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A Utilitarian and Deontological Critique of Genetic Engineering

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by

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I. INTRODUCTION

Genetic engineering is a pioneering science in the field of biology. It has revolutionized our understanding of living systems and quite literally revealed a common thread throughout life. Human reason has developed from using animals to plow fields, to being able to use enzymes to increase yields while making plowing obsolete. (Rauch) We have risen to be able to control our surroundings so much that we now are controlling the universal chemical environment that constitutes life. This has been developed in university laboratories under government funding and at private corporations. These advances impose regulations on the dynamic flow of genetic and chemical material. This regulation comes from entities not regulated by moral considerations but by financial dividends. To allow such control over a universal commodity places the freedom of all beings in jeopardy.

Deoxyribonucleic acid (DNA) is a linear, double helical molecule that codes for the proteins that make up organisms. All the information for the constituents and their regulation is contained in the simple structure of DNA. Genetic engineering is the manipulation of the sequence contained in the molecule using purified enzymes and chemical modifications. Recombinant DNA technology is an umbrella term for genetic engineering that involves inserting a new gene, or portion of DNA, into another piece of DNA that is already inside an organism, known as the genome. The organism expresses the new DNA sequence as if it were its own. These technologies have opened new doors in the exploration of life and its components.

Genetic engineering has gone so far as to change the components of breast milk to manipulating corn crops to be resistant to herbicides. Many of the genes that are targeted and expressed in these organisms are foreign, in that they originate from other organisms. The genes that are being inserted can potentially "pop out" of the host genome and into another species. Consequently, undesirable side effects, such as mutagenic weeds, inevitably will occur. Due to the universal and unpredictable nature of these technologies they present an unacceptable risk.

The expression of new genetic information within an animal is a drastic procedure. One is essentially turning off part of them in some cases, and other times, one is turning on something novel. This violates the rights of the animals that are being tested. They are being subjected to conditions that destroy their autonomy or independence and cause pain and unhappiness. (Regan, 14)

Animals are being used as a means to an end; seen as objects to serve the purposes of humanity. Our rational and emotional capacity has developed to the point where the inherent worth of the application of universal moral laws to restrict behavior to that which would not impede the freedom of any other is self-evident. Anything that demonstrates the ability to choose its path in life ought to be able to actually do so. Genetic engineering of animals violates the rights of them by impeding their free will. Animal research causes the degradation of integrity of the subjects and this is wrong.

While pain is not dramatic during the insertion of genetic material, the after effects may be horrendous. Transgenic animals refer to animals that have been genetically engineered to contract or exhibit diseases they would not normally get. In this way, researchers can study the effects of various treatments on the newly sickened animals. Not only are scientists purposely exposing animals to genetic material for uptake into their genome, they are causing illnesses that are entirely unnatural. The animals are transformed into patients and are put through excruciating pain "in the name of science". The forcing of pain on conscious and independent beings through genetic engineering is wrong because it causes them to suffer. (Regan, 14)

Genetic engineering also reflects the idea that humans are above other beings on this planet. Humans act as if they are gods and deserve to live life recklessly and wastefully with no consideration for the other subjects on Earth. All the beings that inhabit this planet are part of a network of interactions that connect everyone and everything. Human actions disrespect this fragile system and cause harm to it, and in the process, cause harm to everyone and everything. This attitude is offensive because of the irresponsible actions done by society despite the major effects they have had on the planet. (Merchant, 85)

Genetically Modified Organisms (GMO's), which are the product of genetic engineering, are wrong because they endanger the stability of Earth's natural ecosystem. This includes non-sentient beings such as plants and microorganisms since they too are involved in the network of interactions that connect everything to everyone. The genetic material that is inserted into these organisms can pop back out and be taken up by some other species. This horizontal gene transfer can lead to mutant weed hybrids, new pathogenic viruses, et cetera, that arose from unexpected gene recombination.

The unforeseeable pollutants that will arise from the applications of GMO technology could endanger the sustainability of life on Earth. This is with precedent with the so-called "green revolution" that occurred in the mid-twentieth when fertilizer applications boosted harvest for farmers. However, farmers now rely heavily on fertilizers to artificially restore depleted nutrients in the soil. Fertilizers also caused more small farms to go out of business since large-scale operations with high yields out-competed them. GMO technology aims to increase yields to a greater extent than fertilizers, so one can assume farms will dwindle in number while increasing in average size as a result.

The “green revolution”, while appearing terrific from the onset of producing results, has proved to be detrimental to the ecosystem of a farm. When it rains after fertilizer application, the excess “runs-off” into the local water shed. Highly powerful synthetic nutrients end up in lakes and ponds where they ought not to be. The consequence is what is called eutrophication; this is the uncontrollable and exponential growth of algae. The algae bloom creates a cascade of imbalance in the food chain that ultimately causes the death of all aerobic organisms in the ecosystem due to oxygen depletion. While this is very well known and documented, little has been done about it. (Rauch, 103)

This effect was not foreseen when fertilizer synthesis was created, and the effects of GMO’s are also unforeseeable. Since the focus of the technology is in the very molecule that connects all life, one can predict that the effects of genetic engineering will be felt by all organisms and the ecosystem that they are part of.

The thesis of this work is that genetic engineering should not continue since it negatively affects the well being of the world and life that Earth supports. This will be examined using utilitarian and deontological ethical systems for moral evaluation. The foundation of the science, DNA, connects all forms of life and any complications, that will eventually arise, will detrimentally affect the global ecosystem. Humans falsely assume that they are superior to other inhabitants of the Earth and this viewpoint has allowed the gradual destruction of all forms of life, including humans. This point of view also lends itself to disenfranchising animals “in the name of science”. Animals, as sentient beings who demonstrate that ability to make choices and feel emotion, ought to not be kept in captivity and subjected to tortuous experiments. For these reasons the science of genetics should not continue in the manner that it has been, for it risks the stability of our fragile planet. (Klingmuller, 1)

In the second chapter of the work, a historical background and a general state of the technology are given. From the discovery of laws of inheritance to gene manipulation, the story of DNA technology is laid out and explained. This information provides the vocabulary and facts that are necessary to intelligibly discuss the science. After the background is provided a critical look at the literature on GMO risk assessment and the speculative nature of the technology is examined.

The third chapter discussed the ethical system of utilitarianism and how it can be used to evaluate genetic engineering. Rule utilitarianism is defined and illustrated using common examples. The application of a utilitarian point of view is defended as a valid method of assessing the moral issues of genetic engineering.

The fourth chapter is a moral argument from a utilitarian point of view that evaluates the technology. Since utilitarians attempt to maximize positive results, the advantages and disadvantages of the technology are discussed. After evaluation, the potential catastrophic damage that the technology poses is so large that any benefit obtained through experimentation is not worth the risk. Additionally, the disenfranchisement of the animals tested degrades society and the integrity of individuals. For this reason, the utility of the science is diminished and any gain is in spite of moral atrocities.

The fifth chapter presents the introduction to Deontological ethics as proposed by Kant. The concepts of duty, autonomy and the inherent worth of the good will are defined. Kant describes a rational framework for moral evaluation and the precepts to form universal moral laws, to which we are obligated to abide. The presiding contingency of moral law is illustrated as autonomy. Deontological ethics is proposed as an alternate ethical basis but is drawn to the same conclusion as that reached through the utilitarian analysis.

In chapter six the deontological framework is critiqued and applied to the development of the industrial application of genetic technologies. The inherent worth of all sentient beings and natural ecological harmony is highlighted by the extension of the autonomy of rational beings to all those things interwoven into our earthly existence.

In conclusion we illustrate the importance of ethical debate and progress of mind and spirit, reason and compassion together. The inherent value and integrity of sentient beings, and the systems they rely upon, must be preserved. The acclimation of our existence to fit within the realm of our natural means is drawn to be the highest motivation in ethical pursuits. Genetic technology endangers the stability of the global ecosystem that all organisms depend upon. Genetics encroaches on the autonomy of all beings and is wrong on this basis.

II. STATE OF THE TECHNOLOGY

History/Background

The study of genes is a very young science when compared to other natural sciences like physics and chemistry, which have been around for hundreds of years. Gregor Mendel was an Augustinian monk who lived in a monastery in Brno and taught natural sciences. He joined the church in an effort to continue developing his curiosity for the world. While in the monastery's garden he noticed the differences in pea plant morphology. He then began a rigorous experiment over the course of several years where he observed deliberate crosses between pea plants. He then concluded several laws of inheritance that conflicted with the prevailing beliefs at the time. One such myth is that one parent passed on more traits than the other. Aristotle came up with the idea that it was the man that contributed more by way of a "homunculus" or a fully developed fetus in the head of a sperm. (Hartwell, 11)

Mendel, through careful observation and recording of data, dispelled this idea. He chose a nearly perfect model, which was the garden pea that generated large numbers of offspring in a relatively short period of time. He also only studied traits that were one or the other, such as white or purple flowers, not traits that blended. Over time he generated strains of peas that bred true or "carried on parental traits that remain constant from generation to generation." (Hartwell, 11) He could then do crosses and switch up whether the male or female transmitted the trait being looked at. In this way he was able to disprove that one parent contributed more traits than the other.

Mendel also worked with large numbers of plants and used rigorous statistical analysis to determine which traits were being transmitted and in what proportion. This quantitative analysis revealed the underlying laws of heredity. Major conclusions drawn from his scientific paper entitled "Experiments on Plant Hybrids" were that the discrete units of inheritance are alleles of genes. Alleles are a single copy of a set of genes that code for a particular function.

The law of segregation, one of Mendel's laws of inheritance, explains how genes are transmitted which is "The two alleles for each trait separate (segregate) during gamete (sex cell, i.e. sperm or egg) formation, then unite at random, one from each parent, at fertilization". (Hartwell, 17) One type of allele may be "dominant" over the other, which is termed "recessive". A single copy of a dominant allele will be expressed even if there is a copy of a recessive allele present. The dominant trait will be the one that can be seen in the phenotype, or physical appearance of the organism.

