



Recently, one of the members of ITEST wrote to me about a recurring question in the faith/science dialogue. Where are the Catholic scientists? Aren't we producing enough or aren't we reaching enough? Where are they? I answered as best I could — speaking only about Catholics. My experience is not so great when it comes to Protestants and other believers but I suspect that there's not all that much difference.

That letter called to mind a letter I received from a nuclear physicist almost twenty years ago. He told the story of a meeting he attended somewhere or other. He mentioned that four people from the Oak Ridge Lab attended the meeting as well. When Sunday came they met on the steps of the church — much to their mutual surprise. None had the remotest idea that any of the others were Catholics. As he said: "Catholics in science don't tell their colleagues that they're Catholic; they don't tell their pastors that they are scientists." How can we reach them and their colleagues to tap their expertise and enthusiasm?

How can ITEST members, either individually or collectively, change this situation. We know that it is important, nay, urgent, for Catholics (and Protestants, Jews and Moslems) to be visible in the scientific community — as religious people. One of the problems is that Catholics may not so identify themselves because they realize there's nothing Catholic they can bring to the table, either because of lack of interest or a lack of education. Some scientists are inundated with professional responsibilities of one kind or another ("publish or perish") and others must live and act in an anti-Christian atmosphere, maybe especially in academia. Let us know why this situation is the way it is or how to do things better; we'll get the message out to all ITEST members. It's part of our baptismal privilege. We need to know the situation and we need ways to make it better — unless we don't think it urgent. Maybe in the glare of eternity it isn't; but in the "darkness" of this life it seems to be critically important. Please help us with this effort to raise up Catholic and Protestant scientists and scholars.

In the meantime, may each of you have a blessed and joyous Easter.

Robert Brungs, S.J.

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ANNOUNCEMENTS

1. All is in place for the October 16-18, 1998 workshop, *The Future of the Family/The Family of the Future*, a topic of long-term interest for the members of the Board. Essayists and topics include: Professor Robert Bertram, "Sain"* Sex; S. Timothy Prokes, FSE, *Convergence of Trinitarian Mutuality and Technological Truth*; Peggy Keilholz, *Family in the 21st Century: Speculation about the Family of the Future*; Kenneth Schmitz, PhD, *Philosophy of Marriage and the Family*. Promotional materials and invitations to the workshop will be sent out shortly to members. If you know of any church agency staff who would be interested in this topic, let us know and we will include them on the mailing list. Again, the place is Fordyce Conference & Education Center on the bluffs of the Mississippi in South Saint Louis, MO. Early pre-registration will insure you a place at the workshop. Space limitations necessarily impose on us a total of 55 participants.

*Old term for the sign of the cross.

2. You should be receiving the edited proceedings of the October, 1997 workshop: *Evolution AND Creation* soon. Because this workshop sparked so much interest, we ordered extra copies of the book for those who might want to purchase it for friends or colleagues.

3. ITEST received media requests for interviews on the October, 1997 workshop topic, *Evolution AND Creation* resulting in an article from a phone interview with Brungs by Molly Mulqueen of the *National Catholic Register*. (See volume 74, No. 10 issue of the March 8-14, 1998 NCR for the write-up.) Mulqueen spoke to Dr. Michael Behe, essayist at the ITEST workshop and author of *Darwin's Black Box*, for that article as well as Philip Johnson, legal scholar and teacher of law at the University of California, Berkeley and Frank Sherwin, a creation scientist and director at the Institute for Creation Research in Santee, California. All in all, a well-balanced portrayal of the Evolution/Creation "debate".

4. A reminder to mark your calendars for the big celebration of ITEST's 31st anniversary in 1999 at Loyola University, the Lake Shore, Campus in Chicago, **August 1** (evening) to **August 5** (noon), 1999. Join us for this joyful event! We encourage family attendance since we are planning activities for all ages in addition to the formal meetings. Look for more information and a progress report in each upcoming bulletin. As soon as we have the two main speakers, we will let you know.

5. We think you will like our re-designed Web Site. Although we were pleased with the original design, we decided to proceed with a change mainly because some of you who use a web browser other than NetScape found it difficult to see the text clearly on the opening pages of the Web Site. If you access the site now at <http://ITEST.slu.edu>, you should have no difficulty reading the material. We are also increasing the list of faith/science groups on the "related organizations" so that cross-linking will be easier for those researching faith/science issues. You may want to suggest such a group for inclusion if they are not already on the ITEST list. In turn we have asked these groups to list us on their "links" pages.

We have recently added to the Web Site selected proceedings of the 1970's that are out of print. Eventually we will have the entire 20 sessions of the Seventies on the Web.

6. Available for purchase at \$6.95 each (discounts for orders over 5), *Readings in Faith and Science* (1997) - discussion guide for campus ministry and adult education or parish discussion groups. A review of *Readings* appears in the Feb., 1998 issue of *Initiatives*, the newsletter of the National Center for the Laity, based in Chicago. The reviewer states, "Throughout (the book) the relationship or lack thereof between the religious community and the scientific community is taken seriously and the influences of the two communities upon each other are considered in detail." Finally, "The overall thrust toward mutual benefit (science/religion, science/faith) communicated in these articles is wonderfully refreshing."

7. We are looking for articles for the Bulletin and/or for a projected Volume II of *Readings*.... If you have anything ready on faith or science, send it in to us and it will be given every consideration. If you e-mail your article as an appended document, please send it in any form of WordPerfect (up to 6.1) or, to be even safer, in ASCII. We will also accept hard copy or a floppy disk.

8. Although we send personal notes of thanks to those who contribute generously to ITEST, we understand that not everyone can contribute a large donation to the ITEST ministry. In any case we want to thank those too who can send only "a widow's mite." A number of members send an extra \$5 or \$10 or more with their dues as a gesture of generosity. Thank you! We appreciate it.

SCIENCE AND TECHNOLOGY IN CLONING — FROM SHEEP TO HUMANS WHAT ARE THE POSSIBILITIES OF HUMAN CLONING

Robert J. Collier

[Dr. Robert Collier is a Senior Fellow at the Monsanto Company in St. Louis, Mo. He is Preclinical Research Director: Monsanto Agricultural Company. He is also a member of the Board of Directors of ITEST. This paper was given as a talk to the clergy of the Diocese of Lincoln, Nebraska and was also presented as a talk at Tulane University.]

