dealing with death and dying issues is the relatively late adoption by states of the provisions of the Uniform Determination of Death Act. While the need for changes in the definition of death was obvious as early as the 1960s and early 1970s, it was not until the 1980s that definitions of death extant in the states were nudged toward the goal of uniformity by the National Conference of Commissioners on Uniform State Laws.[3]

Fifth, on a spectrum of most conservative to most liberal, doctor intervention in practice settings to hasten death has always been limited by law to the most conservative approach. Obviously doctors may honor a terminally ill person's wish not to be treated before entering the hospital. Only since 1990 could they honor the same wish after the patient entered. Will we see public policy move in a slightly more liberal direction? Most thought *Glucksberg v. State of Washington* and *Vacco v. Quill* were *the* cases that would bring just the right amount of tectonic tilt to the political geology of U. S. public policy to avoid major seismic changes in the superficial moral harmony holding the medico-legal system together.

Now for a more controversial point.

Sixth, in the area of euthanasia jurisprudence, political conservatism coupled with a principled judicial conservatism in the form of *stare decisis* has often not only resulted in what is arguably the worst public policy (because it gives a dishonest impression of what doctors are doing in caring for dying patients) but in what Supreme Court Justices attempt to avoid often at considerable cost—a radical judicial opinion. By following the rule of precedent, the Supreme Court has managed to support, through a series of contorted arguments, the most radical social policy in the area of euthanasia jurisprudence in the developed countries of the world surpassed only by Holland. At least one justice (Justice John Paul Stevens) acknowledges that modern medicine *as practiced* really is more consistent with a more active role in the dying process than simply withdrawing care.

What has the Supreme Court done? The nine justices sitting on the federal bench inadvertently and collectively pushed doctors into accepting a policy of *de facto* active, voluntary euthanasia. On the other hand, a more moderate approach is available in only one state: Oregon. And thoughtful commentators familiar with the socio-cultural dynamics of American society think that physician-assisted suicide (a medical option in the state of Oregon) is the most ethically appropriate fit as between policy and populations for the United States.

The radical policy justices avoid can be simply stated: it is the one that allows a patient to request that doctors give them a lethal dose of medication to hasten the dying process. Under current law, this is medical homicide, NOT physician-assisted suicide.

By examining a longer string of decisions a stronger case could be made that the Supreme Court has endorsed, under the banner of "judicial restraint" and only by "winking" at accepted medical practice, a judicially radical doctrine. But I will examine only one case: *Washington v. Glucksberg* (argued January 9, 1997 and decided June 26, 1997). The decision in this case was handed down simultaneously with *Vacco v. Quill* (decided June 26, 1997). I will try to summarize my arguments briefly.

Let me offer the following chain of reasoning to capture the "judicial logic" that seems to percolate to the top in *Washington v. Glucksberg* when one reads the entire array of

opinions from Rehnquist (joined by O'Connor, Scalia, Kennedy, and Thomas) to Stevens to Breyer to Souter to Ginsburg. One cannot gainsay that the individual opinions are not brilliantly written. In *Glucksberg*, Justice Souter mounts what must be the most extensive and sensitive and carefully argued analysis of the application of substantive "due process" to physician-assisted suicide federal litigation. Similar comments might be offered about the judicial opinions of every single justice who wrote in this case.

What I am saying is this: if we look at the logic of the opinion, the philosophical Gestalt that emerges is unacceptable to the conservative in the euthanasia debate and dishonest to the liberal. Here is an assessment of that logic.

1. If a terminally ill patient consults a physician, she may be offered treatment for medical conditions: surgery, pain medication, etc.
2. If treatment is offered, then it may be refused or accepted either at the time it is offered or through "advanced directives" or a "durable power of medical attorney," etc.
3. If accepted, it might include instructions about resuscitation and the full use of associated technology.
4. But even if such technology is deployed, one may still effect withdrawal through prior preparation of an "advanced directive" or, if conscious and rational, by personal refusal.
5. If one personally refuses to use such technological assists in coping with the dying process, one may still experience terrifying pain.
6. If one experiences such pain, a doctor may not/ought not abandon the one who needs medication for "pain management."
7. Any doctor not abandoning a patient to pain will use every medically acceptable strategy for pain management.
8. One medically acceptable strategy is the use of dosages of pain medication that may hasten or actually cause death.
9. Such medication that hastens or causes death as the ultimate form of pain management is administered to produce "terminal sedation."
10. If one is "terminally sedated" by a doctor, then the doctor has effectively engaged in an act of voluntary, active euthanasia.
11. Therefore, terminally ill patients consulting physicians may request and receive lethal medication.

Only one qualification is in order. The range of cases under which a patient may receive "terminal sedation" is not as broad as the range of cases in which reform advocates would wish that active, voluntary euthanasia might be administered. The range of qualifiers that would narrow the class of people to whom doctors might ethically administer medication might range from 1 to 12 or more. Still, "terminal sedation" is morally, medically and empirically (extensionally) equivalent to "active euthanasia."

The reason this logic emerges as the most acceptable despite its "radical" consequential nature is that Chief Justice Rehnquist in his "opinion of the Court" in *Glucksberg v. Washington* immediately took the option of physician-assisted suicide "off the table." His opening comments were:

> The question presented in this case is whether Washington's prohibition against "causing" or "aiding" a suicide offends the Fourteenth Amendment to the United States Constitution. We hold that it does not.[4]

Chief Justice Rehnquist also made the prescient observation, quoting another judicial opinion, that "Each step, when taken, appears a reasonable step in relation to that which preceded it, although the aggregate or end result is one that would never have been seriously considered in the first instance."[5] It is my contention that a more apt characterization of the collective judicial opinions filed in *Glucksberg* could not have been penned. For it holds for liberal and conservative opinions alike.

In this case, plaintiffs (including 4 doctors and 3 terminally ill patients who died during the course of litigation and appeal) challenged a 1994 Washington law that stated: "A person is guilty of promoting a suicide attempt when he knowingly causes or aids another person to attempt suicide." Plaintiffs asserted "a liberty interest protected by the Fourteenth Amendment" extending to "a personal choice by a mentally competent terminally ill adult to commit physician-assisted suicide."[6] Using the language of *Planned Parenthood v. Casey,* the plaintiffs asserted and the District Court and *en banc* Circuit Court agreed that the Washington "assisted-suicide ban" placed an "undue burden on the exercise of the constitutionally protected liberty interest." The District Court also held that this statute violated "the Equal Protection Clause's requirement that 'all persons similarly situated...be treated alike.'" It would be an understatement to say that this case and these claims zigzagged on their way to the Supreme Court.

In the beginning, Washington state law abolished any liberties like the ones claimed by plaintiffs (denying exercise of plaintiffs' alleged liberty rights) characterizing assistance in suicide as felony homicide. Plaintiffs challenged the law on the basis of its interference with liberty rights. The District Court upheld the claims of the plaintiffs (agreeing with plaintiffs). The 9th Circuit Appellate Court denied plaintiffs' claims (disagreeing with plaintiffs). Upon a petition for a rehearing *en banc*, an *en banc* 9th Circuit Appellate Court reversed the first Appellate Court's ruling(agreeing with plaintiffs).[7] The U. S. Supreme Court then reversed the *en banc* 9th Circuit Court's ruling (disagreeing with plaintiffs). This only meant, however, that as the court formulated the question, the ban on assisted-suicide violated no known constitutional right. Nor incidentally, in a challenge that eventually failed, did the Oregon Death With Dignity Act of 1994, violate any known constitutional right *in permitting* physician-assisted suicide (at issue in a collateral case that had already begun to make its way up the judicial ladder from the state of Oregon). Eventual bottom line: the Constitution is neutral with regard to the right to assistance in committing suicide as it relates to the terminally ill. The constitution neither prescribes that states honor the right to physician-assisted suicide (because it is a liberty right protected by the Fourteenth Amendment) nor proscribes state recognition of such a right.

Why did the Supreme Court not just recognize the "liberty interest in committing suicide"? After all, the judicial foundation for such an interest could have easily been cobbled together (as plaintiffs had done using *Roe v. Wade* and *Planned Parenthood v. Casey*). The reason for not recognizing this right is a technical one in part, and one of the clearest explanations is in Justice John Paul Stevens's concurring opinion. Plaintiffs can present a general "facial challenge" or an "as applied challenge" to a particular law. The plaintiffs in this case originally presented a facial challenge to the Washington law banning physician-assisted suicide *as applied to* "three terminally ill, mentally competent patients and to four physicians who treat terminally ill patients." So long as the terminally ill but competent patients lived, the *as applied standard* would be the very easiest obstacle to overcome. This particular set of plaintiffs was at least being denied a negative liberty right to die with dignity—a right often enjoyed by those "fortunate enough" to die quickly, without pain, while still rational. After the District Court (the original trial court) issued its opinion that the law

did in fact place an undue burden on the patients' (plaintiffs') right to physician-assisted suicide, the three patients (plaintiffs) died. This now meant that the challenge to the law was no longer "limited to a particular set of plaintiffs" before any particular court of law. With no particular set of plaintiffs before the court and no "doctor who was threatened with prosecution for assisting in the suicide of a particular patient," the very easiest obstacle was no longer the only obstacle to a facial challenge. So a general facial challenge to the Washington ban had to be pushed forward.