When Mendel published his work and presented it to the Natural Science Society of Brno, it was unappreciated and unaccepted. It took 34 years for Carl Correns, Hugo de Vries, and Erich von Tschermak to independently rediscover Mendel's laws and acknowledge their legitimacy. Since 1934, genetics has been an area of intense research and discovery. The next innovative step in our understanding of the process was the discovery of the molecule, DNA, which is passed on from generation to generation. (Hartwell, 25)

While Mendel was able to explain some of the phenomena of inheritance using abstract conceptual laws, he did not know what caused this observable fact. He knew there was an element of a cell that must separate and recombine equally with similar material from the other parent cell to form an offspring. The chromosomes of an organism are found in the nucleus of a cell that is a porous envelope that regulates cellular processes. When a cell is undergoing mitosis and meiosis, which are types of cellular division. Mitosis is the duplication of non-sex, or somatic cells and meiosis is the reproduction of sex cells, which are sperm and eggs. When a somatic cell replicates, it doubles its genetic material and condenses it into chromosomes. When a sex cell forms, the genetic material is not doubled so that only half the chromosomes are passed on to the offspring. Scientists are able to view chromosomes when using dyes that are specific for the components in the chromosomes. Chromosomes are dark-staining bodies that look like X's under a microscope, and were suspected to be the primary candidate for the transmission of traits. This was due to the fact that chromosomes are split into two when undergoing cellular division and half goes into each new cell. (Hartwell, 71)

This was confirmed when microscopists, studying frog fertilization, determined that the nuclei of the sperm and egg were the only elements that are contributed equally by the cells. Chromosome-staining dyes then allowed microscopists to see the separation of the two strands that constitute the chromosomes into two sex cells. Therefore, it was concluded that gametes contain one copy of a chromosome and one gamete from each parent must combine to give the traits that an offspring exhibits. (Hartwell, 72)

While everyone knows today that DNA is the molecule responsible for passing on genetic traits, it took around 50 years to prove it to the scientific community. Around the same time Mendel was formulating his rules of inheritance, Friedrich Miescher purified a phosphorous-rich substance from white blood cells. The compound turned out to be DNA and Miescher termed the material "nuclein". The backbone of the molecule is comprised of linked sugars known as deoxyribose. Along the length of the chain there are four subunits called nucleotides and phosphodiester bonds connect them to each other. To find the location of the molecule within the cell a Schiff reagent that stains DNA red was used and DNA was found exclusively in the chromosomes. (Hartwell, 145)

However chromosomes are not solely DNA, they are half protein. Proteins exhibit diverse structures and properties so they were thought to be the component of the genetic code over the simplistic, four subunit, DNA. However, in 1928, Frederick Griffith performed a series of experiments that proved DNA is the element that causes genetic expression. He was studying bacterial *Streptococcus pneumonia* strains and their effects on mice. (Hartwell, 146)

There were two strains, smooth and rough, which describe colony morphology or the characteristic appearance cell aggregations. The smooth form of the bacteria is the natural form and kills mice when injected. The rough form is harmless, however, when the smooth form is heat-killed and added to the rough form, the mice die. The blood from the dead mice was found to contain only the smooth bacteria. Griffith determined that there was some material in the cellular components of the heat-killed smooth bacteria that caused the harmless rough form to transform and become pathogenic.

Three years after Griffith's data was published; another lab duplicated the experiment and took it a step further. Oswald Avery's lab found that they didn't need to kill mice to prove that the bacteria had been transformed. They could grow them on plates and observe the transformation in colony morphology. Avery then purified the cellular component that actively caused the transformation. This proved to take 15 years for his lab to do so. The transforming principle was incredibly active even in a dilution of 1 part to 600 million. (Hartwell, 148)

Avery then set out to prove the chemical composition of this component using enzymes that degrade specific types of molecules. When subjected to enzymes, or proteins that catalyze chemical reactions, that break down RiboNucleic Acid (RNA), protein, or sugars, the activity of the material remained. However, when subjected to enzymes that degrade DNA, the activity was eliminated. Therefore, Avery concluded that the transforming principle that Griffith described was DNA. However, the scientific community needed more proof that the genetic material was not protein.

Alfred Hershey and Martha Chase set out to prove this using a type of virus that are called bacteriophages and infect bacteria. The electron microscope allowed scientists to observe viral infection of the bacteria and noticed that the entire phage never enters the cell. The viral body sits on the surface and injects material into the cell like a syringe. This material then transforms the cell into a viral factory that produces hundreds of new viruses.

So Hershey and Chase used radioactive dyes to tag the protein exterior of the phage and the DNA interior. The radioactive labels allow scientists to "fish out" whatever is labeled and run analysis on just the targeted material. In the experiment where the protein coat was labeled, the radioactivity was found in the empty viral particles that were originally labeled. However, in the DNA labeling experiment, the new phage particles and the bacteria cells contained radioactive DNA. This proves that DNA is injected into the cell and transforms the genetic machinery. Therefore, DNA is conclusively determined to be the genetic material that passes on traits.

The next major step in genetic studies was to determine the chemical structure of DNA. James Watson and Francis Crick used X-ray crystallography and physical models to determine the structure of the molecule. Rosalind Franklin was a very talented X-ray crystallographer who was able to crystallize DNA. Molecules that are crystallized can have X-rays shown at them to produce characteristic patterns that are determined by the molecular structure. The determination of the structure, in most cases, is trivial when compared to the actual difficulty of getting molecules to crystallize. Watson and Crick acquired Rosalind's data and were able to deduce the structure of DNA. They arrived at a double-helical model that consisted of two deoxyribose strands running anti-parallel. On the inside of these strands were nucleotides that could be adenosine, guanine, thymidine, or cytosine. One nucleotide in one strand must pair up with another nucleotide in the opposite strand. Adenosine always pairs with thymidine and guanine always pairs with cytosine. This structure is the foundation of genetic function or control and the next task was to decipher the code contained in the nucleotide base sequence. (Hartwell, 150)

Both Watson and Crick took credit for the work of numerous people (30-40) including Rosalind Franklin, whose data provided crucial understanding regarding the composition of the molecule. All those involved knew little of their contributions to their Nobel Prize, which they were awarded in 1962.

It seems that even at its birth, secrecy and selfishness were intimately associated with the biotechnology industry. This theme predominates today with new laws that allow the patents of organisms and techniques. These elements of science traditionally considered property of the scientific community, now have copyrights and royalty fees bound to them. The sense of unity disbands further as knowledge of the genetic code and genome accumulates. Competition in the 1960's became very fierce as scientists struggled to answer the most important questions about life and how to profit from these answers. (Yoxen, 28)

Follow-up questions included the mode of replication of this molecule and how this message can be translated into proteins that carry out the processes of life. The base sequence in the center of the molecule lends itself to a coding mechanism, however there are only four nucleotides and 20 amino acids that constitute proteins. Even if one used two nucleotides in a row, which would still only leave 16 (4^2) possibilities for codes that translate into amino acids. Therefore, a triplicate code ($4^3 = 64$) is necessary to get enough sequences to code for at least all 20 amino acids. The term codon refers to the piece of the nucleotide sequence that codes for a particular amino acid.

With 64 combinations of nucleotides, there is redundancy in the code and a single amino acid could be coded for by four unique codons. This was proven when Crick and Sydney Brenner used a mutagen to insert or delete sequences into DNA. What was found was when one or two bases are inserted; the mutation is drastic since it moves the reading frame that the sequence is read from to be off by one or two. Therefore all codons after the insertion or deletion code for the improper amino acid. However, if three or multiple of three are added or deleted, the protein is mutated, but the proper amino acids are present and can function. From this data, it was concluded that the code is indeed in triplicate.

Matthew Meselson and Franklin Stahl elucidated the process of replication in 1958. The two strands of DNA can easily be melted apart from one another and this allows replication to occur. The manner by which the new strands are synthesized was open to debate since it could occur by three different modes. Each strand could serve as a template for a new strand each. A whole new molecule could be generated off the original, or each new and old strand could be comprised of both newly synthesized and original DNA. (Hartwell, 158)

Meselson and Stahl labeled the DNA with a radioactive dye and allowed it to replicate once. They then separated the new molecules and found an intermediate band of dye that showed the molecules to be half radioactive, half original. When the cells were allowed to replicate again, the results were very telling. There were two bands; one that was half radioactive and the other had no radioactivity. This proves that the molecule melts apart and a new strand is synthesized off one of the original. The radioactivity tagged half the molecule in the first round. Then it tagged a quarter of the molecules by having half of the total molecules carry on as half radioactive. The other molecules are entirely newly synthesized off of strands produced in the first generation of replication.

The process of turning a nucleotide sequence into a protein is a very elaborate process. To explain the sequence of experiments that formulated the model known today would take a significant amount of time and literature. A summary is described below and the two major processes are termed transcription and translation. Transcription is the process of copying a small segment of DNA that codes for a protein. This copy is comprised of a single strand of mRNA ('m' stands for messenger) that then travels from the cellular nucleus to a ribosome in the cytoplasm.

Once at the ribosome, the mRNA has to be translated to protein, which is simply a sequence of amino acids. This is where the code copied into the mRNA is read by proteins called tRNA's ('t' stands for translational). The tRNA's have an amino acid attached to them at one end and a portion of RNA that can read the piece of mRNA. The ribosomal unit then catalyzes the polymerization of the amino acids that have been aligned by the tRNA's. In this way, a sequence of DNA is converted into a chain of amino acids that can then fold into a functional protein. (Hartwell, 233)

Genetic engineering is a diverse science that relies heavily upon the equipment or technology produced for analysis. The reoccurring theme of genetics is the model that was outlined in the preceding paragraphs. The model is what all observations and theories are evaluated against. Enzymes, chemical analysis and imaging techniques are merely the tools that geneticists use to explore the unknown traits of the biochemical system. (Davies, 1)

In the 1970's recombinant DNA technology was developed and the first transgenic bacteria were constructed. Plasmids that coded for genes that one wished to express could be inserted into a bacteria's DNA when treated with calcium chloride, a common salt. Restriction enzymes that cut the bacterial DNA open at very specific sequences were used essentially as scissors. The plasmids and the genes that they coded are then expressed in the bacteria, which act as a processing plant for the protein.