INTRODUCTION

The pace and scale of breakthroughs in mammalian reproduction and genetics in 1997 has stunned the world. First Dolly, then Polly and finally Gene demonstrated cloning both by nuclear transfer of cells from an adult animal as well as fusion of embryonic stem cells and fertilized enucleated ova to produce duplicate copies of domestic animals (sheep and cattle). Clearly, the cloning of humans (adult and embryonic) had become a real possibility. A ban on public funding for human cloning was quickly enacted by President Clinton. The Federation of American Societies for Experimental Biology (FASEB) followed with a voluntary 5-year moratorium on human cloning. However, in July, the culture of the first human stem cells was announced providing the evidence that cloning of humans was a step closer. Also, the rapid pace of various genome programs continued with the addition of the one billionth base to the National Genome Database. We are now collecting the genetic sequences of 25,000 different species of animals with no end in sight and the human genome data base is scheduled to finish essentially on schedule around 2005. These events have ignited a worldwide public debate over the scope and control of these technologies. The objective of this paper will be to describe these technologies and their development as well as the forces which have shaped them. The paper which follows discusses the ethical and moral issues raised.

HISTORY OF CLONING

In biology, the process of cloning is the production of an exact copy of a genetic sequence or the production of an organism containing the same genetic sequence as the founder. Cloning a genetic sequence is a routine component of many molecular biology techniques. Cloning plants has become commonplace in many parts of agriculture. Cloning animals is a recent development but its roots extend back into several fields of agriculture and biology. In the context of agriculture the process of cloning is a logical outcome of the desire to obtain the highest quality plants and animals and to maximize their genetics. This desire is

noted in Genesis 30:41-42 where Jacob uses a technique based on superstition to alter the coat color of the offspring from the best males and females but did not use this technique when the weaker males and females mated thereby imposing selection pressure on this uncle's flock. Since the offspring with imperfect coat color belonged to him he quickly built a flock of hardy animals and became wealthy.

It is generally believed that animals were first domesticated around 8000 B.C., but the process of domestication continues today. For example, numerous species of fish are being domesticated every year as populations of these species in the wild decline. Additionally, world population increases demand continued fish production via aquaculture. Domestication of plants and trees also continues. Availability of orchids has grown rapidly since the ability to clone them has developed and many forests are cultivated as a cloned crop rather than a wild assemblage. The process of domestication of some species and the exclusion of others has resulted in some describing nature as a "Social Construct" which is unique to each culture.

Although the process of domestication has been around a long time the use of production records to identify superior plants and animals did not occur until the 1800's. Artificial insemination of cattle was introduced in the 1940's which permitted use of only the best bulls in the national dairy herd. Today a few hundred "proven" bulls supply all of the semen used to inseminate 6 million dairy cows in the U.S. During the period that animal scientists were developing artificial insemination the concept of cloning embryos by transferring the nucleus from one cell to another (nuclear transfer) was first proposed by Hans Speman, a German embryologist in 1938. In 1953 James Watson and Francis Crick first correctly deduced the double helical structure of DNA and set the stage for the coming biotechnology revolution. About the same time the first cloning attempts using nuclear transfer were taking place using amphibians. It was not until 1970 that these attempts were successful but the resulting tadpoles did not mature properly. By 1984, a live lamb had been produced by nuclear transfer

using the cell from an early-stage embryo. In 1994, Neal First, of the University of Wisconsin, cloned a mammal from an advanced embryo using nuclear transfer. In 1997, the first clone of an adult was achieved. Thus, in the short span of 30 years mankind had moved from cloning frogs to cloning adult mammals. This was the result of several powerful technologies developing simultaneously.

As animal scientists were refining methods for maximizing the use of the genetics of the male through artificial insemination, reproductive biologists began addressing the issue of maximizing the genetics of the female. Practically, a domestic female animal has only a handful of offspring. Even litter bearing species such as the pig rarely exceed 20 offspring per pregnancy limiting their impact on the genetics of a breed. Rapid genetic progress could be made if two breakthroughs could occur. If genetically superior animals could be identified at the embryonic level the generation interval would be eliminated, increasing the rate of genetic progress and, if those superior embryo's could be cloned to produce thousands of copies, the impact of a single female on a breed or species would be greatly magnified.

Additionally, the several decade effort to find a cure for cancer had resulted in a great increase in the understanding of the cell cycle and how cell growth is regulated. The discovery of enzymes which could cut DNA and repair it resulted in an explosion of research in molecular biology and the production of transgenic organisms. The increase in fertility research in humans increased interest in regulating reproductive function in a wide variety of species which provided models for humans. Finally, the human genome project began the first serious attempt to link human physical traits with underlying genetic differences. All of these forces have converged upon the process of reproduction in general and the embryo in particular.

REPRODUCTIVE TECHNOLOGIES

Cloning is the outcome of many years of research into the regulation of reproduction. The interest in reproductive processes is directly influenced by both the need to reduce the rate of population growth of some species and improve the fertility of others (endangered species or domestic animals) This process involved understanding the factors governing the production of gametes (sperm and eggs), the culture and freezing of gametes for *in vitro* (outside the body) fertilization, gender (sex) selection, the culture of growing embryos and fi

nally the ability to split and eventually clone embryos in order to multiply superior genetic stock. All of these technologies are evidence of our continued interest in controlling the world we live in.

Gamete Collection

When farmers began collecting records of the productivity of animals, (milk yield, growth rate, disease incidence) they gained the ability to identify superior plants and animals in their crops and animal herds. Subsequently, they needed to multiply the genetic makeup of superior animals or plants by maximizing their breeding. In animals, this is most easily done by maximizing the use of superior males. This is because the male produces sperm far in excess of those required for fertilization of a single or even 20 ova. Therefore, artificial insemination was developed in order to collect the sperm of superior males for breeding as many females as possible. This also required development of the ability to freeze sperm for transport around the world. Today, approximately 150 bulls supply the sperm required to mate approximately 6 million dairy cows. However, since most females produce only a small number of offspring in their lifetime there was no way to multiply the genetic makeup of the female except by selecting her male offspring for subsequent breeding. This problem is solved with embryo cloning which permits maximization of the genotype of the female as well as the male.