Justice Stevens reasoned that in order for the broader facial challenge to be successful, "the challenger must establish that no set of circumstances exists under which the act would be valid." This is the very strictest standard for a facial challenge, and Justice Stevens readily admits that the court never actually has applied this standard. But in order to meet a lower standard, the plaintiffs would at least have to establish a "liberty interest" protected by the Fourteenth Amendment which "includes a right to commit suicide" and that also entails "a right to assistance in doing so." Even this weaker standard erected a judicial barrier too high to overcome.

The weaker standard provided too high a barrier because the only way one could demonstrate the existence of such a right is to show, first, that such a right is "rooted in the nation's history and traditions" or that it is "implicit in the concept of ordered liberty." And here, as Justice Stevens points out, "History and tradition provide ample support for refusing to recognize an open-ended constitutional right to commit suicide." Just as the lower court had, Stevens then proceeded to an "interest-balancing" analysis of the concept to see if a right to physician-assisted suicide might be justified that trumped state interests in refusing to acknowledge such a right. The reasons the State might give for a ban on assisted suicide might be three:

1. An interest in protecting the vulnerable from abuse.
2. An interest in preventing patients who are receiving inadequate palliative care from prematurely requesting physician-assisted suicide.
3. An interest in preserving "the traditional integrity of the medical profession."

And he agreed that the State had a legitimate interest in preventing suicide and in "protecting the vulnerable from abuse" but acknowledged that these concerns were less significant "in this context." For when individuals are not depressed, not suicidal, not "victimized by coercion," not really vulnerable, the state's interest is not as compelling.

Stevens then goes on to make some rather sharp observations about the practice setting:

- "palliative care...cannot alleviate all pain and suffering...."
- "Greater use of palliative care (may) reduce the demand for assisted suicide, but it will not eliminate it."
- "...as death becomes more imminent, pain and suffering become progressively more difficult to treat"

And then draws the conclusion that, given these facts, an individual "might make a rational choice for physician-assisted suicide." Therefore, the State's interest in preventing "abuse is only minimally implicated."

As for preserving the traditional integrity of the medical profession, again Stevens makes a number of deeply incisive comments:

- A physician who refuses "to ease the suffering and make (a patient's) death tolerable and dignified" is acting in a manner inconsistent with the "healing role" of the medical profession.
- A doctor's refusal to "hasten death 'may be experienced as an abandonment, a rejection, or an expression of inappropriate paternalistic authority'."
- "Furthermore, because physicians are already involved in making decisions that hasten the death of terminally ill patients—through termination of life support, withholding of medical treatment, and terminal sedation—there is in fact significant tension between the traditional view of the physician's role and the actual practice in a growing number of cases."

Stevens concludes by admitting that the distinction between permitting a person to die from an underlying fatal disease and administering a fatal dose of medication might provide a sufficient justification for classifying one of the acts as permissible while the other is not. But he warns in a remark that is bound to be cited as more cases involving physician-assisted suicide work their way through the legislative labyrinth to the Supreme Court: "I am not persuaded that in all cases there will in fact be a significant difference between the intent of the physicians, the patients or the families in the two situations."

Perhaps the most tragic part of this judicial history is contained in these further comments of Justice Stevens. Stevens writes:

> I do not agree, however, with the Court's formulation of the claimed "liberty" interest. The Court describes it as a "right to commit suicide with another's assistance." But I would not reject the respondents' claim without considering a different formulation, for which our legal tradition may provide greater support. That formulation would use words roughly like a "right to die with dignity." But irrespective of the exact words used, at its core would lie personal control over the manner of death, professional medical assistance, and the avoidance of unnecessary and severe physical suffering—combined.

I would say, end of story, end of argument. For no stronger legal case could be made that physician-assisted suicide ought to be legal than the one Justice Stevens made. But two observations are necessary. First, if intention counts for anything in the assessment of the morality of an action, then surely the act of a doctor whose intentional withdrawal of care becomes the "immediate, not the proximate, cause of death" is morally culpable for an "act of killing" (when death ensues) as one who intentionally administers or prescribes a medication to either terminally sedate or cause the death of a patient. Chief Justice Rehnquist may argue that the acts are not the same (as he did in *Vacco v. Quill*), but the intentions are.

The second observation is simply this. Since the acts of those who withdraw care, terminally sedate, or prescribe lethal doses of medication cannot, in the cases relevant to this decision, be distinguished motivationally, consequentially, characterologically, or in their act-descriptions, even the philosophically illiterate will one day recognize the need to extend "Death With Dignity" laws like the one in Oregon, for example, to every state in the United States. Then perhaps the most conservative of Supreme Court Justices will rescind their radical commitment to limited uses of voluntary, active euthanasia for terminally ill patients.

The second observation requires considerable argument, but let me just suggest the obvious line of argument. Motivationally, "honest" physicians who terminally sedate, withdraw care from, or provide lethal medication to bring about the death of a willing patient know their actions would in any case have the same *intention*: to bring about the death of the patient. Their actions would have the same *consequences*: the patients die. *Aretaically*, the actions are no different: physicians in such cases are merely showing compassion for and respecting the autonomous choices of their patients. And the act-descriptions characterizing what the physicians would be doing are the same: the physicians are making decisions and engaging in acts that will knowingly result in the death of the autonomous patient.

If being uncharitable is a vice, however, one must note without disrespect that our august justices have exhibited that vice more than once: sometimes recently, and in some cases, long ago. Let us say that a judge or justice can be uncharitable when he or she characterizes the issue being litigated in morally disparaging terms that would prejudice the outcome of the litigation or disparage the motives of either plaintiffs or defendants. A woman's privacy right to control her reproductive life has been variously characterized by individual justices as "abortion on demand"; the demands of gay couples to a zone of privacy in their intimate relationships was "judicially parodied" (in *Hardwick v. Bowers)* as a demand for the recognition of a constitutional right to practice homosexual sodomy (by the way, in case no one noticed, the constitution did/does not enumerate the generic rights of heterosexual couples to marry, copulate, reproduce, practice birth control, etc.); the legalization of contraceptives has been caricatured as condoning indulgence in extramarital relations; the right to terminate late-term abortions for medical reasons, as "a visibly brutal means of eliminating our half-born posterity." What is important is this: how one *frames* the "liberty right" determines whether support for it can be found in the history and traditions of the nation. If one frames it narrowly and in negatively charged emotive language, little support will be found. If framed broadly, much support will often be found.

The true irony in this judicial exercise we have come to know as the physician-assisted suicide cases is that, in trying to avoid the worst abuses allegedly associated with PAS, the court practically guaranteed that there would be hundreds of Kevorkian clones practicing voluntary active euthanasia under the cloak of "terminally sedating" patients as a method of pain control. If doctors are left free to decide with patients what kinds of pain control they will use, every doctor can decide when, in principle, to kill a patient. How does one define "unbearable" or "uncontrollable pain" for which terminal sedation is the treatment? In lieu of one or a few loose cannons popping up here and there on the medical landscape to terminate the lives of patients, thousands of doctors are technically empowered to practice voluntary, active euthanasia. Moreover, empowered physicians are not constrained by all the elaborate procedural protections for the rights of the terminally ill such as the ones contained in the Oregon Death With Dignity Act.

The Oregon Death With Dignity Act (adopted in 1994) provided the framework within which many feel that decisions about physician-assisted suicide should be made. The most important provision of the Oregon law is in § 3.14:

> Nothing in this Act shall be construed to authorize a physician or any other person to end a patient's life by lethal injection, mercy killing or active euthanasia. Actions taken in accordance with the Act shall not, for any purpose, constitute suicide, assisted suicide, mercy killing or homicide, under the law.

How are patients protected under this law? The procedural requirements are almost too numerous to list. But here is a partial list:

1. Valid requests for PAS must be "signed and dated by the patient" and "witnessed by at least two individuals...who can attest...the patient is capable, acting voluntarily, and is not being coerced..."
2. At least one qualified witness must not be any of the following: "A relative by blood, marriage, or adoption....A person...entitled to any portion of the estate of the qualified patient....An employee of a health care facility where...patient" is being treated.
3. Attending physicians may not be qualified witnesses to requests for PAS.
4. Attending physicians must make a determination that the patient "has a terminal disease."
5. Patient must be informed of their medical diagnosis and prognosis, the risks and probable results of taking the medication.
6. A consulting physician must confirm opinions of the attending physician.
7. Next of kin must be notified of a patient's request for PAS.
8. Patients must be given the opportunity to rescind requests for PAS.
9. Documentation of oral and written requests for PAS must be included in the patient's records.
10. Prior to actually writing a prescription for a life-ending medication, physicians must re-confirm informed consent of patient.
11. Counseling consultation must be provided for patients suspected of having psychological, psychiatric diagnoses or depression that might impair judgment.
12. A mandatory waiting period of 15 days is required after the initial request for medication.
13. An additional mandatory waiting period of 48 hours from the time of signing a written request for medication is required.
14. Abuses of the act (forging documents, coercing patients) carry criminal sanctions as Class A felonies.
15. Obligations under any existing contract cannot be conditioned or affected by the making or rescinding of a request for medication by a patient to end his or her life in a humane and dignified manner."
16. Only adults (persons 18 years of age or older) may make valid legal requests for PAS.[8]

No law can be "abuse proofed." But no abuses of the Oregon law have been reported since its activation in 1997. The elaborate list of procedural requirements almost guarantees that the law won't be abused. But there is no such elaborate list of procedures to which physicians must conform their actions when administering pain control in the form of "terminal sedation." It is quiet, it is private, it is personal, and it can be hidden. And there are no required "legal checks and balances" on physician decisions even if ethical physicians follow an elaborate set of procedures before administering such sedation. A far more frightening outcome than abuse of the Oregon law, moreover, can be imagined. Consider the prospect of thousands of patients without healthcare and primary physicians languishing on the brink of death, wracked by uncontrollable pain, unable to obtain hospice care, destitute,

terminally ill, rational, having executed a "living will" authorizing withdrawal of care, and wanting to die, but unable to do so.