The possibilities of such a technique is infinite, for example, proteins that code for the excretion of a pest deterrent in one plant can be expressed in a plant like corn to make it also resistant. Another more lucrative example is bacterial production of insulin for diabetics. With such manipulative power, scientists in the early 1970's like Paul Berg questioned the implications.

The Moratorium

Paul Berg was working on splicing the simian virus 40 with a bacterial virus that could transfect *E. coli* at Stanford University in 1974. *E. coli* is a type of bacteria that commonly are found in the intestines of mammals. It is also a model organism for genetic engineering of bacteria. Berg was alarmed at the implications of his work to the point where he halted his own and wrote to the National Science Foundation about the risks of gene splicing. He was attempting to convert ubiquitous bacteria in humans to become cancer causing. If the strain produced was pathogenic it may have exterminated the human population.

The letter of Berg and various followers from other organizations asked for a moratorium or delay from research in this area till the risks could be assessed. The moratorium was lifted in 1976 after guidelines were constructed that governed lab practices in regards to the resources' and wastes' storage and disposal. No protocols were formulated as to what should or should not be experimented upon except for infectious agents that already were regulated.

Moreover, the moratorium stirred a huge amount of public interest and opinion, which was relatively unheard of at the time since scientists are very elitist in their nature and have never asked for the public's permission or thoughts on any matter. Many, like James Watson, one of the founders of the double helix, think of this relinquishing of control as the biggest blunder ever-made in science. Instead of performing whatever experiments one were granted funds for, science, specifically biotechnology, was under scrutiny from the populace.

The scientific "community" with its ideals of shared knowledge and resources began to dissociate due to the demands and prospects of big business. Patents, such as the first in genetic engineering by Hebert Boyer and Stanley Cohen were both wise and arrogant. In 1974 they sought a patent under the name and authority of their respective universities, University of California, San Francisco and Stanford University, for the techniques they developed for splicing DNA. They were patenting the accumulated common knowledge of numerous years of labor and ingenuity. From then on, all scientists were more secretive with their ideas and techniques.

Moreover, the prospects of big business opened up the medical industry with the new technology. Drugs could be made more cheaply in bacteria and research interested in the causes of disease could now be focused on the genetic and molecular level. Transgenic animals that were engineered to exhibit symptoms of the disease could replace human subjects in studies. New and innovative strategies for curing diseases are being thought up more frequently than ever before. However, many of these ideas are top-secret till publication to prevent a competitor from developing the technique faster or better. (Yoxen, 30)

Applications

Genetic modification is an ancient process that is as old as beer and cheese. Humans selectively grow organisms, which produce desired results, in a controlled manner. This is the essence of genetic engineering and it is something that everyone can identify with. It only makes sense to continue to grow corn that yielded more or tasted better than other corn. We desire the biggest and best results from our labors, and this shows in the human ability to domesticate wild plants and animals that exhibit looked-for traits. No better example exists than corn where "domestication took place in Mesoamerica, around 5-6,000 B.C. Its ancestral origins are unknown, although primitive pod corn, *Tripsacum*, and teosinte are potential ancestors." (Stevens) which began as grass. They are still grass, but humans have selectively bred them to produce abnormally large heads of grain.

Another great example is the use of microorganisms like yeast to create byproducts that humans desire such as alcohol. Some strains of yeast can survive higher concentrations of alcohol; therefore they can live longer and generate more alcohol than other strains. To many humans, higher alcohol concentrations in beverages are sought after. So brewers of beer would select for strains of yeast that produced the best results. Over time they are changing the genetic make-up of the yeast to allow a more desired physical trait to be passed on. Genetic engineering is no different superficially. (Fletcher, 10)

Genetic engineering involves taking a DNA sequence that codes for a certain protein or group of proteins that have a specific function. The application of the technology is as diverse as the function of proteins that carry out all the processes of life. Applications are generally put into a few categories: transgenic animals, transfarming, DNA fingerprinting, and GMO's. Transgenic animals have had DNA sequences inserted into their genome to cause a manifestation or lack of a protein. If a protein is desired, the aim of the insertion is to cause expression of the gene. Insertions, if placed within a gene, can cause the "knockout" of this gene and the organism will not express a functional protein. This protein may be involved in cell cycle, or cell growth, regulation. If that is the case, cancer will ensue since it is little more than uncontrolled cell growth. However, if the knockout is in an essential protein, a disease such as Cystic Fibrosis may occur. (Yoxen, 81)

Transgenic animals have been used to model a disease by expressing or not expressing certain genes that are related to the manifestation of the disease. By knocking out the cystic fibrosis transmembrane regulator (CFTR) gene, the ion channel does not function properly. Cystic fibrosis is the manifestation of this channel not working. A transgenic model of this disease has had the function of the CFTR gene eliminated using DNA manipulation techniques. Transgenic animals allow scientists to test these techniques scrupulously without the use of human test subjects.

Beyond medical testing transgenic technology presents great promise in the field of biochemical synthesis. Transfarming refers to the creation of transgenic animals that produce proteins in their breast milk. These proteins can then be purified out using separation techniques. In this way, proteins can be farmed from milk. The advantage to doing this is that eukaryotic cells (not prokaryotic, or bacterial cells) have complex protein folding mechanisms that cannot be recreated in bacteria.

Non-industrial application of current genetic techniques has brought about great change in the field of forensic science. DNA fingerprinting is the use of DNA analysis techniques that break up the genome and separate the fragments. The pattern created from the separation is unique to the person if done in a manner that looks at the extremely characteristic region of the DNA. This tool is relied upon in court cases and paternity tests. The resolution of the technique allows a very high degree of accuracy and differentiation between individuals.

Genetically modified organisms (GMOs) is an umbrella term that describes organisms as diverse as bacteria, fungi, plants and animals that have had their DNA altered in some way. Often, GMOs are for mass production of a protein product or incorporation of a function in a novel organism. This has revolutionized the drug industry by making it possible to make drugs without plants or animals to extract them from. As long as a gene can be isolated and sequenced, the product of that gene can be expressed in another organism if it doesn't kill them. (Mooney, 6) In this way, bacteria can be harvested after rapid growth in a fermenter. They can be modified to produce a large amount of desired chemicals in a short period of time. The solution of bacteria and compounds, called broth, can be separated and the desired product can be purified.

Another example of GMOs application is the planting of corn that has been modified to be resistant to herbicide. Farmers can then spray their fields with these toxic chemicals and kill everything that is not corn. Tomatoes that have had a gene "up regulated" in order to produce more proteins from that gene have also hit the farm. The gene codes for a molecule, that keeps the fruit firm and fresh. This molecule produced no toxic effects and did not alter the components of the tomato. The only change was that the fruit could withstand approximately another week of transportation and distribution without bruising. (Redenbaugh, 2)

While GMOs literally refer to anything that has been altered using DNA techniques, the term is often referred to in the context that they will be released into the environment, as in the case of the corn and tomatoes. This has raised several issues concerning the safety of doing this and the acceptable risk of possible catastrophe. (Levin, Strauss, 14)

Risk Assessment

An adage has said that life is much like shooting an arrow at a target far away. One can refine their aim as much as they will, but the winds of the world still blow ones arrow in directions unforeseen. Within the realm of modern technological application the duel sided nature of progress has been apparent. Consequently, fields related to the remediation of the impacts associated with our modern society have risen to meet the present need. The discovery of techniques for genetic manipulation stood out so much from the rest of biological scientific advances that it called the attention of all scientists. June Goodfield in *Playing God* wrote a retelling of the conference at Asilomar in 1974, which called the momentary halt of all genetic research. Four questions were directly addressed during the meeting, while select media members were allowed to record the proceedings. The scheduled topics to address were the following; the benefits of this technology were discussed to coordinate the campaign to push their research further; if safety procedures should emphasize physical containment; should scientists to experiments to assess future hazards and their nature; and lastly how to enforce compliance to regulations. There was no talk of, should these technologies be developed for the good of life on earth, only that it may have bad consequences that should be minimized. (Goodfield, 98)

The media involve was to the dismay of many scientists who feared the scrutiny of the general public. Experimental methods and motivations which previously faced little public exposure were brought up to be critiqued by not only their colleagues, but anyone who cared to read about them. About ten percent of the scientists felt that there should be no regulation at all, that to stifle the scientific dynamic was ignorant; while for the most part there was an even split between those who thought the conference asked to much and those who thought the proposed sanctions were not enough. The fruition of the conference was the assignment of six classes of experiments and containment methods for each. Reaction classes are separated by the nature of the species in question and the ban of all experiments that combined bacteria with antibiotics and tumor causing agents. Among those who criticized the regulations for being loose, the points emphasized were those of risk assessment, the greatest weaknesses pointed out were human error, such as sloppy waste handling, and the nature of GM products in general. This is unavoidable and would surely lead to some level of environmental contamination. During the Alisomar conference, a point that was glossed over by most of the scientists, but was addressed by several lawyers that were in attendance, was that of scientific accountability. To say, if a horrible outbreak of an infectious virus due to scientific malpractice, a finger will be pointed at someone. Most scientists passed these concerns off with the sentiment that all of science is inherently uncertain, and that no outside party could assess the risks of an experiment better than those who have dedicated their life to the study in which the experiment is involved. Despite the confidence of a scientist in their own research, the point of the lawyers is still made; due to the magnitude of repercussions possible as a result of a genetic calamity, risk assessment is crucial in the development of such technologies prior to their implementation. Many books have been written on the subject of risk assessment of GMOs, most provide introductions to what one describes as “a dynamic biological equilibrium among the microbes that shifts and changes in the physiochemical status of the environment,” (Ginsburg, 100) but yet show no attempt to ask wither we should be approaching our problems in this manner.

Lev R. Ginsburg gives a description of current considerations of the risk associated with genetic technologies in *Assessing Ecological Risks of Biotechnology.* Ginsburg tells how the focus of debate over Genetically Engineered Microorganisms (GEM) has shifted from how to contain the waste materials from labs doing testing on GEMs to how to assess and confront the dangers involved with the intentional release of GEMs into the environment. This shift has developed as the commercial prospects of GEMs have become more apparent. They have potential roles in all realms of life from agricultural growth accelerators, pesticides, toxic waste remediation, wastewater treatment, and biochemical synthesis. They are on the market and in use.