Early in cloning research, it became clear that widespread application of this technology would be very dependent on the production of low cost ova (eggs) for fertilization. In order to fertilize ova *in vitro* (outside the body) and subsequently clone the embryo the process of ova culture was developed. This permits the collection of ova from unovulated ovaries after removal of the ovary from the animal or by transvaginal needle aspiration. Transvaginal needle aspiration utilizes ultrasound to locate follicles on the ovary inside the animal and subsequent aspiration of the ova by inserting a needle through the vaginal wall into the follicle. Using this technique, fresh ova can be collected from animals on a weekly or biweekly basis. In order to obtain ova on such a short interval the normal cycle of ovulation in the female is accelerated using hormones which stimulate greater than normal number of follicles to develop so more than one ova can be collected. The ova collected must still undergo maturation *in vitro* to reach the point at which fertilization can occur. Research is still underway on the best method for culturing and maturing ova *in vitro*.

Gender Selection

In many domestic animal species there is a need for gender selection. For instance, in the dairy industry only a few young bulls are required each year for use in artificial insemination. The vast majority are raised as veal or dairy steers which represent much lower profit opportunity since the female can have several lactations, each producing more profit than a male calf or steer going to slaughter. Despite the fact that male calves in the dairy industry have little value to the producer compared to females, half of all calves born are male. Therefore, the ability to select embryos or sperm to produce only females has significant economic value. In the human population, there is interest in using gender selection of the offspring to avoid the occurrence of sex-linked diseases which occur only in one sex.

Gender selection can be accomplished by separating the x and y bearing sperm or by identifying the gender of the embryo and destroying the unwanted gender embryos. In order to identify x and y bearing sperm the semen is processed by flow cytometry which can identify the slight difference in sperm head size due to the x (larger) or y (smaller) chromosome. The y chromosome is smaller because it is missing one arm present in the x chromosome. This process is slow and time consuming and is used sparingly due to high cost. The alternative method is to remove a single cell from a multicellular embryo and determine the sex using genetic probes for the y chromosome. This process can also be used to identify the sex of a clone which need be done only once since all subsequent copies will be the same gender.

Embryo Culture

The successful production of *in vitro* produced (IVP) embryos is pivotal to the successful production of sexed, cloned and transgenic animals. The stages of cattle embryo development after hatching of the blastocyst are not able to occur *in vitro* and must occur *in vivo*. The cattle blastocyst hatches (breaks out of the protective covering called the Zona Pellucida) 8-10 days after fertilization and begins the process of elongation and development of the placenta. Despite several years of research the percentage of IVP embryos developing to the blastocyst stage has not exceeded an average of 26%. Thus the majority of IVP embryos are not viable for reintroduction to a host. Oocyte maturation involves two components, nuclear and cytoplasmic. Nuclear maturation is readily achieved during *in vitro* maturation (IVM) and it is generally regarded that cytoplasmic maturation is sub-optimal and largely responsible for the low develop-

mental rates during IVP. Typically ova and embryos are cultured in medium containing cells from the follicle or oviduct which secrete factors required for normal maturation. The embryo is undergoing rapid development and has hormonal and nutrient requirements that are typically supplied by the oviduct and uterus as it migrates into the uterus to implant or develop a placenta. If these hormonal and nutrient conditions are not supplied correctly the development of the embryo is affected and embryo death can occur.

Embryo Splitting

Embryo splitting is one way to exploit the superior genetics of animals. An assumption that is inherent in this approach is that one can identify superior animals at the embryonic stage. The procedure for embryo splitting is not complicated but requires delicate instrumentation. Using microdissection tools embryos are separated into two to four pieces. The split embryos are then transferred into the uterus of foster mothers for development. Animals that are produced from the same original embryo are identical twins and should be genetically equivalent. The highest success rate for the production of identical offspring occurs when embryos are split into halves, resulting in identical twins. Splitting embryos into four pieces can yield identical quadruplets, but the probability of pregnancy is much lower. Typically, the survival rate is less than half that of demi-embryos. Embryo splitting has several limitations, of which the most obvious is the low number of offspring resulting from the process. The second limitation is the fact that at the embryonic stage it is presently impossible to identify superior animals. The ability to clone animals that are adults and have proven their superiority is obviously much more desirable. However, until recently it was always believed that adult cells could not be reprogrammed to the embryonic stage.

Embryo Cloning

In 1986 a scientist at Cambridge University in England demonstrated that it was possible to produce clones by fusing a whole nucleated blastomere from a donor sheep embryo with an enucleated recipient oocyte. This process is called "nuclear transfer." The enucleated recipient oocyte appears to have the ability to reprogram the donor nucleus and tricks it into beginning development as though it were a recently fertilized oocyte. The ability of the enucleated recipient oocyte to reprogram the nucleus from the blastomere is believed to be due to regulatory proteins in the cytoplasm which are taken up by the nucleus of the blastomere. However, the process required a nucleus from a early stage embryo. A nucleus from a later

stage embryo would not successfully reprogram and it was generally believed that this was because the nucleus was differentiated and too far along the development pathway to be reprogrammed. Using this example it would appear to be impossible to reprogram a cell from an adult. Ian Wilmut of the Rosling Institute in Scotland proved this was wrong. He took mammary cells from an adult sheep and placed them into culture. He then starved the cells of hormones and nutrients required for growth and forced the cells into a stage of cellular development called G-0. In this stage there is no DNA replication going on since the cells have stopped dividing. When he transferred nuclei of these cells into a recipient fertilized and enucleated oocyte he successfully reprogrammed the nucleus from the adult animal to initiate embryonic development from the very beginning. He then inserted the developing embryo into a recipient animal and Dolly, the first clone of an adult animal became a reality. However, the success came after 277 failures and the process remains difficult.