(One is reminded of two of Kevorkian's paintings. About the one entitled "Fever," he comments: "It depicts the great discomfort of intense bodily heat. The inferno is internal; and in some tragic cases even the will to live is charred." And commenting on another painting entitled "The Gourmet (War)," he writes: "How long before we really believe that salvation lies not in an insane paradox fostered by brute and selfish gluttony, but in the far more 'nutritious' and healthful viand in the sadly neglected garden of human compassion and understanding?")[9]

If sunshine is the best antiseptic for medical arbitrariness and abuse, then written procedural guidelines in the form of public law are the best preventives for erratic practice standards in assisting patients to die with dignity. The moral justifications readily at hand to justify a changed public policy are too numerous to mention. Certainly utility (absence of pain, presence of pleasure) would be promoted if U. S. public policy tilted toward physician-assisted suicide. Certainly such a policy would exhibit respect for persons. It is arguably consistent with preserving the integrity of the medical profession (as Eric Cassell once argued). The rules that instantiate this compassionate approach are also, despite Kant's distaste for suicide, universalizeable principles. A physician-assisted suicide law could be construed as the honoring of a social contract whose principles are consistent with those rational beings starting from a bargaining position of equal liberty would adopt to maximize the benefits and minimize their disadvantages. And, such a policy is consistent with universal ethical egoism, the only defensible form of *ethical* egoism. Almost every ethical theory available with strategically enhanced additives can fuel the engine of justification that would drive toward a policy of humane dying like physician-assisted suicide. Legislators have but to summon the will simultaneously to think deeply, feel compassionately, and act on rules that are general, public, prospective, consistent and coherent, and perhaps nonsectarian. Legislators can remove arbitrariness in access to the liberty right to die with dignity. They can also remove all suspicion from medical practitioners who now feel morally justified in assisting in dying through "terminal sedation." And they can refuse to adopt an eyes-wide-shut approach that fails to acknowledge that the practice of "terminal sedation" is the moral equivalent of active euthanasia and the legal equivalent of felony homicide.

One can merely hope that Justice Souter's observation that because "legislatures...have more flexible mechanisms for factfinding than the judiciary...mechanisms (that) include the power to experiment...(move) forward and (pull) back as facts emerge in their own jurisdictions," this will guarantee that the failure to win a judgment in favor of plaintiffs in 1997 (getting close to a decade ago) will encourage "such experimentation." So far it has not. One suspects that, like almost every other issue involving so fundamental a right, though laws implementing such rights will vary from state to state, states will not be incubators for experiments in uniform social change. That is why federalism makes sense, and that is why the judiciary must re-think its construal of the core questions at issue in this debate. One fears that, as time has elapsed, armies have already been recruited and wagons, circled to wage "cultural wars" over the "right to life" down to the last dying patient's breath. It took the state of Oregon from November 1994 (when the law was passed) until October 1997 (when the Ninth Circuit Appellate Court lifted its injunction against physician-assisted suicide) to make the case before the judicial system that a state right to PAS could exist without jeopardizing the Constitution. For now, the state of Oregon soldiers on to offer the best, if not last, hope for encouraging the reproduction of liberty rights for the terminally ill who wish to determine the time and manner of their deaths.[10] And the terminally ill in other

states will be making decisions about "assistance in dying" absent any of the procedural protections provided by Oregon law, a really more horrific prospect to contemplate than the reality of recognizing the constitutional right to physician-assisted suicide under proper guidelines, crafted by legislatures after careful and honest consideration of the alternatives. We are fortunate that the people of Oregon, unlike the people of New York and Washington who were plaintiffs in *Glucksberg* and *Quill,* had the prescience to foresee the day when state legislative initiatives would be the only avenue through which the courts would come to recognize a right, though lamentably not a constitutional right, to die with dignity.

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[1] For perhaps the most thorough and interesting discussion of the arguments for the "cultural appropriateness" of each method for dealing with the physician's role in death decisions, see Margaret Pabst Battin's *The Least Worst Death* (New York: Oxford University Press, 1994).

[2] Federal Patient Self Determination Act 1990, 42 U.S.C. 1395.

[3] Almost every state has since adopted the two methods for determining death since the Uniform Determination of Death Act was first introduced.

[4] *Washington v. Glucksberg,* 521 U.S. 702.

[5] See *U.S. v. 12 200-ft Reels of Super 8MM Film,* 413 U.S. 123, 127 (1973).

[6] From this point forward, unless otherwise noted, quoted material is from *Washington v. Glucksberg,* 521 U.S. 702.

[7] "When Congress enlarged the Ninth Circuit from thirteen to twenty-three judges in 1978, it also authorized any court of appeals with more than fifteen active judges to 'perform its en banc function by such numbers or members of its en banc court as may be prescribed by rule of the court." Quoted from *Glucksberg v. Washington*, 85 F.3d 1440 (1996), citing Omnibus Judgeship Act of October 20, 1978, PL 95-486.

[8] The Oregon Death With Dignity Act is published on a number of websites and Annual Reports of the Statistics associated with the implementation of the Act are also readily available. For the Legislative Statute, please see http://www.ohd.hr.state.or.us/chs/pas/ors.cfm. For the home page with navigation bar links to the annual reports, please see http://www.ohd.hr.state.or.us/chs/pas/pas.cfm.

[9] A PBS link to six of Kevorkian's paintings can be found at the bottom of the following page: http://www.pbs.org/wgbh/pages/frontline/kevorkian/aboutk/art/index.html. This page also has a brief description of his brief career as a creative artist.

[10] I had intended to include a discussion of "interest balancing" analysis of the right to physician-assisted suicide, especially in the 9th Circuit's first appellate review of Glucksberg, in this paper. Not only does that state's experience with physician-assisted suicide reveal that no compelling state interests are threatened by allowing the practice, it suggests that the structure of procedural protections is sufficient to ward off any inroads HMOs, insurance companies, or healthcare delivery institutions might make on the rights of vulnerable populations. Since copies of the Oregon Death With Dignity Act are readily available online in a variety of places, I have refrained from including a copy in the endnotes attached to this paper.

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Curtis, Kendrick J.
Givan, Shundreka
Hill, Miriam H.
Holland, A. Priscilla
Izeogu, Chukudi V.
Kush, John S.
Martinson, Tom L.
McAllister, William K.
Nene, Nicholas
Ruffin, Patrice

SECTION V
PHYSICS AND MATHEMATICS
Alford, William L.
Baksay, Laszio
Bateman, B.J.
Bauman, Robert P.
Bearden, T.E.
Beiersdorf, Peter
Belyi, Sergey
Case, Jan
Essenwanger, Oskar M.
Fairchild, Marcie
Forte, Aldo
Furman, W.L.
Glotfelty, Henry W.
Harrison, Joseph G.
Helminger, Paul
Knight, Martha V.
Massey, Julia E.
Mixon, Stacy Tyrone
Omasta, Eugene
Osei, Albert
Pontius, Duane
Robinson, Edward L.
Roblee, Kenneth
Sharma, P.C.
Shealy, David L.
Smith, Brian
Tan, Arjun
Thompson, D. Brian
Tompkins, Perry
Varghese, S.L.
Wills, Edward L.

SECTION VI
INDUSTRY AND ECONOMICS
Absher, Keith
Alexander, Paulette
Gabremikael, Fesseha
Griffin, Marsha D.
McCain, J. Wayne
Rahimian, Eric
Williams, Robert J.

SECTION VII
SCIENCE EDUCATION
Benford, Helen H.
Bilbo, Thomas
Froning, Michael
Kastenmayer , Ruth W.
Nall, Jane
Radford, David
Tidwell, Cynthia
Wilson, Karl M.

SECTION VIII
BEHAVIORAL AND SOCIAL SCIENCES
Barty, Peter F.
Bates, Larry
Bice, Leslie
Brown, David C.
Buckalew, L.W.
Burnett, Emily C.
Carmichael, Beth
Collins, Kenneth
Eiland, Krystal
Fisher, Gerald P.
Gray, John
Grissom, Rhonda
Halbrooks, Elizabeth A.
Harris, Louise M.
Harzem, Peter
Holliman, Diane
Hudiburg, Richard A.
Johnson, James A.
Kelly, William E.
Osterhoff, William F.
Powell, Larry
Roberts, Robin
Weber, B.C.
Wittekind, Janice

SECTION IX
HEALTH SCIENCES
Adams, Rebecca
Austell, Stephanie
Beaton, John M.
Beck, Lee R.
Boots, Larry R.
Buckner, Ellen
College of Nursing S.AL
Cooper, Gabriella
Davis, Richard
Davis, W.R.
Emerson, Geraldine M.
Finley, Sara
Finley, Wayne H.
French, James H.
Gibbs, Brian
Gilbert, Fred
Hardin, Amanda
Hays, M. Peggy
Herbert, Donald
Hill, Jennifer
Hughes, Virginia
Iddins, Brenda W.
James, Eric
James, Nadine
Katz, Judd A.
Lansdon, Adam
Maloney, Mary G.
Mosley, Saraj
Mullins, Dail W., Jr.
Navia, Juan M.
Parsons, Daniel L.
Payne, Dorothy

Pieroni, Robert E.
Pittman, James A., Jr.
Pitts, Marshall
Rhodes, Stephanie
Ross, Jill
Roush, Donald
Shoemaker, R.L.
Stryker, Jennie
Sullivan, Linda
Taylor, Catherine
Thompson, Jerry N.
Warboys, Ina
Washington, Ruth
Wilborn, W.H.
Winters, Alvin L.