The commercial application of GEMs brings several new aspects into consideration. For a GEM to produce a desired effect it must change a part of the system. In order to affect the system the GEM must establish itself within the system population. In doing such the GEM is open to the possibility of relocating to a non-target system. In order to establish itself within a natural system the GEM must be stable within the conditions of the target environment. Much of the application of GEM technology is agricultural, that means the target is usually the environment of natural or docile nature. Such a normal range of stability means that the GMO may establish itself outside of the target range, unless predetermined to have selectivity for a given isolated condition.

To address risk assessment of such introductions involves a deep understanding of the interactions of microbes with other organisms and their surrounding. Microbial populations are omnipresent in the soil, air, and water. Like animal populations in the jungle, microbes exist in a constant state of flux around equilibrium. The equilibrium is dependant on many interwoven metabolic pathways as well as the physiochemical state of the growth medium there in. Shifts in relative populations and ambient conditions can cause indirect fluctuations in population stability.

Such variation of population dynamic causes large surges and lulls in populations. As populations die they excrete DNA because of the possibility that the DNA can permeate another cell and replicate. This occurs only in solution, so it does not happen in dry soil, but it does in saturated soils. This DNA swapping gives great resilience to populations leading to independence of certain ambient conditions such as pH or antibiotics. (Ginsburg, 108)

For most applications of GM products it requires multiple applications or releases of GMOs, the introduced specimen must establish itself in the affected region, maybe even in a permanent status, to cause the desired effect. To be able to assess the risk associated with the release of such an organism, one should look at previous releases similar to compare the systems in question. In the case of man-made GMOs for global distribution, our experience is very limited and our appreciation for the risks is very low. There are myriads of chemical pathways that are interwoven in ecology, all in harmony. Changes in a system that may present problems are numerous. "In an ecological context, environmental impact can be defined as any effect of an introduced species on a non target organism." (Ginsburg, 27) "Every release of a biological-control agent or a transgenic species constitutes a perturbation experiment, and all attendant ecological effects should be documented so as to enhance our understanding of the structure and the function of the target system." (Ginsburg, 28) A problem arises therein the definition of the "target system" due to the nature of bacteria genetic material is passed through all of the ecosystems on the planet.

Environmental variables are soil bacteria populations, die off rates, moisture, light, pH, rainfall and runoff, all of which influence a species' ability to proliferate as well as make it very difficult to follow (Ginsburg). When exposed to adverse ambient conditions microorganisms go through cellular deficiencies, eventually resulting in cells dying off. As the cells die, they release segments of DNA for the absorption by another cell. Bacteria can transfer DNA by conjugation (cell to cell contact), transduction (via a bacteriophage, a virus that infects bacteria) and transformation (uptake of free DNA). (Ginsburg, 108) Through different organisms analogous genes can be found in the same relative location providing a common functional order of all life. (McHughen, 29) On average there are 850 airborne bacteria per cubic meter ever a city street, 763 per cubic meter over city parks, 99 per cubic meter over agricultural districts, 63 per cubic meter along the coastline and up to 1,000,000 airborne bacteria per cubic meter downwind of a sewage plant. Due to the prolific abundance of bacteria and their dynamic living criteria, the current ability to document the genetic effects of GMO release is limited, and the ability to control unforeseen side effects presents a paramount challenge. (Ginsburg)

III. UTILITARIANISM, an introduction

Normative ethics is the formulation of a set of rules, moral rules to be precise, that govern our actions and behavior. There are two primary types of normative formulations and they differ in significant ways. A *teleological* system is one in which a value, such as happiness, is used to evaluate actions and behavior. This value, if fulfilled by an act, passes on the virtue of the value to the act; if the action produces desirable consequences, then the act is deemed good and valued. Genetic technologies, as all human pursuits, must be evaluated by under such a morally framed approach because it has within it the power to change our world for better or for worse.

The second normative formulation is *deontological*, wherein the will of a being is used to evaluate their actions. Inherent moral value is placed soley on the good will because all other traits that are associated with "happiness" are subjective in their nature and can be to a flaw. A moral duty is a kind of action that "satisfies the requirements of an *ultimate norm* or *supreme principle* of duty, which is often designated as 'the Moral Law.'" (Psychological…, 56) Regardless of consequences, a duty is a means to an end. Now this end can be described as what Immanuel Kant termed " realm of ends." A society where all beings freely and independently follow a set of moral rules which, are universally agreed upon. These rules treat rational beings as ends, not means to an end. For a means to an end, is merely an object to be manipulated to produce that which another desires.

Utilitarianism is a teleological system of normative ethics that is based on "two moral principles…everyone's interests count, and similar interests must be counted as having similar weight or importance…[and] does the act…bring about the best balance between satisfaction and frustration for everyone affected by the outcome." (Regan, 18) The great allure of the utilitarian view is the equal importance of those involved. It would seem that this would provide the greatest balance of viewpoints and everyone would be treated properly with respect for integrity and happiness.

The way of evaluating actions using the utilitarian viewpoint is to decide upon a value that is relevant to the situation, for instance happiness. A utilitarian would then score each action in reference to its consequences, for instance whether happiness or its opposite, unhappiness, was created. The action that generates the best consequences, or most happiness, is the "right" option. The action has the value of happiness and the good meaning of happiness applied to it using this line of thought. The consequences of the action determine the value(s) that the action possesses.

To any posed utilitarian moral decree another individual may question its validity. There are three options if an objection is made to a utilitarian argument. The principle can be rejected it there are objectionable extensions that can be made. The results can be rejected themselves and the principle can be preserved or they can be shown to not follow from the principle. Because the opinion of every individual is of consideration when weighing the worth of an action, such disputes must not be left unresolved.

One subset of general utilitarian views is rule utilitarianism where one can evaluate which action is right by outlining rules that determine which values are important. These rules are substantiated with supportable arguments, facts and appropriate criticisms. The aim of the rules is to define criteria that are used in deciding the extent of the value fulfilled by the action. Critical discussion of the criteria is used to refine the rules to accommodate for extrapolated, or extended, situations. (Weston, 89)

The classic example given in Tom Regan's essay, *The Case for Animal Rights*, is ingenious in its simplicity but universal in that it can be altered to describe a myriad of situations.

Suppose your aunt is extremely old and wealthy. Upon her death you will inherent her wealth, but will donate a large portion to a children's hospital to get a tax break. All the children involved will be very happy after your generous gift. You, yourself will also be very happy, so why don't you kill her right now? According to the utilitarian view, you should since it will make a lot more people happy than it will make people unhappy. This illustrates one of the objections to utilitarianism, the benefits of others does not justify the exploitation of individuals.

Obviously, murder is not moral by any means and the utilitarian view needs modification to account for this scenario. The rule that "the act that generates the greatest amount of happiness ought to the act carried out" must be revised. One must ask, "if we know this act to be wrong, why is it wrong?" Your aunt is a person who has emotions and demonstrates autonomy. Therefore she deserves respect for having those characteristics and the disrespect generated by killing her outweighs any potential benefit. The integrity of an individual cannot be sacrificed for the gains of others.

Individuals will be sacrificed for general good unless it is shown that this example does not generate the greatest good. One must consider the long-term results of this action such as fear and unease among the population who accumulates wealth. What if everyone who knew they were to inherit a great sum of money killed the person prematurely? This reasoning used to make the action wrong is flawed as well. The rights of the individual are dependent on the consequences of others. This is unsound for what if no one else is affected or found out about the murder? The rights of the individual would still be violated.

As Regan puts it, sentient beings have inherent value and consideration for the quality and maintenance of that value are necessary. People that are subject to these moral rules are not the producers of happiness as a consequence of an act; they are more than that. They are individuals and this value must transcend race, sex and creed in order to be just. “All have inherent value, all possess it equally, and all have an equal right to be treated with respect, to be treated in ways that do not reduce them to the status of things, as if they existed as resources for others.” (Regan, 21) Everyone is important because they exist, not because they have utility to others. The view generated from this belief was termed the rights view by the author. This view does not allow discrimination in any form or “justifies good results by using evil means that violate and individual’s rights.” (Regan, 24) Therefore the previous rule must account for this worth and be rewritten, as “the act that generates the greatest amount of happiness, without disrespecting the integrity of sentient beings, ought to be carried out”. (Regan, 25)

Who is referred to by “everyone,” who has worth for just existing? Humans value the ability to use intelligence and display autonomy. So a definition may be any being that is experiencing life and can use these experiences to make choices and have preferences based upon stimuli. Some kinds of actions stimulate pain, while others pleasure. Due to this variety of feelings, sentient beings have emotions and they must be protected to preserve the right to live life in the manner they desire. This lifestyle should not interfere with the lifestyle of others since it will violate their rights.

Utilitarianism viewpoints are relevant to genetic engineering since the technology has produced useful products and has the potential for great benefits. However, like the previous example, there are underlying moral dilemmas that must be addressed when evaluating the happiness, or good, generated by an action. The science reduces animals to objects and illustrates the idea that humans place themselves above other forms of life. The negative values associated with these actions condemn the science based on the moral grounds that it violates the integrity of sentient beings in many manifestations. (Regan, 25 ;Mill, 64) Ecological sustainability is the only path of rational consideration due to the inherent worth of all individuals.

IV. UTILITARIANISM on Genetics

The manipulation of genes in organisms has raised several ethical issues concerning the commercial exploitation of living systems. The current and future utility, or value, of the science may be enormous. Because of these proposed benefits, genetics is the obvious focus of much attention currently. However, this does not justify it in and of itself. Questions about the accuracy of the models and containment of the modified organisms only add to the anti-genetics argument. Consequently, once the science is developed into a large-scale technology, there will be huge social changes. For instance, what if the "new thing" were to have your children manufactured to your desires. Or if marriage became obsolete since you could clone yourself. These questions and potential moral issues must be addressed before the technology advances further. (Fletcher, 2)

A utilitarian viewpoint of the argument would be that the benefits of genetic engineering provide a huge utility. There are many reasons why genetic engineering is a billion dollar industry. It has revolutionized drug development and production, and deep insights have been gained in how organisms work. Many diseases that were once thought incurable have been brought back to light for more consideration and analysis due to these techniques. In fact, the development of new techniques is happening at a fantastic rate, and the data that has been collected thus far will forever affect our perspective of living systems. The potential to cure virtually everything that ails everyone is there. The industrial applications are numerous in that organisms can be used to produce products like drugs and chemicals that couldn't be produced efficiently using chemistry. (Yoxen, 2)

The use of transgenic animals allows the potential curing of any genetically inherited disease. If the source of the disease's manifestation is known, the cause can be isolated in the DNA sequence. Animals can then have their analogous gene "knocked out" to cause the disease manifestation. Therapies and treatments can then be tested on the animals in sufficient numbers to conclude statistically significant effects. Additionally, the synthesis of drugs and chemicals in animals as in transfarming and fermentation allows relatively simple production and purification.