The process of nuclear transfer now imparts the ability to clone adult animals but the numbers of animals that can be produced still remain relatively low. An immortal cell line could potentially produce unlimited numbers of cells for nuclear transfer as well as genetic manipulation. Recent developments have also occurred in this area as stem cell populations have been identified for several species including humans. Stem cells are undifferentiated immortalized cells which can provide the unlimited supply of nuclei for nuclear transfer. Therefore, the basic tools to produce a cloned population of animals exist. However, similar to the issue with splitting embryos, the stem cell population cannot be classified for its genetic value unless it comes from an adult which has already proven its genetic worth. Presently, stem cell populations are primarily from embryonic sources. These embryos are of unknown genetic value. Since it does no good to clone an animal unless it is superior, the value of the process is doubtful. Cloning adults or embryos that are transgenic and therefore of increased value are more valuable to the animal industry than producing copies of embryos of unknown value.

GENOMIC TECHNOLOGIES

Genomic technologies produce information relating the genetic makeup of an organism with its physical performance in a given environment. The human genome project is presently mapping the location of all human genes which will permit identification of genetic bases for human diseases. Similar programs are underway for many domestic plant and animal species in order to better understand the relationship

between an animal's genetic makeup and its productivity. Location of the genes which regulate animal growth, milk yield as well as plant production traits will allow improved genetic progress in identifying superior plants and animals. Location of genes will also permit moving certain genes between species in order to confer new properties to a plant or animal. Examples would be improved nitrogen fixation in plants, improved milk composition in cattle, improved food quality and improved pest resistance in plants. These are powerful technologies that go hand in hand with reproductive technologies to manipulate the genome for improved performance.

Chromosome Mapping

Most mammals have about 70,000-100,000 genes arranged along structures known as chromosomes. Each gene codes for a specific protein and each protein has a specific function at some point in the animal's life cycle. At any point in time only a portion of the genes are "expressing" their proteins. The code in each gene is made up of Deoxyribonucleic acid (DNA) which is composed of 4 nucleic acids or nucleotides. The sequence of nucleotides within DNA is called the genotype. The genotype varies across individuals within a species by slight variations in the sequence of nucleotides. This genotypic variation leads to phenotypic (outwardly visible characteristics) variation among animals. Phenotypic variation might be observed as differences between animals in coat color, milk yield, growth rate, behavior and thousands of other observable traits. The variation in sequence of some genes are not economically important. However, genes associated with disease resistance, milk production, growth rate, reproductive performance, to name a few, have great economic value to livestock producers. Therefore, mapping chromosomes to identify the exact location of genes and their sequence of nucleotides holds great promise for agricultural production as well as disease prevention and treatment in humans. However, the task of obtaining the entire genetic sequence of a species (genome) is a monumental task. The average genome of a mammal is about 6 billion nucleotide pairs. Obviously, the size of work involved is too large to obtain the genome map of many species. Therefore, the scientific community has focused on a few major species of interest. The genome with the highest priority is the human genome. Other genomes being studied include cow (bovine), pig (porcine), sheep (ovine) as well as several bacterial genomes. This list is not inclusive and presently partial sequences on 25,000 species exist in the National Genome Database (NGDB). Additionally, since sequences for given genes are highly conserved the human genome data base will provide a

template for identification of similar genes in other species.

Generally there are two types of genetic maps; physical and recombination. Physical maps provide the location and order of genes on chromosomes by the physical assignment of genes to chromosomal segments.

Marker Identification

As the process of gene mapping goes forwards, large pieces of chromosomes are identified by gene sequences with unknown function. These sequences are referred to as markers and permit the identification of areas of a given chromosome containing gene sequences associated with important traits. An example would be growth rate which is a quantitative trait meaning it can be measured. The location of a gene sequence containing a gene(s) controlling a quantitative trait is called a quantitative trait loci (QTL). As gene mapping progresses the QTL's of important traits are localized. The next task is to identify the specific genes within the QTL's which code for a given quantitative trait.

Mapping Quantitative Traits

Chromosomal locations are assigned to markers after they are identified. This is accomplished by a combination of approaches involving linkage analysis of pedigrees and somatic cell hybrid analysis. The goal of these procedures is to develop a genetic map that has markers at regular intervals throughout the genome. Initial genetic maps contain 400-500 markers. The distance between these markers is about 10 centimorgans or 1 million nucleotide base pairs. After the location of a specific QTL is identified the scientists can concentrate their gene sequencing efforts on that piece of chromosome and eventually identify the specific genes involved. Once the QTL's are mapped down to specific genes, the pace of genetic progress will increase, since the generation interval will be eliminated and animals will be selected while they are at the embryo level of development.

TRANSGENESIS

The objective in transgenesis is to alter function of the resulting offspring in order to produce novel proteins of significant economic value, to cure genetic diseases, to improve livestock productivity or to produce organs for human transplants. A transgenic animal is an animal that has a modified gene inserted into its DNA. This modified or foreign gene is called a transgene. Transgenesis requires functional knowledge of the gene of interest and the ability to manipulate

the embryo in order to insert the transgene and to obtain functional expression of the molecule of interest when needed. This last component has remained a significant challenge, since success in directing the insertion of the transgene and its expression is problematic for several reasons.

Transfer of foreign genes into animals is done at an early stage of embryonic development (one cell to blastocyst stage) prior to implantation or placentation. Embryos at this stage of development can be grown outside the uterus of the mother (*in vitro*) in specialized medium containing nutrients and growth factors required for their development. For best results, micromanipulation and gene transfer are performed on one-cell embryos because integration of the transgene into the DNA of a one-cell embryo theoretically assures that all cells of the adult animal carry the foreign gene.

Transgenes as Bioreactors

Several species of animals have potential as sources of pharmaceutical proteins for treatment of human disease. In fact, the first cloned animals were produced for this purpose. Creating a transgenic animal is an expensive process and once created it has considerable value. Therefore, cloning an adult transgenic animal has great commercial potential. Recently, PPL Therapeutics, the company responsible for the cloning of Dolly, reported the first successful production of transgenic clones using nuclear transfer of cells from an adult which will produce Human Factor TX for treatment of Hemophilia. The potential for several other types of clones is also apparent. These include cloned cattle producing infant formula with human proteins instead of cattle proteins, pigs with hearts available for human transplantation that would be immunologically acceptable to humans and not cause transplant rejection, milk from cattle and sheep that contain various pharmaceutical peptides to name a few. Transgenes can also be produced to model human diseases such as cystic fibrosis and AIDS in order to develop new treatments.