SECTION X
ENGINEERING AND
COMPUTER SCIENCE
Barrett, John
Craig, Thomas F.
Dooley, Isaac
Guan, Zhijie
Javed, Faizan
Lin, Yuehua
Liu, Shih-his
Liu, Yin
Parker, Donald L.
Sadasivam, Rajani
Sloan, Kenneth R.
Sprague, Alan P.
Sun, Changlin
Thomas, Robert E.
Velusamy,Vijay
Wu, Xiaqing

SECTION XI
ANTHROPOLOGY
Gougeon, Ramie
Henson, B. Bart
O'Beirne, Rosie
Ridley, Rebecca
Rowe, Bobby
Runquist, Jeanette
Sherard, Jeffrey L.

SECTION XII
Elfstrom, Gerard
Gibson, Keith
Ortmann, Leonard
Sidler, Michelle

Minutes
AAS Fall Executive Committee Meeting
Samford Sciencenter
Birmingham, AL
October 30, 2004

Call to Order and Approval of Minutes (A) President Ron Jenkins called the meeting to order at 10:12 a.m. Minutes of the March 17, 2004 meeting at the University of Montevallo were unavailable. The minutes were provisionally approved with final approval to be obtained after being sent electronically to members of the committee.

Officer Reports (B)

1. Eugene Omasta **(Board of Trustees)** reported on three priorities:
    - Establishing online registration for the meeting and for dues payment
    - Placing abstracts online so they can be viewed prior to the meeting
    - Reviewing time of day for the Friday banquet

2. Ron Jenkins **(President)** submitted the following written reports, including a letter written to the State Department of Education:

The following items have been accomplished in recent months.

- I worked with members of the executive committee for the arrangements of the Fall Executive Dinner and Executive Meeting, to be hosted at Samford University on Oct 29th and 30th.
- Along with other members of the Steering Committee, I presided over an AAS site visit of Birmingham Southern College in preparation for the March meeting. My summary of this meeting is attached.
- On April 25, 2004 I submitted to Ms. Martha B. Donaldson, Executive Secretary, of the State of Alabama Department of Education a letter in reference to the stand of the AAS on the revision of the science curriculum conducted by the State Courses of Study Committee. This letter is attached to this summary.
- In relation to the necessary stand of the AAS for the teaching of evolution in the public classroom, I responded by letter and email to nine inquiries from the community.
- Submitted AAS 2004 Resolutions to Dr. Neil Berte, Dr. Houston Byrd, Dr. Anne Cusic, Dr. Dan Holliman, Dr. Robert McChestney, Dr. Steve Stuckwisch, and Elsie Spencer.
- During the summer 2004, I recruited nominees for the position of Treasurer as Betsy Dobbins will be stepping down following the Fall 2004 Executive meeting and for Editor of the Journal after James Bradley steps down following the 2004-2005 year.
- I interacted with several AAS members on potential topics for a symposium at the March 2005 annual meeting. Two potential topics will be presented at the Fall Executive Meeting, Oct 30th.

Summary of Birmingham Southern College Site Visit

Attendees: BSC: Clyde Stanton, Local Arrangements Chair
Anne Curry
Nikki Phillips
Patty, Secretary to Division of Science and Mathematics
AAS: Larry Krannich, Executive Director
Ron Jenkins, President
Larry Davenport, 1st V.P.
B.J. Bateman, Director Junior Academy
Eugene Matson, Chairman of AAS Board of Trustees

Items Covered
Dates: The 82nd Annual Meeting of the AAS will be held on the campus of BSC on March 16, 17 & 18 (Wednesday, Thursday and Friday).

Registrant Costs: With all catering handled by Valley Catering on the BSC campus the following costs are to be incurred.

Executive Dinner Wednesday, March 16 at 6PM at the Norton Campus Center	$15.00
Full Registration Thursday and Friday (to include AM and PM refreshment breaks, Lunch and Thursday Social)	$66.00
Single Day Registration - Thursday only (AM & PM refreshment breaks, Lunch and Social)	$36.00
Single Day Registration - Friday only (AM & PM refreshment breaks and Lunch)	$30.00
Banquet, Friday PM	$15.00

Registrants will be strongly encouraged to prepay during online registration. Payments made during registration from AAS registrants will be made payable to BSC and deposited into an account designated by Dr. Stanton. BSC internal payments will be made from this account.

A list of local hotel/motels with costs, addresses, and phone numbers will be emailed to Ron Jenkins.

The Social maybe held on Thursday evening at the Ecoscape facility on the BSC campus and will consist of catered hors d'oeuvres (Valley Catering). The rain plan will require the use of the Great Hall.

Registration will be held in the lobby of the Stephen Science Center on the lower entrance level. Tables will be equipped to receive registrants' payments (checks only) and provide BSC materials and name tags. The registration tables manned from 8:30 AM to 4:00PM on Thursday and Friday.

Vendor's tables, poster display and refreshment bars will be located in the hall way and atrium of the Stephens Science Center.

Session Rooms:
The senior Academy will require the following rooms with seating capacities of 20-30 and equipped AV (PC based).

Thursday AM	6 classrooms
Thursday PM	7 classrooms
Friday AM	Theater in the Norton Campus Center
Friday PM	7 classrooms

The Junior Academy will require five rooms on Friday AM, which may include the biology laboratories.

The Gorgas Scholarship Program will require two rooms for displays on Friday AM, which may include biology or chemistry labs. For judge/student interviews small rooms or offices should be available.

The Business meeting will be held Friday 6PM in Rm 134 of the Stephens Science Center.

The Banquet will be held in the Great Room and is scheduled for Friday 7PM to 9:30PM. It should seat 100 +/- with a speakers table and podium. The buffet menu will be selected later. The AAS invites BSC to select a plenary speaker for the banquet.

Dr. Clyde Stanton as Chair of the Local Arrangements Committee for BSC is invited to attend the Fall Executive Meeting at Samford University (Saturday, Oct 30th 9AM in Sci 033) to introduce the meeting plans and address questions from the AAS executive committee.

Prepared by Ronald Jenkins, President
August 2, 2004

April 25, 2004

Ms. Martha B. Donaldson
Executive Secretary, State Courses of Study Committee
State of Alabama Department of Education
P.O. Box 302101
Montgomery, AL 36130-2101

FAX: (334) 242-0482
Number of Pages: Two (2)

Dear Ms. Donaldson:

I write to support the revision efforts of the Science State Course of Study Committee. I have been a biologist and professional educator for 20 years and am currently a member of the teaching faculty of the Department of Biology Samford University. Our primary objective in this department is to energize our students and facilitate the learning

with the best possible teaching methods in the sciences. It is important to me and this department that the Department of Education produce well educated science students. These students in turn become our students.

During the 2004-2005 academic year, I will serve as the president of the Alabama Academy of Science. Solid science education in K-12 is a major emphasis of the Academy. The Academy sponsors numerous science programs for our young science students, including the Gorgas Competition, Junior Academy of Science, state and regional science fairs and the Science Olympiad.

I have thoroughly reviewed the Course of Study: Science (Bulletin 2001, No. 20). While the document is impressive, I provide the following comments.

1. The emphasis on the scientific process at all levels of education and the application to the real world is exemplary. In the revision this should only be increased.
2. The emphasis on scientific knowledge and scientific content is exemplary.
3. The inclusion of inquiry based instruction with first hand observation and data collection with problem solving is a significant learning strategy. This emphasis in the 2004 revision should only be increased.
4. The emphasis on technological proficiency in the operation of scientific equipment and in the retrieval information from the internet should only be increased.
5. The teaching of the concepts of evolution by natural selection in the 9 - 12 grades is well represented. It would be helpful to increase the lists of "examples" provided in the document to include:
    a. the process of fossilization and radioisotope dating
    b. comparative anatomy
    c. DNA sequence and molecular biology
    d. embryology
    e. biogeography
    f. stratography

6. The theoretical mechanisms involved with the theory of evolution by natural selection should provide additional examples. These include
    a. genetic drift
    b. mutation of genetic material
    c. migration into and out of a population
    d. natural selection

I can not over emphasize the importance of including in the science curriculum the concepts and scientific evidence for evolution of the species. It is imperative for the students of Alabama to be well informed and to be competitive in the science arena of the university and their future professional careers. To exclude any component of the science curriculum, including evolution, we are handicapping our students and limiting their interest and progress in the sciences.

As a Christian and a scientist I am not opposed to the inclusion of creationism in the school curriculum. However, there is no place in the science curriculum for creationism in light of the fact that creationism is not supported by science. Creationism is more likely to be included into a civic or sociology curriculum.