The UN speculates that the population will increase 40% before 2050 at its current pace (6.3-8.9 billion). At this rate all the forests of the world (16 million sq mi) will be used for farmland to support these additional people. While transgenic plants and organisms will not fix the cause of the problem (equal distribution of resources, lack of birth control and responsible breeding) it may very well reduce the agricultural footprint that humans leave behind. The output of food needs to double or triple to preserve the current forests. (Rauch, 104)

This tripling of production occurred during the Green Revolution of the 1960's that spawned myriads of industrially synthesized herbicides and fertilizers. Transgenic crops offer potentially a greater amount of growth in food production. To support continually growing populations, changes in our lifestyle or agriculture must be made, and genetics poses a possibility for great change.

The maintenance of the current farmland from salination and heavy metal deposits also needs to happen. Salination damage renders 25 million acres a year of farmland useless and 40% of the world and 25% of US have it to some degree. Transgenic plants such as a tomato that is fifty times more resistant to salt, as a regular tomato, may be the answer. After repetitive use of these tomatoes, salt concentrations in the soil actually lessen with time. And to think that this and other strains of plants can be converted to utilizing 25 million acres that are considered desert due to high salt concentrations. The vegetables and grain produced on this land alone would significantly help in feeding the world if the food could be distributed efficiently. (Rauch, 105)

Another genetic application has been the development of plant strains that are hardy enough to propagate without the turning of the soil every season. Tilling the soil destroys the natural microbial ecosystem that exists and benefits the plants grown in it. No-till methods turn the soil into a rich sponge full of life, however herbicides are needed to kill the "weeds" that sap nutrients from the crop. These herbicides, as one can imagine, are detrimental to the crop if applied accidentally. RoundUp Ready® transgenic plants like corn, tobacco and soybeans are tolerant to the herbicide RoundUp®. Therefore the soil need not be tilled and the crop can be sprayed with it.

Sounds great doesn't it? Lets not forget why these products are being created, to save humanity from starvation right? So why aren't they cheap enough for third world farmers? It's in the third world countries, after all, that population size is the biggest problem. These products are expensive so that the companies that made them can make back the money that they spent on research plus a huge profit. What needs to happen is a price drop in the products so that the farmers who feed the world can feed their families. A price drop alone would not suffice to feed everyone, since in the third world farmers are going to need one-on-one attention with investors to convert their crops over to these transgenic varieties. This puts the lively hood of the population of the world at the stipulation of a multinational corporation, which bases its action on financial returns not moral worth. (Rauch, 107)

The proposed benefits of genetically engineered agricultural methods of global substantiation are great, and the ability for humans to reach these goals would redefine the limits of human society. These benefits are not limited to agricultural application nor are they without risk. Influence has reached that of industrial synthesis of materials that are now part of everyday modern convenience such as plastics and polymers by manipulation of genomic sequences. A now booming industry is that for biosynthesis of pharmaceuticals through what is called transfarming. That is the reaping of a biological byproduct that has been transgenically inserted.

Transfarming has opened the door to producing natural chemicals synthesized by our bodies. Some diseases, such as diabetes, results from the lack of a natural chemical, in this case insulin. The processing of insulin takes sophisticated cellular machinery, something that prokaryotic bacteria don't have. The endoplasmic reticulum of a eukaryotic cell has the ability to process and fold proteins as well as add sugars to the outside. The advantages to using organisms over industrial processes are that the manufacture of complicated molecules is ultimately cheaper and more efficient than a series of complex synthesis reactions.

The nature of genetic science is to further elucidate the mechanisms of genetic control and regulation of processes. Over the course of the last century, the model of heredity and life has changed drastically. New crystallizing and imaging techniques, and equipment for separations have allowed scientists to view the enzymes in DNA replication and determine their structures. These structures give one an idea of the players in life processes and often display similarities across species. Now, more than ever, it is obvious that all organisms are related through similar ancestors. The search for such probing questions inevitably leads to confusion. The search for genetic or human perfection is based on a fallacy. Perfection is a myth of human creation. As has been seen in past human leaps of progress that the dual nature of life shall prevail to taint the attained benefits with unforeseen drawbacks, such as the ecological damage done by industrial fertilizer run-off that was apparent since the "Green Revolution".

Genetic manipulation seeks to optimize genetic sequences to better suit human desire. This pays no head to the foundations of evolution, which are based on slow symbiotic processes that develop together over time. The scope of influence that any one part of an ecological system has on the whole cannot be realized by any means now or in the near future. The potential drawbacks of genetic technology are many and must be weighed heavily for moral consideration.

The drive for more sophisticated technologies has caused the cost of health care to rise higher than any time in the past. While biotechnology and the health field are making dramatic advances, it is at a seriously increased cost to the average consumer. While the production may be at a slightly lesser overall cost, the investment in the research must be compensated. Research takes a lot of infrastructure and capital to start up initially, all of which must be made back via the consumer. This leads to the de-facto exclusion of much of the population whose interests were supposedly being protected.

Another feasible detriment to genetic manipulation is the development of biological agents that are potentially pandemic. Due to the nature of the technology, the use of viruses and other harmful agents can be enhanced to become more deadly or transmissible. In this way, a weapon of infection can be made that very well could be devastating. Anthrax and other biological agents can be transported to unsuspecting victims and start an epidemic with catastrophic results. DNA technologies study the very nature of viruses and disease quite often and one could easily use the science for destructive means. Potential for bioterrorism presents a real risk that must too be weighed in moral consideration of such technologies.

Genetics attacks the course of life and makes it inherently more dangerous. Unforeseeable outbreaks of viruses and mutagenic pests can not only happen, but will happen. It is only a matter of time.

No matter how careful lab practices are, organisms can and will escape. For the most part, lab-bred animals have decreased survival rates outside the lab, but one can never predict when a mutant will become hardy enough to survive on their own. (Organisation…, 29) Genetics as a science has not produced a pathogen that has been linked to it. However, the nature of many studies uses viruses and pathogenic strains for research and even as tools. The viral mechanisms that exploit life for their benefit and proliferation are very specific. This specificity lends itself to advanced targeting systems for drug delivery. (Davies, 485)

Genetic manipulation is still not at extremely huge scale applications; questions concerning goals and safety are still relevant. For instance, where are the wastes of the technology ultimately going to end up? This is an interesting question, the bulk of the wastes are highly regulated in laboratories. There are several containers in each lab for various kinds of trash. Criteria used to evaluate each kind of waste include the shape, whether or not living organisms are being disposed of, and whether toxic or harmful materials are involved. There are special units for sharp wastes such as syringes and broken glass. Additional containers are used for pipettes and still others for blunt plastics. There are contained receptacles for biological materials and special bottles for chemical wastes.

The fate of all waste, except chemical, is to be autoclaved at 300 degrees Fahrenheit. This destroys all living material and the liquids can be drained into a sink for further chemical inactivation at the facility. The plastics in the container are melted due to the heat and pressure and can be thrown away.

The interesting aspect of waste containment is that many fear not what ends up in the trash, but what doesn't. No person is perfect, and spills are common in routine lab work. The improper clean up of a contaminant can lead to not only bad data, but also potentially dangerous situations. For instance, if a radioactive labeling dye was spilt on the handle of a drawer, some unsuspecting worker can get it on their hand. This dye can then be found all over the lab due to unaware contact.

Now, think about a pathogenic or resistance encoding genetic element that may have gotten into an *E. coli* culture by accidentally using a micropipetter improperly. The genetic material may actually get inside the unit and a repeated improper use can expose a later solution to it. Now, many scientists may claim to not use a simple tool such as a micropipetter incorrectly, but we all make mistakes sometimes and there are a lot of scientists out there. This infected culture or solution may then be carelessly handled and the scientist may be exposed to a nasty bug with unexpected properties such as antibody resistance. This is hypothetical and a similar incident is foreseeable since inexperience and human error are prevalent in any event.

But lets not get caught up in what "can" be done; we need to ask ourselves "should this be done?" Lets say we are talking about taking a virus and using it to target a part of our body. This virus has its pathogenicity 'gutted' out of its genome, but by the same processes, it can regain them. Genetics gets its enzymatic tools from nature, they are extracted and analyzed and then processed for standard lab use. The 'gutting' out process came from nature, and by the same token, the "insertion" processes, that are also commonly used, came from nature.

These examples raise some serious questions that need to be addressed with every technology including genetic manipulation, before they are used worldwide. For instance, is there the possibility of irreversible environmental harm that may ultimately be devastating locally and/or globally? What is the fate of harmful materials that are generated? If damage is time-dependent, how many generations will have to deal with it? Lets take a look at a science that became a technology with adverse effects globally.

Nuclear energy was studied very rigorously in the 1950s and many similar questions were asked by concerned individuals working on the projects and by the ill-informed public. However, the Cold War with Russia pushed the technology to use when it should not have been due to the infancy of the science that the technology is founded upon. At the time of development, there was numerous negative government assessments by the Atomic Energy Commission (AEC) pointed to the technical difficulties inherent in the technology. They warned Congress in 1948 against "unwarranted optimism" about nuclear power since all projections pointed towards its costly nature. Some of the early propaganda spoke of "energy too cheap to meter" and "the peaceful atom." (Makhijani, Saleska, 2)

Many people who were spokesmen served as chairmen for the AEC. Which goes to show one the depth to which the misinformation campaign reached. Not surprisingly, the chairmen of the congressional Joint Committee on Atomic Energy's report stated that the U.S. would lose its position in the world if Russia developed a 'peaceful application' of nuclear technology first. In this way, nuclear research could be carried out under a guise of peaceful intentions. At the time, naturally the U.S. had almost all its efforts focused on nuclear weapon development. In an effort to change the image of U.S. nuclear technology, Eisenhower made a 1953 speech entitled, "Atoms for Peace." The propaganda value of being the first country to develop nuclear power was very high after World War II. This caused the Eisenhower administration to push the engineers to develop the technology faster than they would have liked.