Summary

The rapid progress in the fields of molecular biology, reproductive technologies and computer technologies have resulted in significant new issues for ethical and moral consideration. Clearly, these technologies are applicable to humans and any other mammal. They are powerful tools capable of redefining any species or to create new species and to clone thousands of copies. The opportunities to improve food production, develop new treatments for disease and to provide

new and healthier foods to a growing population are considerable and essential if we are to support a doubling of the planet's population in the next 30 years.

However, these technologies will also provide new issues for society at large. The first public debate over reengineering the human species has already begun. As the human genome project progresses we will learn more about the genetic basis for personality, behavior and mental ability. Will we use this information wisely or will it be used to identify a new elite class and a lower class of people based on genetic makeup. Although there is a Federal ban on human cloning, there is nothing to prevent private money to be used for this purpose. These issues are serious ones which require our full attention as a society.

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THE WORLDVIEW OF GENESIS 1-11

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It is common knowledge, of course, that the "history of the Jews" begins with the account of the call to Abram in Genesis 12.

Genesis 1-11, containing the creation account, the narrative of the fall, the story of the spread of civilization, the flood, and the subsequent accounts (including the 'generations' with the many genealogies) culminates with the story of the building of the Tower of Babel, the resultant confusion of the tongues and the generations of Seth from which lineage Abram comes. Thus it is introductory to the account with

which the author is most interested, serving basically as a fundamental "frame of reference," a "universal history," a preparation, so to speak, for the "holy history" that begins with chapter 12.

The worldview set forth in these chapters underlies, in turn, the rest of the Jewish/Christian understandings about how things either were intended to or do in fact function in this world. Thus it establishes both the setting for God's reign over history and also the need for God's saving presence within that history.

The Apostolic Creed encapsules this whole worldview in one short phrase: "I believe in God, the Father Almighty, maker of heaven and earth." It is confessed with such ease. . . almost as a "tip of the hat" to the One from whom all things have come and to whom all things go! But what a huge confession is packed into these few words!

It is our purpose here to let Genesis 1-11 speak to this confession. . . or, better put, to let Genesis 1-11 speak out of this confession (for, in a very real sense of the term, this section is a basic confession of faith about the world within which the people of God live and move and have their being). . . so that the confessor can find not only the many implications of this article of the creed for those of ancient times, but also the implications for us who live in the West of the late twentieth century. And not least of all for us who work in campus ministry, this "credal statement" establishes some very basic understandings for students and members of the academic communities within which we work.

It is important to review these fundamental understandings from time to time, for they are more and more being called into question on a variety of levels in the unfolding world of the late twentieth century after having been the basic and unquestioned presuppositions of the Judeo/Christian heritage century after century for the better part of at least six millennia. If we understand the Holy Scriptures to be our fundamental source of self-understanding we need to be highly conscious of what it was that the author of Genesis 1-11 was trying to communicate to those who serve the God of Abraham, Isaac and Jacob throughout the ages lest we too readily give away that which our forebears have considered basic to understanding the world in which we live and our human place in it.

THE ESTABLISHMENT OF ESSENTIAL RELATIONSHIPS WITHIN THE WORLD

The Relationship between God and Nature

Genesis 1 is emphatic about establishing the fundamental truth that God is separate from all nature. God is the origin of all things and beings in the natural world and therefore the One who controls the entire world of nature, but neither nature nor the things contained therein are gods.

Inasmuch as we are so saturated with this thinking in the modern world of the West this fundamental emphasis is not always evident, but the world of the holy writer's time was filled with nature religions and fertility cults and there was a tremendous awe in

general before the natural forces holding so much power over the earth's inhabitants. If the sun threatens the community, the sun god needs to be placated. If the rain threatens. . . or the wind or the lightning or any other such natural power. . . then the community had to deal with that/those gods in whatever way(s) that could be contrived.

Over against this understanding of nature as either the direct manifestation or the abode of the gods, Genesis 1 thunders with majesty that all things were made by God and stand under God for divine service. The *things* of nature, whether heavenly bodies far away or water and wind near at hand, all originate with God and are, therefore, not to be confused with God. Any such confusion is the source of serious idolatry. This truth is taught so subtly but so really that one almost misses it in a day when such confusion is not as commonplace. But note, e.g., how the writer, after the rather awesome pause in the narrative describing the making of "the greater light to rule the day" and "the lesser light to rule the night," sweeps away the whole astrological enterprise with the simple phrase, "He made the stars also." In what seems almost a contemptuous or at least ironic "afterthought" the writer destroys all concepts of the heavens ruling the affairs of humans who inhabit the earth. These heavenly bodies are, to be sure, the servants of the Creator, for they shall be "for signs and for seasons and for days and years," but they shall not and cannot control the creation!

In such simple but firm and emphatic ways the writer "runs through" the whole creation, placing it at the disposal of the Creator while separating it cleanly and clearly from the Creator by whom it was made.

Another basic and fundamental understanding carried by Israel as part of its elementary world-view is established here at the same time: the earth and all material things are good! Evil and sin do not reside within the material creation, for all this comes from the hand of a God who is good and all this serves the goodness of God. The material world is not, as in some mythic stories in religious thought around Israel, contaminated by the very stuff from which it is made nor from the actions by which it came into existence. There was, in fact, no pre-existent "stuff" that gave these material things birth. The Word of the Lord alone called them into being and the hand of the Lord shaped them, and that Word and hand of God was good. Therefore, while one must by no means idolize the material creation one must also respect it since it came forth as something good to serve God. This is echoed over and over as in a liturgical refrain at the end of each creative day. "And God saw that it

was good," culminating in a final viewing of the completed project when God pronounces it all "very good." The creation as such is good, uncontaminated when coming from the creative hand.

In this way the first two fundamental views of the world are laid bare in the account of creation found in Genesis 1: 1-2:3: (1) created things come from the hand of God and are designed to serve the Creator, not be confused with Him, and (2) all creation is essentially good, so evil must therefore arise from some place other than the creation as such.

The Relationship Between Humans and Nature

Three more fundamental points emerge from the very narrative itself to give further shape and form to Israel's worldview.