Sincerely yours,

Ronald L. Jenkins, Professor
Department of Biology
Samford University
Birmingham, AL 35229
Work : (205) 726-2947
FAX: (205) 726-2479
Email: rljenkin@samford.edu

Ellen Buckner moved that the letter to Martha Donaldson be placed on the Academy web site in the next week. Betsy Dobbins seconded. Motion passed unanimously. A discussion then arose as to what observations or comments would be put on the site regarding this issue. A copy of the letter was distributed to members.

Ron Jenkins reported that there will be a vote under New Business for qualified and willing candidates for the position of Treasurer and the position of Journal Editor. He also asked for new suggestions for the Symposium.

3. Larry Davenport **(First Vice-President)** submitted the following written report for activities for the past year:

- Served as Nominations Committee; nominations presented 17 March 2004 at University of Montevallo meeting; see list below*
- Attended site visit at Birmingham-Southern College, 20 July 2004
- Assisted President Ron Jenkins with decisions of the Academy

*The slate of Academy officers for 2004-2005 is the following, with those serving new or renewed positions printed in boldface:

President: Ron Jenkins (2005)

President-Elect: Larry Davenport (2005)

Second Vice-President: David Nelson (2005)

Secretary: M. Peggy Hays (2007)

Treasurer: Betsy Dobbins (2006)

Editor: Jim Bradley (2005)

State Counselor to the Junior Academy: B. J. Bateman (2005)

Associate Counselor to the Junior Academy: Henry Barwood (2007)

Associate Counselor to the Junior Academy: Wanda Phillips (2005)

Coordinator of State Science Fairs: Virginia Valardi (2006)

Coordinator of State Science Olympiad: Jane Nall (2007)

AAAS Representative: Steve Watts (2007)

Trustees: Wayne Finley (2005)
Ken Marion (2005)
Prakash Sharma (2005)
Walter Wilborn (2005)
B. J. Bateman (2006)
Dan Holliman (2006)
Joe Thomas (2006)
Ellen Buckner (2006)
Larry Boots (2007)
Gene Omasta (2007)
Adriane Ludwick (2007)
Mike Moeller (2007)

4. David Nelson (**Second Vice-President**) attended meeting. No report.

5. M. Peggy Hays **(Secretary)** reported:
   - Recorded minutes of the evening Annual Business Meeting, March 19, 2004, at the University of Montevallo
   - Accepted electronic data base from outgoing secretary Dail Mullins
   - Transferred all checks received for dues along with an electronic Dues Transmittal Log to the Treasurer after recording information on the master roll
   - Supplied the Journal editor with membership rolls and mailing labels as requested
   - Provided Mark Meade, membership chair, with a membership list that included those members who have paid annual dues
   - Made requested address changes to the master data base upon receipt of information from individual members
   - Responded to individual member requests for information on poster and paper presentations, section chairs, fees, and accessing materials on the Academy website

6. Betsy Dobbins **(Treasurer)** submitted the following documents and report:

The treasurer's report consists of the following:

ALL ACCOUNT BALANCES as of October 26, 2004
INCOME AND EXPENSE STATEMENT as of October 26, 2004
ACTIVITIES RELATIVE TO THE 2003 BUDGET
TREASURER'S SUMMARY REPORT BY ACCOUNT (1/1/03 through 10/26/04)
TREASURER'S SUMMARY REPORT BY QUARTER (1/1/03 through 10/26/04)
PROPOSED BUDGET 2005 vs. 2004
GRAPH TOTAL INCOME AND EXPENSES 2003 VS 2004

The current annual income for the Academy is $37,712.17. To date, expenses have exceeded income by $1,222.93, which is less than in previous years: $1,410.61 for 2003, $3,993 for 2002 and $2,286 for 2001. Total income to date is ahead of last year. We received a check from Montevallo for the 2004 meeting. We also received both the 2003 and 2004 ISEF check from the State, and there was a slight increase in Gorgas income and Journal income. Due to the timing of interest payments on our CDs, there has been a slight decrease in interest income from last year. Dues income is below the 2003 level, but we usually receive approximately $3,000 in the final quarter.

The expenses to date are $9,201 more than in 2003. This difference is primarily due to $9805.77 more in Journal expenses and $600 more in student research grants. In 2003 only 1 journal was published, but three have been published this year. Unlike 2003, we did not award a Mason Scholarship ($1,000) nor have we given the budgeted $1,600 to the Junior Academy.

A copy of the proposed budget for 2005 is also attached. The budget has been minimally altered to reflect the real expected income from the annual meeting (-$500) and the continued trend in increased journal income (+ $200). The expected dues remain stable at $9,000, though we may only collect $8,000 for this year. Changes in expenses reflect the real cost of the Gardner award (+$30) and a reduction in typing expense for the Journal (-300). The flow-through expenses for ISEF are maintained at $20,000 to reflect the Arizona location.

- Following presentation of the official report, Betsy Dobbins concluded that revenue usually increases by $3,000 in the last quarter. She emphasized that the Academy is close to budget but since the predicted revenue for the annual meeting does not match the revenue received, that the budget ought to reflect this difference.
- Ron Jenkins complimented Dr. Dobbins on the thoroughness of the Treasurer's report.
- Larry Krannich emphasized that the dues received to this point are $4215.00 which is below the budgeted amount. He will prepare a Dues Statement that can be sent electronically to members on the membership roster.

7. Jim Bradley **(Journal Editor)** submitted the following report:

I am away on professional improvement leave until January, the following items are presented.

- Although I greatly appreciate the work that Richard Hudiberg did in order to allow abstracts to be submitted electronically, the process did not facilitate my gathering and getting ready for publication the abstracts. In fact, it was sometime this summer after I'd already left town on sabbatical before my wife received the disk containing them. Now the problem is for her to find a place and the time to print them all off in my absence. The snail mail way, although antiquated by some peoples' estimate, was preferable to me, and I'd suggest that we return to that for this next year using the same deadlines and instructions as we used for the 2003 meeting.

- I am still interested in the Academy identifying a good person(s) to take over the editorship of the journal. I will fill out my term if nobody can be found before then, but I'll definitely not be interested in another term after this one.

- Publication of the journal is way behind schedule, but I do now have all of the material needed for all three volumes for 2004 and plan to get those out in rapid succession when I return to Auburn before the holidays. Auburn University continues to subsidize the Journal at the regular amount of a bit over $4000/year.

Following the reading of the Journal Editor's report by Ron Jenkins, Richard Hudiburg recommended that we confer with the new Journal Editor regarding the form to submit but still use one that would easily go to the Journal.

Betsy Dobbins moved that the Academy continue with the electronic submission of the abstracts with an option to also be sent in bulk in hard copy or on a disc. Eugene Omasta seconded. Motion passed.

Ellen Buckner complimented Jim Bradley for his solicitation of the first-ever papers for the Bioethics Section.

8. Benjamin Bateman **(Counselor to AJAS)** submitted the following report:

2004 Annual Report of the Alabama Junior Academy of Science
and the Junior Science and Humanities Symposium

State Officers/Counselors Meeting

The State Officers and the State Counselors met at Jacksonville State University to discuss the State Officer's roles for the upcoming year (2003-2004).

Fall AAS Executive Meeting

The State Counselor (B. J. Bateman) attended the Fall Executive meeting of the Senior Academy of Science held at Southern Research

Center. A report was given concerning the forthcoming annual meeting to be held at the University of Montevallo.

Annual Meeting

The 2004 Annual Meeting, like all previous meetings of AJAS, was shared jointly with the Alabama Academy of Science. The host institution was the University of Montevallo
Cindy Tidwell, local arrangements for the AJAS, B. J. Bateman, Counselor to the AJAS, and Wanda Phillips Associate Counselor, planned registration procedures, space needs, and arrangements for the AJAS-JSHS social and banquet. Registration was held at the Best Western Inn in Calera.

Highlights of the program were:

- Paper Competition - The paper competition was conducted on Friday morning In Harmon Hall. Alexander Dillard was chosen to be the overall winner and would therefore represent Alabama in national competition held at Baltimore Maryland. April 28-May 2. Of the other three state winners (Auroop Roy, Jennifer Taylor,and Cassie Byrom) only Cassie, Jennifer and B. J. Bateman as well as Linda Kanipe would accompany Alex to Baltimore.
- Banquet - More than one hundred students, teachers, university professors, and members of business, industry and government shared the Friday night banquet at the University of Montevallo Anna Irvin Dining Hall. A major part of the after-dinner program was the recognition of the first and second-place winners of the paper competition, and other competitions On alternate years the Junior Academy is responsible for the banquet speaker. This year's speaker, Dr. Mike Hardig, University of Montevallo who spoke on the conservation of wetlands.

- AJAS-JSHS Social Activities- A tour of the University of Montevallo "Ghosts" was after the banquet.

- Business Meeting - The customary AJAS business meeting was held on Saturday morning. This provided a time for awarding a plaque to the outstanding region, a certificate and a check to the outstanding teacher(s), and other awards.