This resulted in less long-term safety assessments and less flexible designing of the systems. The engineers needed to get the reactors to work, not work well or with the best design.

Not only were government agencies pointing to the danger, but also commercial industries showed the cost of the process to be too high to compete with other forms of energy. The Vice-President of General Electric in 1950 made a statement that “atomic power is *not* the means by which man will for the first time emancipate himself economically…” (Makhijani, Saleska, 2) Other assessments were made that stated that eventually, nuclear energy might be able to compete with coal. However, this was if coal prices increased and atomic energy was developed efficiently.

Safety is obviously the first issue many think of when they hear atomic energy. When the reactors were built, unfortunately it was not that high of a priority. The designs used had flaws in them and they were known at the time of development. The reason the designs were and still are in use is the amount of money invested in them. The administration used the “sunken cost” line of thinking and tried to improve inferior designs. The designs should have been rethought entirely with new goals such as safety in mind. (Makhijani, Saleska, 82)

Very early on, safety issues were discovered and the AEC responded by attempting to stop all discussion. However, the U.S. public did come to learn of the dangers, as many had suspected from the initial demonstration of nuclear power in Japan. The official AEC reaction tried to quell concerns using informal and slow processes. Everyone concerned was unsatisfied with the response and the avoidance of the problem caused more problems for the administration due to numerous lawsuits. The AEC had a hearing to generate rules to deal with the most common safety issue, which was the loss of coolant in light water reactors (LWR).

In its rush to build these structures, almost all other safety criteria were ignored and minimalist safeguards were implemented. This mindset has led to several nuclear accidents including a partial meltdown of the Fermi I reactor in Detroit and the Chernobyl meltdown. New reactor designs were implemented eventually and termed 'inherently safe' reactors since they were less likely to have a loss-of-coolant accident like the LWRs. However, other types of accidents that were not brought to the public's attention still existed and were not addressed. Many of the manufacturers of the reactors built plants at a loss in order to stimulate the industry. This resulted in using inferior materials in some aspects of manufacturing to cut cost and subsequently lower levels of safety. (Makhijani, Saleska, 63)

Nuclear power became available in the 1960s for several reasons including the government offering subsidized insurance and relaxing safety criteria for plants. When the AEC changed the safety requirements in the 1970s, the profits began to decline due to increased maintenance costs and retroactive safety improvements. In addition, the manufacturers of plants and reactors stopped offering them at a loss. Subsequently, the price of nuclear energy dramatically rose in the seventies and eighties. This was coupled with a growing lack of public confidence in the safety of the industry. The effort to cover-up some of the early safety warnings was eventually exposed with the numerous accidents that happened, including the Three Mile Island reactor meltdown. (Makhijani, Saleska, 102)

The waste of the industry is in the form of plutonium and fission products from the nuclear reaction. Plutonium can be used for nuclear weapons, however it requires substantial reprocessing in plants. The U.S. has taken a stance to not reprocess the material for weapons, however several other countries have, such as Britain and France. This presents an interesting dilemma to the U.S. due to the location of waste dump-offs and containment measures. Nuclear waste has been generated for approximately forty years and yet there has been no proposal for alternate fates than generate weapons or bury it in lead bunkers. This lack of foresight has led to numerous environmental problems on a scale greater than any landfill can imagine. Not to mention, the mining of uranium poses its own set of unique environmental issues. The most concentrated ore has around or less than one percent uranium which may not be the right isotope. The whole process of enrichment and preparation is sloppy and low doses of radiation are present during mining. Instead of affecting a few scientists who handle the material, a large number of miners are exposed. (Makhijani, Saleska, 30)

With so many problems, a reasonably educated person would not have developed this technological application in this manner. From the very first demonstration, the power and devastation of atomic energy was known. Many of the problems we still face, today such as waste disposal, were known during development. They were and are ignored. A large radioactive dump in the mountains, out of sight, is not a solution.

Here, one can see that once a technology is in the commercial marketplace, it is essentially out of the hands of the individuals who created it. The scientists who developed this technology scoffed at the statements made about its price and safety. However, when the government regulatory agencies such as AEC declared it safe to the public, the industry followed. A huge amount of private investment from Westinghouse and G.E. in LWR technology stimulated reactor production despite the still unresolved safety issues. (Makhijani, Saleska, 7)

Once again, all technologies need to be questioned as to how they will impact the world. Nuclear energy was never a panacea for our energy needs. The myth was generated to serve the public relations needs of the foolish government at that time. The subsequent problems that occurred were not surprising either. The safety of the reactors was questionable from the outset; however it was an acceptable risk to the administration. (Makhajani, Saleska, 6)

There are several drawbacks to genetics, but it is all speculative and estimated at this point in time. It's important that these risks be considered since the techniques are still infantile. Numerous potential hazards are taken into consideration with every experiment and a biosafety committee approves all large-scale experiments. But, many factors of consideration are not yet known and will not become realized until they have taken affect in our ecologies. The cons of the technology are present but less evident than the pros, such as improved health care with rising coasts. It is even more apparent since it has been admitted that genetic pollution has occurred in Mexico with the U.S.'s transgenic corn. The Commission for Environmental Cooperation found insect –resistant corn from the U.S. in Oaxaca fields in 2001. It is only a matter of time before genetic repercussions permeate in detrimental ways.

Life has always found a way to live and nothing illustrates this better than viruses. It has been over twenty years since we have begun research on human immunodeficiency virus (HIV). Some treatments have been created that treat the symptoms more than treating the infection. It is a rapidly evolving virus that inserts mutations in its genome six orders of magnitude more than humans. In a single patient there could be 10^{10} virions produced a day. What all this boils down to is that a single infected individual, over time, can have a diverse population of viruses living inside them. This population is extremely stable and for the most part there will be a higher resistance to treatment. Virologists have a tough task ahead of them, since the composition of the virus always changes. The strain that is prevalent right now is a recombined version of two original strains. This only further complicates the problem and illustrates that the technology we have will take significant investment of resources to rival those of nature. (Gao, et al, 7013)

Another question to think about is how long may the earth be affected, if a problem were to occur? Due to the nature of evolution, the earth may be affected for a very long time. If a transgenic weed were to be created through horizontal gene transfer, the effects of that weed may be global and catastrophic. It could destroy widespread crops and shake the agricultural ecosystem up till a solution was found to manage it. This transgenic pest could overtake our fragile system and change how the world finds its food. Famine may occur for several years and new techniques for dealing with the problem will have to be developed. These techniques could then be incorporated into the farmers' way of life and last for many generations. These questions about the level of risk that is acceptable diminish the overall utility of the science to an unacceptable level. (Makhajani, Saleska)

Animal Testing in Genetics

However, the previous scenarios are speculation and do not touch upon the inherent problem of genetics. Living creatures, which were born from natural processes, are dissected on the molecular level. They are reconstructed and distorted to be something that they would never naturally become. This, of course, is without their consent and it is without the necessary consideration for such a severe procedure. Anything, that is conscious and aware of one self, ought to be treated as an equal to humans in relevant situations. Plants lack the ability to make decisions, or experience unhappiness as animals can, therefore they must be excluded from this argument. The lack of frustration due to obstruction of free will alone justifies the exclusion of plants. (Regan)

Although the abilities of animals differ from humans, the abilities of humans also differ from other humans. The similarities between sentient beings are greater than the differences.

“We are each of us experiencing subject of life, a conscious creature having an individual welfare that has importance to us whatever our usefulness to others.” (Regan, 23) Therefore anything that has a consciousness and is actively partaking in life, has an inherent value that makes it distinctly different from an object.

The benefits associated with genetics do not take into consideration the pain, psychological distress, loss of free will and unnecessary death that accompanies all scientific animal research. The benefits of the technology are for one species and none of the hugely outnumbering others. The pain and agony that is derived affects a large number of sentient beings. So the presence of pain must factor into the argument since any organism that is aware of it, feels it. The unhappiness of the animals decreases the overall utility of the action.

The use of animal subjects for clinical trials has expedited any studies that would have been done with humans for their entirety. This is due to the smaller group size for each experiment that would cause a more difficult statistical analysis. With rapidly reproducing subjects like mice, one can run experiments and get results in a month and a half. Humans would take roughly fifteen years in comparison. Besides, reproductive studies with humans would be immoral since we are not taking into consideration their preferences and autonomy.

If the biochemical pathway is known for producing a desired chemical and the genes for the pathway are isolated, it can be inserted into novel hosts. In this way, drugs like insulin can be produced through fermentation and chemicals like citric acid can be made from molasses and *Aspergillus niger* which is a bacterium that degrades sugars like cellulose. (Yoxen, 162) Many industrial versions of production are impractical or expensive unless made from cheap materials and genetic engineering provides potential opportunities to do so.

The Regan essay mentioned earlier called, *The Case for Animal Rights*, discusses *inherent value*, in order to correct the issue with utilitarianism first addressed. The people that are subject to these moral rules are not simply producers of opinions; they are more than that. They are individuals and this value must transcend race, sex and creed in order to be just. "All have inherent value, all possess it equally, and all have an equal right to be treated with respect, to be treated in ways that do not reduce them to the status of things, as if they existed as resources for others." Everyone is important because they exist, not because they have utility to others. The view generated from this belief was termed the rights view by the author. This view does not allow discrimination in any form or "justifies good results by using evil means that violate an individual's rights."

Each sentient being plays a conscious role in the maintenance of a healthy ecology. Because all beings are related through their genetic similarities we are lead to respect the pool of genetic material that supports us all. To ignore this connection would be to disrespect ourselves as well all influences that have contributed to the rise of humans.

Another utilitarian approximation may be that the organism does in fact feel pain, however it is to a lesser degree or that it is inherently different. Therefore its effect on total utility is reduced but present. This position cannot be held since any pain that is perceived is pain, no matter who perceives it.