The first one is contained in embryonic form in the first chapter already when we are told that humans were made at the same time that the earth brought forth all other living creatures (1:24-31). But the point is emphatically made in the second chapter when we are told that before any living thing had yet sprung up on the earth and only a mist watered the ground "the Lord God formed man of dust from the ground, and breathed into his nostrils the breath of life; and man became a living being." (2:7) In no uncertain terms the human creation is associated with "the dust of the ground" just as the earth had brought forth all other living creatures according to their kinds (1:24). Humans are not angelic beings descended from the heavens, but they are part of the structures of the earth, essential parts of the natural world, participating in the "animal life" of this earth. On that level the humans are part and parcel of the material world created by God, equally good and equally servants with all the rest of creation.

But a second great truth coexists with the first one: While humans are part and parcel of the natural world, bound to that world in all kinds of ways, there is still something "set apart" about both their being and their role on this earth. Nothing less than "the breath of life" coming directly from the Creator enlivened that dust from which God formed humans. These humans bore the very "image of God," we are told in the first chapter, and that gives them a special status since they were, so to speak, directly descended from God although living on the earth as the immediate representatives of the divine presence. None of the rest of creation could claim this kind of unique relationship to the Creator even though the rest of creation, too was "good." This is signified by the placement of the humans in the garden of perfection "to till it

and keep it." Even the perfection of the first made garden from God's hand needed the continuing "intervention" of God's representative creature in order to receive necessary care. Nor has that need for the human hand in the care of this earth changed in our day. It has, in fact, only been magnified as humans have all too often become ravagers of the natural world rather than keepers of it. This fundamental truth establishes the human hand as a caretaker, a "lover" of the earth representing God, the Creator and Preserver of the earth, and it forces us away from understanding ourselves merely as "users," careless devastators of that which God has placed on the earth as signs of divine love and care. Here is both the motive for and possibility of assuming responsible stewardship of the earth with all its resources.

The third great truth is now also introduced: an estrangement between God and the humans who first came from the divine hand has deeply disturbed the whole of what had been a perfect creation. Once that initial relationship between God and those who were to be the living representatives of the divine presence was ruptured, everything else was disturbed at the same time. Now humans were left with a world remade by their own hand. It was hardly recognizable any more for what it was meant to be. And, in fact, God was "frustrating" the whole world, so to speak, in order to make it plain that disobedience to God has far-reaching effects. The hard new reality is now set before the primal pair: "I will greatly multiply your pain in childbearing . . . Cursed is the ground because of you; in toil you shall eat of it . . . thorns and thistles it shall bring forth to you . . . in the sweat of your face you shall eat bread till you return to the ground, for out of it you were taken; you are dust and to dust you shall return." In this estranged situation the human origins from the dust shall be accentuated by returning to it. They have now placed themselves squarely into partnership with the world by essentially ratifying its fruits over above the expressed will of God. The humans have now grounded themselves in the dust from which they came by showing preference for the forbidden fruit over against obedience to the divine command and joyful delight in serving God by exercising a godly stewardship over the creation.

Here one sees the essential problem: the earth is alienated from its Creator. Evil is ripping and tearing at what should be a natural harmony within creation as it was originally intended by the Creator. The human is at one and the same time both noble and fallen, the highest of creation and a broken creature concurrently. God desires to restore the nobility of humankind and humans seem determined to stop God from doing that!

The Relationship Between Humans and God

It becomes obvious through the telling of the creation stories in chapters one and two that the human enterprise was intended to be the pinnacle of God's creative activity. God delights in all creation, having authored the earth and all that is on/in/around it from the heavens above the earth to the waters under the earth and all that populates the surface of the earth. Yet the earth is found to be "incomplete" (even though good) without the divine representative known as "adam," a human presence established by and for God to hold a special place in this creation. The human existence is designed to "mirror" God, to bear "the image of God," to have a place on earth that will represent God's finest intentions and activity.

It is equally obvious simply from everyday existence even if one did not have the narrative of Genesis 3 (which narrative certainly secures the observation!) that the divine potential has been turned back in on those whom God has created. In seeing God's "mirror image" in themselves, humans have over-estimated themselves and have taken themselves far too seriously! They have made themselves master over the garden rather than servants in it! They have discarded the rather simple instructions given by the Owner of the garden concerning its care and upkeep and have made their own manual of instructions by which they live. They have heard the Word of the Lord and disregarded it, living as though it made no real difference in or for life. In fact, the word of an alien has superseded the Word of the Lord and the humans have heeded *it* rather than the Word of the Creator and then they have gone on to multiply their own words endlessly in excuse, self-justification and continued rebellion as though their own words were greater and more significant than the Word that had brought the whole of creation into being! They have thereby made their own life count more than the One whose life dwelled within them and through whom alone they have lived and moved and had their being.

The relationship between the human inhabitants of planet earth and the Creator of all things is, therefore, a strangely paradoxical one in which the creatures need the Creator's blessing for everything related to their existence while at the same time they go about life as though they were in charge of their own affairs without any real need to heed the Word of their Creator. Humans often speak of loving God, but the love of humans for God all too often becomes a manipulative one seeking to wrench from the hand of God such things as they perceive necessary or good for their own welfare and happiness by using "wheedling" or "bargaining" as a substitute for love. On the other

hand we read from time to time of how the Creator "repents" that He ever made this bunch of recalcitrant creatures, although at other times He chases after them with a passion that knows no bounds!

It is quite plain that the bottom line of the accounts reads like this: the basic instinct for humans is to turn away from God, to seek their own ways, to pay God obeisance only when it seems strategically necessary and to disregard and to wilfully and flauntingly disobey God when the divine will happens to contradict or stand in the way of their human will. The divine instinct, however, is to love and stand by the creation, for if it were anything other than that the world would long ago have disappeared under God's hand of judgment. The flood becomes the obvious statement of this as the narrative speaks both about God's "repenting" of having made these humans (6:1-7) while at the same time the destructive forces of water do not totally eradicate human life since God continues to treasure the creation too much to do away with it entirely (6:11-22). The same account speaks about both the human depravity of inward-turning, serving only its own purposes (6:1-7), and the possibility of the divine image still finding its way through this corruption of the original intention (6:8-10, 18, 22).