Final Results for 2004 State Science JSHS Paper Competition

Biological Sciences

1st Place	Jennifer Taylor	Bradshaw HS
2nd Place	Kimberly Trawick	JCIB
Best for the Least	Lauren Bradford	Brooks HS
Honorable Mention	Christel Clark	JCIB

Engineering

1st Place	Cassie Byrom	Brooks HS

Mathematics/ Computer Science

1st Place	Auroop Roy	Bradshaw HS
2nd Place	Nirmal Choradia	The Altamont School
Honorable Mention	Jonathan Kentros	The Altamont School

Physical Sciences

1st Place	Alexander Dillard	Bradshaw HSI
2nd Place	Roshan Ahmed	Bradshaw HS
Best for the Least	Chris Phare	JCIB
Honorable Mention	Chris Phare	JCIB

Grant for the Bertie Mae Warren Research Awards
Jennifer Taylor
Heather Hollis
Lauren Bradford

AAAS Award	**Outstanding Region**	**Outstanding Teacher**
Lauren Bradford	Northwest	Linda Kanipe

Newly elected officers for 2004-2005:

President	Lauren Bradford	Brooks High School
Vice-President	Jenny Taylor	Bradshaw High School
Treasurer	Alex Dillard	Bradshaw High School
Secretary	Elise McClanahan	Bradshaw High School

<u>JSHS Participants Attending the Annual Meeting</u>

32 students, sponsors, and counselors attended the annual meeting as JSHS participants.

9. Virginia Valardi **(Science Fair Coordinator)** -- No report.

10. Jane Nall (**Science Olympiad Coordinator)** submitted the following report:

Alabama Science Olympiad 2004-2005

Registrations are coming in as the November 1 deadline for Divisions B and C approaches. We have several new schools registering teams this year.

All dates are set for Divisions B and C, as well as most of the dates for the A tournaments. At present, scheduled are 4 A and 4 B tournaments, 5 Division C tournaments, plus both a State B and a State C tournament.

An additional host for a Division B (grades 6-9) tournament is needed.

National will be hosted by University of Illinois at Urbana-Champaign in May. Depending on our membership in compared with other states, we will send the first place state winning teams in B and C to Nationals and possibly the second places. For several years Alabama membership has been in top ten for the nation and has been invited to send the four teams.

The web master, David Peters, maintains the Alabama Science Olympiad web page (aso.jsu.edu), and continues to receive many compliments from people across the United States. It is updated as often as necessary and continues to be a valuable resource.

Director Nall is most appreciative of all those involved in providing "science at its best" to the students of Alabama! I have been asked to serve as Score Counselor for Division B at Nationals in May.

ALABAMA SCIENCE OLYMPIAD 2004-2005

Elementary Science Olympiad Tournaments

A1 **Geneva High School,** Mr. Robert Chambless, Geneva, AL

A2 **University of West Alabama**, Dr. Ketia L. Shumaker, Department of Biology, University of West Alabama, Station 7, Livingston, AL 35470 205-652-3406 kshumaker@uwa.edu

A2 **Jacksonville High School**, David Peters, 1000 George Douthit Drive SW, Jacksonville, AL 36265 (256) 435-4177, ESOatJHS@hotmail.com

A2 **Auburn University**, Dr. Greg Harris, Department of Mathematics, 218 Parker Hall, Auburn, AL 36830 harriga@mail.auburn.edu

Secondary Regional Science Olympiad Tournaments

B, C **University of Alabama**, Dr. Kevin Whitaker, College of Engineering, Box 870200,Tuscaloosa, AL 35486 (205) 348-2357. Contact Becky Snow phone (205) 348-1598, bsnow@coe.eng.ua.edu

B, C **Auburn University**, Dr. Steve Stuckwisch, Dept. of Mathematics, 108 Tichenor Hall, Auburn University, AL 36830. (334) 844-6575 sstuckwisch@charter.net

B, C **University of Alabama at Huntsville**, Mrs. Vanessa Colebaugh, 5019 Willow Creek Drive, Owens Cross Roads, AL 35763 (256) 922-5747 nessacita@comcast.net

B, C **University of South Alabama**, Dr. Steve Itaya, Dept. of Biomed Science, UCOM 6000, Univ. of South Alabama, Mobile, AL 36608 (334) 380-2710 sitaya@jaguar1.usouthal.edu

C **Jacksonville State University**, Dr. Robert Carter, Dept. of Biology, Jacksonville State University, 700 N Pelham Rd, Jacksonville, AL 36265 (256) 782-5144 rcarter@jsucc.jsu.edu

Secondary State Science Olympiad Tournaments

B **Huntingdon College**, Dr. Sidney Stubbs, 1500 E Fairview Ave, Montgomery, AL 36106 (334) 833-4430 sstubbs@huntingdon.edu

C **Samford University**, Dr. Brian W. Gregory, Assoc. Professor of Chemistry, Samford University, 800 Lakeshore Drive, Birmingham, AL 35229-2236, FAX: (205) 726-2479 bwgregor@samford.edu www.faculty.samford.edu/~bwgregor/

National Science Olympiad University of Illinois at Urbana-Champaign, May 20-21, 2005 State Director: Jane Nall, 31110 Wakefield Drive, Spanish Fort, AL 36527 (251) 621-2911, Fax (251) 625-7032, email drnall@hotmail.com Alabama Science Olympiad web page: **aso.jsu.edu**

11. Stephen Watts **(Counselor to AAS)** submitted the following report:

The annual meeting for the AAAS affiliates will convene in February 17-21, 2005 in Washington DC. The annual meeting will focus on "The Nexus: Where Science Meets Society". Some 17 tentative session tracks were proposed by the AAAS Program Committee, with topics ranging from emerging diseases in developing countries to genomics, nutrition, public safety, "disappearing cultures" and more.

Given the setting for the 2005 AAAS Annual Meeting in Washington, DC, discussions are expected to include science policy matters such as the U.S. Congress's view of science and technology ranging from the vanishing safety net for food security to research without consent.

All state Academies maintain an association with the American Association for the Advancement of Science. We are members of the Section on Agriculture, Food and Renewable Resources. We welcome the opportunity for any AAS member to attend the AAAS meeting on our behalf. Information about the AAAS can be obtained at www.aaasmeeting.org.

12. **Section Officers** Written reports were submitted for Sections V and IX.

- **Section V** (Physics and Mathematics, Kenneth Roblee)--In the 2004 annual meeting at the University of Montevallo, our section hosted a total of five oral presentations. During the business meeting the section members elected Dr. Henry Glotfelty from Samford University as the new section vice-chair. He was elected chair for 2003-04 year, but, due to a sabbatical, Dr. John T. Tarvin of Samford University was the chair. Thus, it was agreed that he would be the 2004-05 vice-chair.

  Another issue discussed was how to increase the number of participants for our section. It was recommended that the 2004-05 chair, Kenneth Roblee of Troy University, contact the chairs of the mathematics and physics departments in the four year colleges and universities in Alabama to encourage their faculty to participate in our section. It was also recommended that he recruit student speakers and solicit poster presentations by students for our section as well. The chair has contacts at several schools in the state, and said he would use these contacts to recruit faculty and student participants.

- **Section IX** (Health Sciences, M. Peggy Hays) –At the 2004 annual meeting, the Health Sciences section hosted 30 presentations, 22 oral and 8 poster. Robert Pieroni was the presiding officer for the morning session and Ruth Washington for the afternoon session. Dr. Washington was elected Section Chair and Dr. Pieroni Vice-Chair.

13. Larry Krannich **(Executive Director)** submitted the following report:

Since March, 2004, I have been involved in the following activities associated with the Executive Director of the Alabama Academy of Science position:

- Revised the membership recruitment flier that is being distributed to all section chairs.
- Met with Ron Jenkins, Clyde Stanton, Anne Curry, and BSC food service representative for a site visit (July 20, 2004) at Birmingham Southern College concerning the Spring 2005 annual meeting of the Academy. Decisions were made concerning the number of sessions to be held each day, registration fees, cost of banquet and executive committee dinner, and parking. All checks will be made payable to the Academy and BSC will bill the Academy for expenses.
- Prepared the Call for Papers for the 82nd meeting of the Academy that is being distributed to all Section Chairs in hard and electronic copy.
- Met with Jan Gryko, Section II Chair, to discuss increasing the participation of undergraduates and Alabama college and university Chemistry faculty in the Academy. The four local sections of the American Chemical Society in the State are being contacted to assess their willingness to co-sponsor a state-wide undergraduate research symposium with the Academy. This symposium would be held in conjunction with the annual meeting of the Academy.

- Prepared a PDF interactive membership application form for posting on the Academy web site.
- Prepared letters for mailing to Alabama colleges and universities to solicit financial support for the Journal.
- Met with the Gorgas Scholarship Committee.

Dr. Krannich then provided five copies of the revised recruitment flyer to each committee member and a copy of the elected officers for AAS for 2004-2005.

A discussion led by Ann Cusic explored the possibility of obtaining grants with a later opportunity for journal publications. Ken Roblee reported on the success of the Annual Math Competition at Troy State in obtaining sponsors.

It was moved, and seconded, that all reports be accepted as written or presented. Motion passed.

Committee Reports (C)

Local Arrangements (Clyde Stanton) submitted the following report and reviewed each item at the meeting:

The Local Sections Committee continues with preparations for the spring meeting at Birmingham-Southern College. This report presents information on catering options and facilities to be used during the meeting.

Facilities
We recommend use of the Elton B. Stephens Science Center and the Humanities Center. These buildings are in close proximity to one another and provide ease of movement between them. Both facilities are ADA compliant. Representatives of the Executive Committee have toured the Science Center and viewed the lecture halls and classrooms. The Science Center has three lecture halls, one with a capacity of 68 and the other two with capacity of 55 each. The Center also has three classrooms with seating capacity of 26, 28, and 32. All lecture halls and classrooms have A/V systems with dedicated personal computers. We will also make available several biology laboratories for use by the Junior Academy and/or Gorgas Scholarship Program, as needed.