For instance, if I had two dogs and one happened to die, the pain I feel is similarly felt by my other dog. We both perceive the absence of a loved one and exhibit reactions to painful stimuli in nearly identical manners. The common response to such events lends one to believe that it is illogical to think that the mental processes associated with the similar perceptions are very different from the mental processes involved with the mental state of physical and emotional pain. The realization of pain and other emotions forces one to consider the being as a moral subject worthy of similar moral considerations. Therefore the hurt and depression felt by lab animals from the environment and procedures we impose is comparable to feelings humans have when caged and tortured. (Mill, 48)

Like humans, this sort of damage can be physical, or in some cases mental. Test subjects in experiments often exhibit depression-like symptoms that are the result of the lab environment. This alone testifies to the cruelty of the treatment and detrimental effects it has. The inherent rights that this organism should have are completely neglected and all sentient being experiments should be abolished. (Midgley, 61)

Subjects in genetic experiments lack this chance. We, as godly-acting elements of nature, have robbed them of the rights they deserve. Humans have never asked them what their thoughts on the procedures were. In fact, most scientists deny animals can form thoughts on complex matters. However, animals can undeniably feel emotion. This entitles them to a certain set of rights (to be developed later), rights that are violated by genetic engineering.

Michael Lynch's essay, *Sacrifice and the Transformation of the Animal Body into a Scientific Object: Laboratory Culture and Ritual Practices in the NeuroSciences,* described the manner by which scientists desensitize their compassion for animal subjects. The process of experiments is very brutal, lonely, and wasteful in the sense that life is destroyed at the end of the experiment. Scientists refer to subjects as numbers and letters arranged in a manner that represents their origin, condition, or the procedure performed on them. (Lynch, 272)

Animals have rights as sentient beings because they are aware of their presence and environment. They deserve respect for their freewill and should be treated as equals. However we know that animals cannot be equal to us in all ways. For instance, I don't ask my dog to drive me to work in the morning. I know that my dog does not have the capacity to drive me to work. My dog cannot fulfill that role in that particular arena as Peter Singer puts it. Arenas are situations or acts that are relevant to a group of individuals. Animals certainly are more qualified for some arenas compared to humans and vice versa. However in the arena of a global ecology all sentient beings are citizens and must be held to moral obligations that provide the least and equal distribution of unhappiness for everyone involved.

In this respect, Singer's One World discussion of the affects and impacts everyday actions on the world parallels our argument. Even small actions can accumulate to unhappiness for others over time. Singer likens our resources to a sink that everyone can dump liquids down with never seeing adverse effects. What happens when wastes start showing up in unexpected places that cause unhappiness for beings? This illustrates a similar question one must ask of their lifestyle. Do the actions of my lifestyle cause unhappiness for others in any amount? Not to dwell on our imperfections, but to realize our limitations and account for them in our actions.

Consciousness is what sets living organisms apart from chaotic chemical reactions. Our power to perceive not only that we exist, but that we can alter the conditions of our existence is a right of all creatures that possess the capacity. All conscious beings should have the right to choose their path in life.

People such as Charles Cantor discuss trends in the industry and ideas such as "directed evolution" where humans gain control of the evolution of all organisms. These thoughts only boost support of genetically modified organisms (GMOs) in that all organisms, including humans, will be GMOs. This support translates into increased profits for the companies who produce the GMOs. Just because humans "can" change evolution, doesn't mean they "ought" to.

Humans are conscious elements of nature and their awareness should give them the ability to coexist with nature to produce the greatest happiness for all sentient beings with inherent value.

Exploitation is wrong since it uses a being as a means to an end. Humans and animals use objects as tools in order to accomplish a task. These tools become our property and are used as a means to an end. Exploitation uses other beings to accomplish something, for instance harvesting cotton; and reduces them to objects.

Objects lack rights, no one would object if I broke my pencil. I would not be violating the rights of the pencil, since it has none. The reason why objects lack rights is that they cannot have autonomy or consciousness. They do not perceive their environment and analyze their interactions with it. They do not "feel" anything, any emotion. Animals feel emotions; they can feel pain. They are not objects by any means. Therefore they ought to not be treated as such.

However most situations are not ideal and a minority, with its own set of opinions, may not be listened to as much. Therefore if everyone thought that putting the minority of African Americans into slavery was a good idea, using a utilitarian viewpoint, it has a higher utility for the majority than the lower utility for the minority. So the disenfranchisement of the African Americans is acceptable by this line of thought. Now we know that this is not true because the opinions and free will of the African Americans are equally important as anyone else's. The exploitation of a smaller group of individuals due to their inability to defend their rights within a larger group of individuals that benefits from their lack of rights is possible using the utilitarian position. Yet, the viewpoint and rules set out can be modified to dispel this possibility. This must be avoided by respecting the opinions and freedom of others. People have rights that should not be violated by anyone's actions.

Others, who are we referring to when we say this? Anyone that exhibits opinions and freedom is qualified by the previous definition. So all creatures that demonstrate an ability to make decisions or have preferences and exercises free will. By preferences we can infer that one would prefer something if it benefited them. So an organism that preferred something, say a type of food, would perceive, compare and contrast previous experiences and make a decision about which type of food it chose to eat. The awareness of this organism warrants the respect of its way of life. It just desires to keep on living, the same way all humans do. A sentient being knows that it is alive, therefore anytime we cause harm to it, it perceives and realizes this damage.

The labeling of living systems as a condition or procedure debases the inherent value deserving of all sentient beings. A lab rat is not 'X3Dc,' it is a being that is attempting to live in the world it is exposed to. The conditions of the lab are entirely different from its natural environment. A meadow with no boundaries and plenty of potential food in no way compares to the tiny cages that lab animals are kept in. Often they are deprived of any social contact for fear of impure breeding. By taking away their freedom of choice, we are taking away part of what makes them special. That is their free will, their ability to decide where they want to be and what they want to do. Their independence is debased and destroyed to reduce them to mere objects. (Lynch, 279) A moral rule could then be stated as:

Any being that 'can' exercise autonomy 'should'.

This last statement deserves some further thought, because by this token anyone can do anything, as long as they can carry out the action. So one can genetically modify organisms as long as they can carry out the procedure. If we know this is wrong and does not agree with our original argument, we must revise the statement. The revision must prevent individuals from doing an act that, if done by everyone, would negatively affect the planet. So a modified moral rule would be stated as:

> As long as it doesn't hurt our fragile ecosystem, a sentient being can exercise free will and autonomy.

John Stuart Mills formulates a similar statement except he uses the right to exercise free will as relevant moral criteria instead of the state of the world's ecosystem. These two views are not different since the destruction of the global ecological system prevents people from exercising the freedom of enjoying the outdoors, for instance. Holes in the ozone layer will forever change how we look at sunlight. Pollution of drinking water alters how we acquire water and how much it costs. Soon, air pollution may have elemental oxygen turned into a commodity like bottled water or fossil fuel for your house. Therefore, the destruction of the world's environment only leads to further complications in the way humans live their life and the degradation of its quality.

So by this argument we should not try to prevent any natural disaster if we could. For instance, an asteroid is heading directly for the earth. The government has lasers and bombs that can vaporize the asteroid at the push of a button. However, as stated in the previous paragraph, since it is natural, we should not destroy it. Now we know that we should destroy it, but why? Well the asteroid would cause a large-scale disaster that would affect every living being. This mass destruction of life merits the destruction of a large rock that happens to be hurtling towards earth. This line of thought reinforces the previous rule:

> As long as it doesn't hurt our fragile ecosystem, a sentient being can exercise free will and autonomy.

Since the natural powers that have been shaping life are unconscious, they cannot be held to the moral criteria that sentient beings must be. A hurricane or forest fire is not unethical, but an arsonist that intentionally starts a forest fire is. The arson is aware of what he is doing and must be aware of the destruction he will cause. His act, if carried out, would lead to negative consequences. Everyone refers to all sentient beings, not to physical matter.

The degradation of human values due to irresponsible lack of respect for other sentient beings is detrimental to humanity. This will carry over from animals to humans and it has in the past, with slavery for example. This violence and disrespect is harmful to society and to the citizens of Earth. Genetics contributes to this damage and should be stopped on the grounds that the technology is destructive to the ecology of the world.

Ecological Degradation from Genetics and Industrialization

Genetics is objectionable for a slightly different reason as well. Genetics is a very useful technology for the world. However it is tampering with the mechanisms that were created by evolution. Yes, we are imperfect (biologically, not to mention mentally); we are not impervious to the world. We contract diseases, get injured and develop ailments with age. Our war on these problems is justifiable since they can cause destruction and loss of life. Yet, the potential risk of serious and catastrophic destruction from the technology used in this war outweighs the advantage it has given us. Nature and the selection process it generated created humans, and the conscious element we possess. However, sentience has given us the confidence to believe we are above the random forces of the universe and our world.

If one believes that God created life, as we know it, then geneticists are essentially playing God. They are raising themselves, morally, above all others. Genetics challenges the stability of the world and the techniques demoralize its subjects who are nothing more than victims. The consciousness and will of the subjects are never taken into account and they are exploited for capitalistic desires and benefits to humans.

Genetics as a science dissociates humans from the rest of the realm of ecology. These technologies violate the moral rule that protects the fragility of our natural world. As Gods, we are treating our fellow citizens of earth as tools or objects for our manipulation. We are so similar that it follows that humans will treat others as objects as well. There is precedent for this with segregation, slavery, the holocaust, et cetera.

Humans, as a part of nature are causing more damage than previously generated by natural phenomena like volcanoes and hurricanes. Greenhouse gases have had global effects on weather and large-scale applications of chemicals have caused pollution that has resulted in numerous tragedies within the animal kingdom that are rivaled only by ice ages and global extinction events. Hydroelectric plants have changed the course of large rivers and have also changed the course and quality of life inside that river. Deforestation has literally changed the face of mountains in a way that far exceeds the effects of any wildfire. Human actions that drastically affect the circle of life within an ecosystem, for the worse, ought to not happen.