This is all unfolded through the early stories in Genesis as this rupture between the humans and God is tied to the disruptions in nature. What was meant to be between God and humans was not sustained and when the intended partnership came apart at the seams all nature suffered with the breakdown. This understanding is crucial for any real understanding of the world as we experience it, for the truth of human existence is wholistic.

The Relationship Between Humans and Humans

This distressed state of affairs between humans and God is, in turn, immediately mirrored in the tormented way humans interact with one another. Broken relationships on the divine level always show up in broken relationships on the human level.

This is clearly not the way things were meant to be, of course, for in the first two chapters one finds the foundations established for understanding the human as a social creature, the constitution of family as the fundamental social unit and, by extrapolation at least, the basis for community, friendship, and the intended linking of humans one to another.

This accent is made in the second chapter more than in the first where the simple sentence, "So God created man in his own image, in the image of God he

created him; male and female he created them," suffices, going on from there to speak mainly of the human dependency on and stewardship of the earth. The second chapter, however, elaborates on this accent considerably as we are told that "the Lord God formed man from the dust of the ground" and placed him in the "garden in Eden." Then God "made to grow every tree that is pleasant to the sight and good for food. . .," but recognized immediately that "It is not good that the man should be alone; I will make him a helper fit for him." Thus the animals were formed to give man companionship, but having examined them all for the capacity to fill this void in his life ("The man gave names to all. . ."), the man is still unfulfilled. The creation, good as it is, is still incomplete.

Therefore the woman is brought forth and, in an exclamation expressing unbounded enthusiasm for what God has now done, the man cries out, "This at last is bone of my bones and flesh of my flesh; she shall be called Woman, because she was taken out of Man." What was still missing in the goodness of the Garden was the social dimension, the companionship necessary to "humanize" the divine creation! It is in society, in the companionship of others like themselves, that humans ultimately were to find their place in God's creation. Here we discover foundational truths for the whole of Israel's self-understanding and for its understanding of how the world is to function.

The complementarity of the man and woman is also apparent in the account, for the woman is to "fill in" that which was missing in the man as the man "fills in" that which the woman could not have alone!

This complementarity within the social sphere of the human world is the basis for marriage. In marriage the basic bonding in this newly founded human culture is created. It is a foundational statement, this understanding that "a man leaves his father and his mother and cleaves to his wife, and they become one flesh," for it is a way of establishing how to most intimately flesh out the vision that God has for the way humans are to relate to other humans.

Not as though all people must marry, for clearly parts of society are built on relationships other than marriage. . . on friendships of men to men, women to women, women to men, etc., or on more casual acquaintances or on familial ties of extended families, and so on. Some, like Jesus, will never marry. But the complementarity of woman and man is grounded in this narrative as foundational for society in a larger way as well as in a narrower way.

Society is now "in place" as human relationships are

structured into the narrative itself. A "vision" is set forth of what can be when God's creation functions with God present among them "walking in the garden."

Unfortunately this vision is soon thrown into a furor as sin floods into the world. Where sin is, these relationships break down and society becomes tormented.

This understanding is made plain as the man and woman turn on one another in an effort at saving their own faces. They manage to hold their relationship together momentarily (as long as both are sharing the same sin, they hide together peaceably enough), but once they are discovered they set about their justification in perfect human style even before anyone can teach them how humans act! Adam took the first shot: "The woman whom Thou gavest to be with me . . ." And since the man had what seemed something of an air-tight case on that level the woman could not respond well in counter-accusation (although had we written the story we would undoubtedly have had the woman responding, "Well, nobody forced you to eat that fruit, Bozo! You're as much to blame as me!" But, fortunately, we did not write the narrative, so we must let the story speak as it stands!) so she immediately placed blame on the creation. "The serpent beguiled me, and I ate." The serpent-creature had pointed to the beauty of a perfect tree and human eyes were that easily turned from God to the creation; human ears heard the word of the creature and the human heart that easily forgot and/or rebelled against the Word of the Creator; and with relative ease the human creatureliness established itself as the arbiter over the Word of the One whose mighty Word had brought all things into being and had established the rule and order of the garden, declaring by the deed that the Word of God was a lesser word and therefore a subservient word to the word of the creature.

And the world stands silent. The serpent says nothing. The trees are hushed. ALL creation waits with bated breath, unable to imagine how a creature would speak so brazenly against the Word that had brought all of this perfection and beauty into existence. The world's future hangs in the balance. What will God say in the face of this incredible development?

The Word of the Lord now spoken is understandably a very hard word, but the first glimmer of grace emerges out of this moment also. Though the couple is now clearly deathbound and deprived of the glories of the garden, they still have an opportunity to care for the earth . . . and they need each other to fulfill their responsibilities. God makes them garments of skins to replace their flimsy and temporary aprons of fig leaves, for this state of brokenness and tension-

filled reunion is not merely a short-term state of affairs. The woman is named "the mother of all living" as they mutually recognize that only by caring for each other will there be a human future on earth at all.

Their spirits run high with the birth of a child and in exaltation they hopefully name the child Cain because, as Eve says so happily, "I have gotten a man with the help of the Lord." They anticipate a new start . . . perhaps even a repair of the poor start from which the mother and father now suffer. Instead, of course, the "new hope" becomes the fulfillment of the old worst fears as Cain becomes the first murderer. Again God tries to warn him off the course he has set for himself, but to no avail. Again, true to humanity, Cain tries to avoid the divine question and denies any knowledge of his brother. But again, true to the divine resolution Cain is cornered, forced into confession and confronted by God with a scathing justice . . . while yet marvelously graced with a mark that will protect him from vengeance seekers.

Cain and Abel are signs of what it will always be like in a society where the inter-human activity is at best in a delicate balance and at worst in a destructive imbalance. Cities can be built and civilizations can arise out of those cities (4:17-22) because of the marvelously creative human ingenuity, but the sad fact is that out of the most civilized settings will continue to arise the most arrogant forms of human exchange (4:23,24).

THE EBB AND FLOW OF HUMAN HISTORY

The combination of relationships which we have been examining now becomes the established underpinning to the unfolding of human history as it is now described for us. This is how Israel understands the world to "work," and establishes the matrix within which it is called into existence and gives it a sense of purpose as to why God called it into being - what God hoped to do in establishing a "chosen people."