The Humanities Center has nine classrooms with capacities ranging from 20-30 seats. Each of these classrooms also is equipped with A/V systems with dedicated personal computers.

All lecture halls and classrooms in both the Science and Humanities Centers are heavily scheduled during the spring term, particularly in the mornings.

Parking
Parking would be readily available during Spring Break. There are lots directly behind and beside the Science Center which could easily accommodate the needs of the meeting during Break.

Catering

Listed below is a comparative look at the costs of catering for the meeting both from an outside caterer and BSC's Valley Food Services, and with last year's costs. The preference for the host institution is to hold the conference during our Spring Break. This would be Wednesday March 30, Thursday March 31, and Friday April 1.

References for Creative Catering have been contacted and they have received positive referrals.

	Cost of Last year's conf.	**BSC Caf.**	***BSC Caf. during Spring Break**	**Creative Catering**
Wednesday executive dinner for 25 (not included in reg. fee total)	$14.00 per person	$10 to $15 depending on selection	$13.00-$19.50 per person 30% increase	$16.00 per person (Buffet style)
Thursday For 125	$31.00 per person (2 refreshment breaks, lunch, Social)	$28.70-$38.70 per person Continental Brkfast @ $3.20 per person. 2 Refreshment Breaks @ $2.75 each. Lunch @ $10-$15 per person. Heavy hors d'oeuvres Reception - approx $10 to $15 per person.	$37.31-$50.31 per person 30% increase	$32.00 per person (continental brkfast, 2 refreshment breaks, lunch, social)
Friday For 125	$36.00 per person (2 refreshment breaks, lunch, banquet)	$28.70-$38.70 per person Continental Brkfast @ $3.20 per person. Catered Lunch - $10 to $15 per person. 2 Refreshment Breaks- $2.75 each. Catered Dinner - approx $10 to $15 depending on selection	$37.31-$50.31 per person 30% increase	$37.00 per person (Cont. brkfast, 2 breaks, lunch, banquet)
TOTALS (approximate)	$67.00	$57.40 - $77.40	$74.62 - $100.62	$69.00

**BSC Caf.- Spring Break:*
To open up solely for a catered special event(s) held during a time when the campus population does not require our food services to be open and we are closed, an event MINIMUM total of $3,500 is required. That $3,500 would be billed regardless of any changes in your attendance guarantees once we are contracted by you to open and operate for your event(s). When we bring in the serving/set-up/production staff that is required just for that event(s), it causes our food and labor costs to increase by approximately 20 to 30 percent as opposed to when we are running a full operation with a full staff. The event meal/beverage prices listed above (during standard operation schedule) would have to be adjusted and increased by that approximate 20 to 30 percent, depending on your selections.

Following the report, the discussion centered on changing the original date of the Annual Meeting to the host's preferred date which coincides with their Spring Break, differences in food costs due to increased vendor rates with the change in date, separation of registration and banquet fees, student fees, the Thursday night social, moving from building to building for laboratory and classroom space, and the Interview Room and the judges for the Gorgas Competition.

Larry Krannich inquired if checks were to be made to AAS, adding that last year the online registration was done by Montevallo with costing sent to the Academy. Clyde Stanton agreed to review the set up at their web site. The consensus was that checks would be made to Birmingham Southern.

Larry Davenport moved that the registration fee for students be $35.00 per student for the whole program with a $5.00 incentive if early registration.. The Banquet fee would be at least $15.00. David Nelson seconded. Motion passed.

The consensus was to hold the Annual Meeting on March 30-31, April 1, 2005.

Finance (Eugene Omasta) submitted the following report: The Alabama Academy of Science continues to be in excellent financial condition with total assets of $74,265. The assets for the past five and three-quarter years as reported at the Fall Executive Committee meetings and Annual Spring meetings of the Academy are listed below:

Period	Assets (End of Period)	Change
1/1 -10/1999	$76,219	
1/1 - 10/16/ 2000	$72,814	-$3,405
1/1 - 10/12/ 2001	$71,763	-$1,051
1/1 - 10/12/ 2002	$72,197	$434
1/1 - 10/12/ 2003	$71,403	-$794
1/1 - 10/12/ 2004	$74,265	$2,862

Period	Assets (End of Period)	Change
1/1 - 12/31/1999	$85,330	
1/1 - 12/31/ 2000	$74,049	-$11,281
1/1 - 12/31/ 2001	$75,813	$1,764
1/1 - 12/31/2002	$72,813	-$ 3,000
1/1 - 12/31/2003	$74,800	$ 1,987

The dues increase of $5 annually and the reduction of the number of Journal Issues from four to three by combining the abstract issue with one of those three issues appears to have had a positive impact on the Academy assets.

Essentially the Treasurers proposed budget for 2005 has little change over the 2004 proposed budget. Income is projected to decrease by $300. This results from a projected decrease in dues which is partially offset by a slight increase in Journal income. This $300 decrease in income coupled with an expected decrease in Journal expenses and other moderate increases and decreases results in a projected deficit of $3,780. This compares to a projected deficit of $3,750 in last year's proposed budget.

I recommend acceptance of the proposed 2005 budget.

At the meeting, Dr. Omasta reviewed the above table depicting the variation in assets over the past five years. Ellen Buckner then recommended that consideration be given to pursuing more aggressive stocks. A discussion ensued as to whether there was a need for further exploration. No decision was made.

Michael Moeller seconded the motion to accept the budget as written. Motion passed unanimously.

Membership (Mark Meade)--No report.

Research (Stephen Watts)—Dr. Watts, who is on research sabbatical and unable to attend meeting, submitted the following report:

This year 26 students applied for travel awards to the Montevallo meeting. However, only 19 showed up to collect, and the remained monies were returned to the treasury. Awards were generally $35 depending on apparent need (distance to meeting). All were presenters. A total of $665 was awarded (Budgeted amount is $750). Seven "best paper/poster" awards were presented for a total of $350. In addition, 10 students applied for research grants. The committee evaluated the grants and most of these were awarded either the partial or fully-requested amount for a total of $2,000 (budgeted amount is $2,400). We decided at the previous meeting that requests for books will no longer be acceptable.

All categories of awards and activities were handled electronically for the first time. Several minor modifications may be needed for next year, but in general electronic submissions greatly improved the process and eliminated a gruesome paper trail.

Suggested modifications for the Research Grant Applicants:

1. Only accept applications from those students whose mentors are members (in good standing) of the academy, and that this information be provided on the application.
2. Provide financial officer information on the application.
3. Remind students that book purchases are no longer acceptable in research requests.

Larry and I discussed a few other electronic changes we might want to make in the system to make sure Section chairs have the appropriate information for those individuals participating in the paper/poster competition. Perhaps he might elaborate in my absence.

Ed note: Interestingly, JSU received about $1000 in research grants last year. Betsy sent their financial officer a check for $1000 for these research grants. The president of JSU then sent **me** a letter thanking me for **my** $1000 "donation" and sent me a personal tax donation receipt for "**my**" generous donation. Man, I love this job.

- Ann Cusic asked committee members at the meeting if certificates were given to students for their research awards. If that has not been done, Dr. Cusic requested that Stephen Watts make arrangements for the students to receive certificates.

Long-Range Planning (Ken Marion)—Marion reported on the issues that were discussed at last night's executive dinner regarding the need to:

- Hold popular symposium topics to draw students such as the stem cell research or environmental changes in the state. It all depends on how it is packaged. We need to stress positives such as diversity and interdisciplinary application.
- Continue to take a position, or modify a position, on issues on the web site
- Conduct a serious review of the annual banquet

Ellen Buckner recommended the symposium present informative topics on medicine and bioethics.

Auditing-Senior Academy (David Schedler)—No report.

Betsy Dobbins suggested it would be helpful to the Academy to have a description of what the internal auditor audits. It was agreed that president Ron Jenkins will write a letter to the senior and junior academy chairs requesting a description of the activities undertaken.

Auditing- Junior Academy (Govind Menon) —No report

Editorial board and Associate Journal Editors (Thane Wibbels) –No report.

Place and Date of Meeting (Thomas Bilbo)—No report.

Newsletter—Open

Public Relations (Richard Buckner)—No report.

Archives (Troy Best)—No report.

Science and Public Policy (Dail Mullins)—No report.

Gardner Award (Prakash Sharma)—

Dr. Sharma reviewed the history and the value of the award. He suggested the qualifications be placed on the Academy website to increase awareness of the award. It was agreed that president Ron Jenkins will write a letter to university presidents describing the award as one way of soliciting nominations for deserving individuals.

It was agreed to change the closing date for nominations for the award to December 31. Ellen Buckner inquired if there could be rollover of nominations from one year to the next. Dr. Sharma responded that he desires new nominations each year. He clarified that a plaque and citation are awarded but no money is attached to the award. The recipient doe not have to be an active member.

Carmichael Award (Velma Richardson)—No report.

Resolutions (Priscilla Holland)—Resolutions to be presented at the March meeting commending individuals for their lifetime service.

Nominating Committee (Larry Davenport)—See list of nominations under report submitted by Larry Davenport as First Vice-President.

