Recently, the Bush administration planted a flag on ethical high ground by updating the charter of the federal advisory committee that addresses the safety of human research subjects to consider the welfare of human embryos along with that of fetuses, children, and adults.

That decision was not, as some critics have charged, the result of inappropriate religious intrusion into policy governing science. The Department of Health and Human Services charter contains no spiritual language, no appeal to supernatural knowledge, nor any reference to religious authorities. Rather, the inclusion of human embryos in discussions about vulnerable human research subjects happens to be the most reasonable response to the latest scientific evidence concerning the nature of nascent human life.

In the mid-nineteenth century the German anatomist Ernst Haeckle could claim that the human embryo was a simple cell containing merely "homogeneous globules of plasm." Prior to the advent of molecular biology, no one knew otherwise. Lacking a precise scientific account of the microscopic physiology of miniature human life, if one believed the human embryo to be anything more than a splatter of sticky protoplasm, one had to look outside of science--and often to religion--to defend speculation about unseen details of hidden form and animation.
All that changed in June 2000 when the Human Genome Project international consortium announced that the mapping of the human genome was complete. Publication of the human genetic blueprint has forever transformed the way we think about humanity and, indeed, about early human life. As attention has shifted from the study of single genes to the contemplation of all genes, one fact has become intriguingly conspicuous. The human embryo, from the moment of conception, possesses a complete and distinct human genome.

The Human Genome Project, by having published but one example of a human genome, has made the point that even a solitary copy is meaningful. Every embryo of human origin is genetically a member of the human species, is genetically male or female, and, with the exception of identical twins and (hypothetically) clones, is genetically unique. The extraordinarily detailed genetic montage of a new human embryo resulting from the recombination of maternal and paternal DNA forms a living entity that differs from every other entity that has ever existed. Moreover, through the genome the continuity of human genetic identity is maintained throughout an individual's lifetime. The genome seated within the zygote, the first cell of the human life span, is the very same genome a person will have in old age. The Orwellian terms "pre-embryo" and "potential human being" no longer have any scientific validity.

The genome is simply the sum of hereditary information for the species. Written in the molecular language of DNA and organized into genes, the genome encodes all the instructions the organism needs to synthesize cellular building blocks and develop from an embryo into a unique, mature individual with a beating heart, sensitive fingers, and a brain that even in toddlers vastly outclasses the most advanced computers. Although microscopic in size, the human genome is enormous in its information content. Its 3.1 billion nucleotide base pairs are arranged along a double helical strand of DNA that, if removed from a single cell and stretched out, would measure more than five feet long, but only 50 trillionths of an inch in thickness. If written out as a book, the human genome would take up the equivalent of 200 volumes the size of a Manhattan telephone book at 1000 pages each. It would take 19 years to read aloud without stopping, at 5 bases per second, the entire sequence of the genome within the nucleus of the human embryo.

To enter the embryo through the eyes of science is to find, not a dormant structure frozen in time but, in the words of Richard Swenson, "a protoplastic pyrotechnic factory in hyperdrive." Much more than a genetic repository, the embryo is actively engaged in transcribing and translating the genome, synthesizing proteins and macromolecules, arranging intracellular architecture, taking in nutrition, burning oxygen for cellular metabolism, and strategically directing the complex process
of cellular specialization on a deliberate trajectory toward actualization of all the functional
capacities that typify a being of the species *Homo sapiens*. Life has begun. And with each cell
division the embryo duplicates the entire genetic library with nearly perfect fidelity.

If the embryo were not so busy, he or she might take a moment to wink at the thousand scientists
who labored for 15 years to sequence the complete human genome. Hailed as "a massive
project on a scale unparalleled in the history of biology," and at a cost of hundreds of millions of
dollars, the Human Genome Project has yielded a staggering volume of data. The only problem
is that science knows how to read only a small portion of the genome. The underrated human
embryo can read it all.

That the life cycle of a person could begin as one tiny cell is as amazing as anything in science.
That wrapped up within the nucleus of the human embryo could be found the complete genetic
design for a being capable of learning, love, and laughter, of sonnets, science, and space
exploration is beyond comprehension. Having discovered this, one can only respond in awe.

Sequencing the human genome, like all important scientific discoveries, has brought to light fresh
questions. Many of them are scientific. What is the function of the expanses of DNA that do not
encode genes? What are the complex interactions that occur between the genome and the
environment? How can only 30,000 genes (a number lower than predicted) explain all that we
know about human biology?

Other questions lie beyond the reach of science. Whereas science deals only with those things
which are objectively quantifiable and empirically verifiable, not all truth fits into such categories.
The discerning investigator will look also for the indirect evidence provided by science where the
record of nature points to something just beyond the limits of scientific inquiry. Nowhere is this
more evident than in the compactness, elegant order, and irreducible complexity of the human
genome, which time and chance alone fail to explain. Codes are not known to arise
spontaneously. Though molecules can carry them, they cannot generate them. Codes are the
result of creative mental process. For there to have arisen a genetic code of life, there must be
an inconceivably wondrous intelligence behind the code.
Science informs us that the human embryo is, objectively speaking, an early human life, and the same kind of being, a human being, as the scientist. But while science is competent to judge what *is* a human life, science has nothing to say about *what it means* to be human. Questions of meaning cannot be resolved by empirical means alone but require judgment, reflection, dialogue, even revelation. It would be a mistake to think that science has replaced faith. Furthermore, if adult humans have capacities that science is incompetent to measure, for example, consciousness, awareness of personal identity over time, free will, striving for purpose, hope, willingness to self-sacrifice, and spiritual aspiration, then the inability of science to locate the emergence of these qualities even in the human embryo is no proof that they are not integral to human life, hence present from the beginning of life.

Francis Collins, Director of the U.S. Human Genome Project, commented that, "We have caught the first glimpse of our own instruction book, previously known only to God." The Human Genome Project has not demystified human nature. Rather, the astonishing detail it has revealed about the human organism gives us new reasons to respect human life at all stages of development. No longer can an observer familiar with the science of the human genome reasonably hold to the belief that a biologic discontinuity separates the embryo from the human adult, for development occurs along a continuum of at least genetic identity. No longer can a reasonable justification for the utilitarian agenda of destructive embryonic stem cell research be found in claiming that the human embryo is some other species.

Thanks to science, arguments that dehumanize the human embryo now belong to a withering and overturned paradigm of the past. Those who choose to cling to that paradigm may find their place in history alongside the U.S. Supreme Court justices who, in the 1857 Dred Scott case, ruled that African-American slaves were not persons but personal property.

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4 http://www.ornl.gov/hgmis/faq/faqs1.html

5 Swenson, p. 61.


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