An ebb and flow of God's grace and human arrogance make the ebb and flow of this human chronicle. Out of all the stories that could be told we hear about the second "new start" with the birth of Seth and his son Enosh. We are told that "at that time men began to call upon the name of the Lord." (4:26) So out of the ruins of the Cain and Abel story there emerges the high hope of the building of cities and the establishment of civilization by Cain and his descendants, a sign that creativity and initiative is not particularly stifled by the sinfulness of humans. But with the rise of the city there also rises one whose boasts of evil deeds puts even Cain to shame. But hope continues as the "generations of Adam" are recounted with yet another emphatic underlining of the human potential:

"When God created man, He made him in the likeness of God. Male and female He created them, and He blessed them and named them Man when they were created . . ." (5:1,2) And from the loins of Adam comes Lamech who bears Noah, saying, "Out of the ground which the Lord has cursed this one shall bring us relief from our work and from the toil of the our hands." (5:29)

The flood account reads like a second creation account. The waters cover the face of the deep, they are parted, dry land appears, the animals are distributed again across the face of the earth and the humans are restored to the place in the creation originally assigned to them in almost identical words to those narrating the first creation.

And Noah thanks God with praise and thanksgiving, sacrifice and . . .

Sin! Hardly has God promised to never again unleash the powers of nature in that form again as a new covenant is sealed between God and humans (even though it is still recognized that "the imagination of man's heart is evil from his youth" [8:21]) when the debacle of Noah's drunkenness and the discovery of his naked father by Ham sets off a new round of disgraceful behavior. Shem and Japheth try to hold it at bay, but the "new order" looks much like the "old order" as Noah thunders a curse upon Canaan (even though Ham is said to be the culprit!) that sets up master/slave relationships that will dehumanize segments of society in the interests of serving other segments of society.

And so life goes on. The ebb and flow of human arrogance and divine justice tempered by divine grace moves through the annals of history.

The generations of Noah's sons are enumerated as the world is re-populated and re-established as a "rainbow coalition." But now the individual arrogance of Cain becomes the communal arrogance of an earth with one language desirous of raising a monument to its own glory.

The story of the tower of Babel epitomizes everything that roots the earth in its own perversion. No longer do they stand at a tree, but at the shrine of their own technology. "Let us make bricks, and burn them thoroughly." They admire the fruit of their own human-built tree and they have no hesitancy about eating that fruit. "Come, let us build ourselves a city, and a tower with its top in the heavens, and let us make a name for ourselves, lest we be scattered abroad upon the face of the whole earth." Again the Lord must seek out the humans in their re-shaped garden. With biting

irony we are told that the Lord in the heavens looked down upon this great tower "with its top in the heavens" . . . and He cannot quite make out what it is. One can almost envision God squinting in an attempt at determining what all the hustle and bustle is about down there on earth. Finally, in order to see this great monument to human capability God must "come down to see the city and the tower, which the sons of men had built." And God finds that the sin of which Adam and Eve had once been at least ashamed is no longer even a little bit shameful to these "modern-day builders of the world." So it is determined that they must be scattered across the face of the earth through a confusion of tongues. But once again grace is sprinkled out into the judgment, for there is not a great devastation that comes upon these rebels. The people must be saved from themselves, for there is no telling what they will do if left to themselves. So God's grace preserves them from their own devices and they must "leave off building the city" (11: 1-9) even though they remain free to go elsewhere and to continue the use of that marvelous creativity that they were using in an idolatrous fashion at Babel.

One senses, though, that these kinds of stories could go on and on, for the cycle of human history is forever playing variations on these themes of human pride and divine grace, on human self-serving and divine self-giving. That is what Israel and the church recognizes and confesses through this "universal history" which we have been reviewing. Foundational understandings have been established about the way the world was meant to be and basic recognitions have been made about the way the world is . . . and the way the world will continue to be so long as it stands on its own. Clearly the high intentions can never be realized.

So a new course is laid out. From the descendants of Shem came a man who would father a new nation, a nation to be set among the nations, establishing among the nations a realization of what it means to be the people of God. They would be a people who know sin and yet can, by the grace of God, somehow transcend the idolatry that lies at the root of sin. They would be, like the rest of the world, exiles from Eden, but they would also be people who know the way home because God walks with them. They would be a people in whom swirls all the human passions that the rest of the world knows and feels, but they would be a Cain marked for protection, a people whose worst moment could not drive them away from the still greater swirl of God's caring protection. They would live, like Noah, in the midst of a degenerating and degenerate world and be borne by the grace of God above the destructive forces sucking and pulling at all the other nations. They would stand in the midst of nations whose tongues separate them and speak with the tongue of the Lord, showing forth the praises of the Creator/Protector, Redeemer and Counselor so that all the world might have a sign, an indicator of how God functions in this world created for the purpose of housing divine activity in a material form. Israel would be set like a city on a hill so that all the world could see the God who rules over all people through her.

Now the Lord said to Abram, "Go from your country and your kindred and your father's house to the land that I will show you. And I will make of you a great nation, and I will bless you, and make your name great, so that you will be a blessing. I will bless those who bless you, and him who curses you I will curse; and in you all the families of the earth shall be blessed." (Genesis 12:1-3)

EXCERPT

[This paragraph appears at the beginning of Sister Joan Gormley's paper, "Creation in the Bible (Genesis 1)," in Evolution AND Creation, published by ITEST That volume will be sent to all dues-paid ITEST members.]

Darwin's theory of evolution descended like a bombshell with publication of *Origin of Species* in 1859, with the sense of disaster perhaps most acute among adherents of biblical religion. For Darwin's theory, at first glance, seemed hopelessly at odds with the accounts of creation in Genesis. Moreover, many of the proponents of theories of evolution made no secret that they were atheists or agnostics. As time went on, however, and as supporting evidence began to mount, the theory was increasingly supported by scientists and non-scientists alike. Biblical exegetes, theologians, and churchmen also came to peace with the theory as they realized that it did not necessarily exclude a personal creator. Also, at approximately the same time as the theory of evolution was gaining ground, historical-critical studies of the Old Testament were showing that the Genesis accounts were not science or history — at least not history in the modern sense. It became clearer therefore, that the biblical accounts were not written for the purpose of giving scientific or historical information, but rather to reveal truths concerning salvation.

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