Mason Scholarship (Michael Moeller) submitted the following report:

Last year we had two completed applications for the William H. Mason Scholarship. After reviewing all application materials and some difficult deliberations, the Scholarship Committee offered the scholarship to an applicant, who decided not to accept the award but go to pharmacy school. The Committee then voted to offer the $1000 award to Ms. Mary Wildman and Ms. Wildman accepted the scholarship.

The previous recipients of the William H. Mason Scholarship are:

1990-1991	Amy Livengood Sumner
1991-1992	Leella Shook Holt
1992-1993	Joni Justice Shankles
1993-1994	Jeffrey Baumbach
1994 -1995	(Not awarded)
1995-1996	Laura W. Cochran
1996-1997	Tina Anne Beams
1997-1998	Carole Collins Clegg
1998-1999	Cynthia Ann Phillips
1999-2000	Ruth Borden
2000-2001	Karen Celestine
	Amy Murphy
2001-2002	Jeannine Ott
2002-2003	(Not awarded)
2003-2004	Kanessa Miller
2004-2005	Mary Wildman

Attached to this report is a copy of an announcement that the committee plans to be sending soon to deans in schools of science and education within Alabama. Members of the AAS Executive Committee are encouraged to copy and disseminate this information.

- Betsy Dobbins reported that the award money has not yet been forwarded to Mary Wildman.

Gorgas Scholarship Program (Ellen Buckner) submitted the following report: The Gorgas committee met prior to the Fall Executive Committee meeting. The balance in the Legacy Endowment Account is $326,050 and available funds for 2005 are expected to be the same as in 2004.

We have received notification from Intel National Science Talent that they are considering dropping their State Science Talent Search affiliations. If that occurs, it will necessitate major changes in our application process.

We received a call from the Scholarship coordinator from Auburn University with concerns about their award commitments. They plan to revise their offering prior to the 2005 competition. Auburn has to this point had the most generous scholarship offering--4 years tuition to all finalists--so a change will probably be some degree of loss from that mark.

Finalists and winners form 2004 competition are attached as per a March 19, 2004 press release:

FOR IMMEDIATE RELEASE

Today the Gorgas Scholarship committee announced the rankings of the finalists of the 2004 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at the University of Montevallo, Montevallo, Alabama.

The winner of the first-place tuition grant of $4000 was:

Sergey Sergeyevich Sarkisov, 2305 Fleer Circle, Huntsville, AL, 35803, Virgil I. Grissom High School, 7901 Bailey Cove Rd, Huntsville AL 35802, Teacher-Deborah Ormond.

First alternate and winner of a tuition grant of $3000 was:

Hannah Elizabeth LeMaster, 122 Mauldin Avenue, Florence, AL 35634, Brooks High School, 5630 Hwy 72, Killen AL 35645- Teacher-Vicki Farina.

Second alternate and winner of a tuition grant of $2000 was:

Ashrit Reddy Kamireddi, 8011 Smoke Rise Road, Huntsville, AL, 35802, Virgil I. Grissom High School, 7901 Bailey Cove Rd, Huntsville AL 35802, Teacher-Lady Emrich.

Third alternate and winner of a tuition grant of $1500 was:

Alisha Sara George, 315 Star Trek Drive, Indian Springs, AL, 35124, Jefferson County International Baccalaureate School, 6100 Old Leeds Rd, Birmingham AL 35210, Teacher-Debbie Anderson.

Fourth alternate and winner of a tuition grant of $1000 was:

Shrayesh Naran Patel, 1066 Forestdale Blvd., Birmingham, AL, 35214, Jefferson County International Baccalaureate School, 6100 Old Leeds Rd, Birmingham AL 35210, Teacher-Debbie Anderson.

(F) National Finalist, (S) National Semi-finalist

Unranked Finalists

Roshan Ara Ahmed, 338 Robbins Beach Road, Killen, AL, 35645, Henry A. Bradshaw High School, 1201 Bradshaw Dr, Florence AL 35630, Teacher-Lori Chittam.

Elijah Wade Riddle, 408 Seminole lane, Trussville, AL, 35173, Jefferson County International Baccalaureate School, 6100 Old Leeds Rd, Birmingham AL 35210, Teacher-Debbie Anderson.

Auroop Mukherji Roy, 510 Robinhood Drive, Florence, AL, 35633, Henry A. Bradshaw High School, 1201 Bradshaw Dr, Florence AL 35630, Teacher-Lori Chittam.

Natasha C. Sanderfer, 4259 County Road 31, Killen, AL, 35645, Brooks High School, 5630 Hwy 72, Killen AL 35645- Teacher-Vicki Farina.

The rankings were established by a panel of judges consisting of department heads, deans and professors from many of the leading universities and industries in Alabama. Winners and finalists in the Gorgas Contest receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Scholarship Program is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the United States Army. The purposes of the Gorgas competition are to promote interest in science and to aid in the education of promising students.

Electronic Media (Richard Hudiburg) submitted the following report:

- I responded to various requests from the President of AAS and other members concerning changes to the AAS website. I posted the updated information for Alabama Academy of Science officers, committees, and section officers for 2004-2005.
- I responded to various requests from the Executive Director of AAS to post information to the AAS website. I posted call of papers information for the 82nd annual meeting and an interactive membership application form.
- I renewed web hosting support (one year - $93.24) for the Academy website: http://www.alabamaacademyofscience.org through PowWeb Hosting.
- I posted information for the 2004-2005 Gorgas Scholarship Competition on the Academy website.

- I assisted the editor of the Journal of the Alabama Academy of Science in the collection of 151 paper abstracts that were e-mailed to the AAS website. I checked the format of all the abstracts submitted and assisted in correcting some abstract format problems.
- I am in the process of revising on-line paper and poster title submission forms for each section of the Alabama Academy of Science for the 82nd annual meeting. The web site will have on-line submission forms for the Committee on Research paper and poster competition and travel.
- I will update information and add links for the 82nd annual meeting at Birmingham Southern College on the Academy website.
- POP3 e-mail addresses (up to 100) are available to AAS officers through the Academy website. If you wish an e-mail account e-mail me at the following address: rhudiburg@alabamaacademyofscience.org.

It was moved, and seconded, that all reports be accepted as written or presented. Motion passed.

Old Business (D) There was no Old Business.

New Business (E) Several items were discussed:

- Ron Jenkins announced that with the anticipated resignation of James Bradley as editor of the Journal following the March meeting, there is one candidate, Safaa Al-Hamdani, Jacksonville State University. His personal web site is at www.jsu.edu/depart/biology/alhamdani.html. He will not accept the position until he knows the qualifications. Dr. Jenkins agreed to approach him with the job description. Sue Bradley has agreed to still do the page layout. The editor can send to the printer of his choice.
- Ken Marion moved, seconded by David Nelson, to offer the editorship of the Journal to Safaa Al-Hamdani. Passed unanimously.
- With the resignation of Betsy Dobbins as treasurer after the fall meeting, there is one candidate, Mijitaba (Taba) Hamissou. His credentials can be reviewed at his web page at www.jsu.edu/depart/biology/hamissou.html. We need to appoint a new treasurer immediately. Dr. Hamissou is willing to meet with Dr. Dobbins this next Tuesday and to take immediate responsibility.
- Ron Jenkins moved to accept Dr. Hamissou as the new treasurer, seconded by David Nelson. Motion passed unanimously.
- Ken Marion suggested that a resolution be prepared to present to Betsy Dobbins at the March meeting.
- Ron Jenkins suggested potential topics for the March 2005 Symposium, emphasizing their importance and that they could draw news reporters and spotlight the Academy. The topics are:
    - The Teaching of Evolution in the Classroom as this topic carries educational, political, religious and scientific significance.
    - The Canaries of Alabama due to the changes in the state such as climate, ground water, plants, loss of native habitat, environmental toxins, the increasing number of endangered species, and the decline of such animal groups as amphibians and butterflies.

- Stem Cell Research as it is underway at Lake Shore Hospital and the University of Alabama at Birmingham. In addition, the Academy has the new Bioethics Section.

- It was the consensus of the committee that evolution and canaries of Alabama were not as important now as stem cell research and its application. It was decided that Ron Jenkins, Larry Krannich, and David Nelson would contact the appropriate persons for presentations on stem cell research for the March meeting. The honorarium for the speaker will also be explored with a suggestion of $800.00 with $75.00 for expenses.
- Ellen Buckner encouraged an early date for papers to be submitted for the March meeting. Ken Marion asked for a deadline. Ron Jenkins said a decision would be made in 2004.
- Betsy Dobbins strongly recommended getting ready now for 2006.
- It was the consensus of the committee that Clyde Stanton as Local Arrangements Chair, arrange for the Banquet Speaker as per the last two Annual Meetings.

Adjournment (F) The meeting was adjourned at 12: 35 p.m.

M. Peggy Hays
Secretary

INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained on the Academy's web site: www.alabamaacademyofscience.org. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology: Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics, Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Submission: Submit an original and two copies to the editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. An abstract not exceeding 200 words will be published if the author so desires. Use heading and subdivisions where necessary for clarity. Common headings are: **Introduction** (including literature review), **Procedures** (or **Materials and Methods**), **Results, Discussion**, and **Literature Cited**. Other formats may be more appropriate for certain subject matter areas. Headings should be in all caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Skip footnote number(s) if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under **Literature Cited.** Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text parenthetically by author-date.

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