There is a long history of technologies that have adversely affected the world. Ranging from the use of agricultural pesticides that ultimately found their way to fish and bird populations, to nuclear energy and widespread fallout from nuclear testing and reactor meltdowns. Even technology we use each day, such as cars and the fossil fuels we use to power our cars, as well as heat our homes, have polluted the environment. Products that may not appear harmful may be made of materials that needed to be mined or chemically produced. Both mining and industrial chemical processes generate very toxic compounds that need to be disposed of properly. Mining often leaves pools of acids on the surface of a scarred landscape that is so polluted life cannot grow. With the number of superfund sites worldwide equaling roughly 40,000 in the U.S. and its territories, it is obvious that chemical disposal methods are far from perfect. (Campbell)

The damage done to the ecosystem affects everyone in one way or another. Cancer rates are increasing due to radiation in the atmosphere and the lack of a protective ozone layer. Genetics and the ecological pollution that it will cause will cause destruction that will be felt by everyone. Whether it is a nasty disease or a mutagenic weed, the well being of the global ecology will be damaged. Our ability to use rational reasoning means we should perform actions that benefit the world, not just ourselves.

We are not only attentive to our surrounding and present situation, but can also reflect on experiences and use our free will to choose our future. Our freedom of choice is conditional on whether or not we are given a chance to exercise that freedom.

Humans are bribed with glamorous visions of a high tech world. Where everything is easy and done with a push of a button. But it will not be like that. The technology that creates these commodities diminishes the value of life. We are tricked into reducing ourselves to objects. Objects to be manipulated by the corporate giants that need us to work at their factories, but pay for their products at significantly higher prices. The arrogance of science, which stems from our own inherent nature, distorts our view of ourselves. (Levins, Lewontin, 227)

We are preventing ourselves from having compassion for the nature that is destroyed in the process. By elevating ourselves to a higher level of importance than our environment, we are propagating policies that risk ending life, as we know it. As a citizen of earth we must respect and have compassion for other living organisms. Not just on an individual level, but we must also respect the intricate network of relationships that evolve from interactions with our world. We are simply a part of a global ecology, and when one thinks that they aren't, they cause problems that endanger the whole system. (Merchant, 94)

What is important here is that we are rational beings; we make choices. We don't need to do genetic research; we choose to do so. We can promote the stability of the world rather than curing the diseases of it. This stability will result in a healthier planet that will be better able to fight these ailments. How can scientists believe that the tools they gain from nature will allow them to cure diseases that are constantly evolving? The duality of nature must be accepted, not only for it's goodness but also for its detriments. For the little challenges are what have caused us to grow, where genetic technologies present the chance for irrevocable harm due to the human assumption of perfection.

Plants are included in this discussion of global ecology since there is merit in having a strong diverse bionetwork, which includes all living systems. The animals that live off of the plants will be healthier as a result, and both will trickle down to humans. There are interactions that connect everyone to everything in some way or another. Thus every act performed in the world affects every other event and person. The healthier the relationship of the interaction, the healthier the world, as a whole, becomes. (Merchant, 85)

V. DEONTOLOGY

Industrial application of genetic technologies has inherent risks that jeopardize natural ecology. Our existence is a symbiotic development with our environment. By creating mass industry we have expanded our scope of influence to a global scale. Applications with such universal implications should not be developed by an entity, which does not itself apply to such universal application such as that of moral law; otherwise the integrity of our individual existence in put into play. The benefits as well as the possibility for major risks are known and applicable to every individual at least through a family member. The current invasive techniques being pursued manipulate organisms beyond their natural existence to give a desired result. This manipulation is done with object-oriented motivation, where the proposed benefits are weighed against the proposed negatives. But life is subject to circumstance, which prevents us from prognosticating accurately. Due to the universal nature of DNA through, not only what are currently considered sentient and rational beings, but also of all life on this planet, we need to treat DNA technology with the prudence it so obviously deserves. The will of those inclined inward towards the universal properties of being could cause negative implications for many and calls for scrutiny by the ethical society. A basis for an ethical framework by which to judge such a technology, contrary to that of utilitarian views, is presented in the *Foundation of the Metaphysics of Morals* by Immanuel Kant and is that of a deontological system.

Kant describes philosophy as a scientific study as physics, where postulates are made and refined in a search for a universal relation. Objective reason is considered a purity that is tainted by desires. In a deontological framework moral value is based on the will, not on the consequence. Due to the free will of rational beings and their capability to recognize other beings as being rational as well, we are obligated to act morally using universal maxims as a means of basis for application. Because of our conception of ourselves as rational beings we can recognize the practicality of universal laws, because if we were to act harshly, then we could certainly be repaid the same. Kant says that the free will then leads to self-restriction through moral law out of duty to all rational beings.

The principle of a good will is set above all else as the one good that is not contingent on other stipulations. Kant rationalizes the worth of good will by illustrating the subjectivity of other qualities such as self-control, moderation of affections and sober reflection. Many for ages have revered these traits, but their value is dependent on the temperament associated with them. Without good will the worth of these traits becomes apparent, in Kant's terms, "the very coolness of a scoundrel makes them, not merely more dangerous, but also immediately more abominable in our eyes than we should have taken him to be without it."(Kant, 10) The good will is not of value because of outcomes, but it is good in it self. For if one attempts to accomplish a task out of good will, and the desired result is not produced due to some natural intervention, the will still remains untainted even to shine brighter in the face of adversity. Kant also states the attributes that contribute the most to one's "happiness", such as power, wealth and health, lead to boldness without goodwill. Positive outcomes merely quell the anxieties of those who cannot see good will for its inherent value. Many times the action that would be considered the morally good thing to do does not coincide with the personally beneficial action and most people do not like to accept less than what they have had before. This fosters self love and a desire for self perfection through subjective moral considerations. Kant also discusses the idea that if a person is happy without good will then they do not deserve such pleasures. That even a person who acts in a moral way, but does so for self gratification, is still morally lacking. Our intellect calls us to act to the full capacity of our understanding.

The sense of reason allows us to observe patterns and expound upon them, but is not the only sense to do so. We observe things of nature and create laws around them, as Newton observed objects fall to the ground he postulated his theory of gravity. The ability to perceive the worth of universalities is what led Kant to place the only worthy truth on rationality. Because of this intrinsic worth of reason, Kant states that all rational beings are to be considered ends, worthy of respect. By the acceptance of the sovereignty of the individual rational being, one realizes that each individual has the choice to act in a manner that may be undesirable to others, which he calls the "autonomy of the will" (Kant, 50). "Now, I say, man and, in general, every rational being exists as an end in himself and not merely as a means to be arbitrarily used by this or that will." (Kant, 46) To maximize the good of the community of beings with the capacity to make such observations, his realm of ends, universal laws are clearly of value (Kant, 52). A moral action entails doing what is good not for one self, but for all that are considered ends, to do ones duty for duties sake.

To elucidate the value associated with good will Kant introduces his concept of a duty; while he states that it may actually deter from a true appreciation of the depth of good will. Duty is the responsibility for beings of rational capacity to act on behalf of the good of not only their clan but the good of all. Good will is then defined as to do ones duty for the sake of duty. Herein lies the large difference between utilitarian and deontological systems; for a utilitarian it is necessary to weigh the consequence of ones actions to determine moral worth. This allows an action to be right in one situation but wrong in another and this evaluation is subject to the contemplation of an individual. Deontological precepts rely on the conception of benefit to the whole, objectively; all personal and subjective considerations are put aside. To illustrate, one who is of good standing, to act on the premise of self preservation does not entail moral worth because their existence is not directly in question, but for one who is destitute and miserable to persevere for the sake of duty, towards the realm of ends, entails moral worth. For that derelict individual to live on in light of the possibility that their existence may show its purpose at a later time, to this end, self-preservation is out of duty. Duty presupposes reason and the capacity to realize the worth inherent in rational beings. Self-mutilation or suicide shows no consideration of self worth and degrades the integrity of the moral whole. Though one has no apparent means of contribution to any benefit, the presence of a good will gives worth to any existence.

The concept of duty is exemplified in *The Dialogues of Plato: Phaedo* which is said to be the recounting of the last day of the philosopher, Socrates, in 399 B.C. The Oracle at Delphi proclaimed him to be the wisest man on earth, for he claimed to know nothing on the basis of all knowledge being subjective to the constraints of the human condition. By accepting his human flaws of perception they became his greatest strength. Socrates was tried for corrupting the youth for his preaching having questioned the Gods of the government. *The Dialogues of Plato* tell of the trial and the time there after. Having stood by his philosophy and giving an eloquent rhetoric at his trial, told in the *Apology*, he was sentenced to death. Socrates shares the same belief as Kant that the reason is a pure entity that is subject to manipulation by the senses.

On the day of his death Socrates was described as seemingly guided by "Providence" (Phaedo, 66), and faced his execution with even positive reflection. Prior to this day, as told in the *Crito*, friends of Socrates had tried to convince him to flee and live elsewhere. But Socrates denies this offer and insists on completing his sentence. In the *Phaedo*, on the last day friends of Socrates gathered at the jail early in the morning to spend their last day in his presence. As they enter his chamber, Socrates is rubbing his skin where the shackles had been, and begins the days' conversation by comparing good and evil. His legs hurt from the shackles, but the relief of such pain brought such pleasure, and he drew that good and evil are like two heads attached to the same body of a dog, in that it is inevitable when looking for one the other is never far behind, and that we must make our choice based on the good of all, not the intended outcomes (Phaedo, 67).

As the day's conversation progresses Socrates develops, through rhetoric with his friends, the notion that a true philosopher would embrace the day of his death as the true attainment of pure consciousness as one transcends from bodily existence. Also, that he should not want to avoid his death if it is so decreed by law, because the law represents the moral will of the whole. To exclude oneself from the regulation of one's actions as so dictated by our reason, would be to put into question the integrity of our moral foundations.

Kant says that to decide the moral worth of an action the rational being is dependant on what he calls imperatives. "The conception of an objective principle, so far as it constrains a will, is a command (of reason), and the formula of this command is called an imperative" (Kant, 30). Nature follows laws and, rational beings act according to the conception of laws. Kant states that because it is such in nature that we do not find organs for no purpose our reason helps define our purpose, so if our ends were to satisfy bodily pleasures and self indulgence we would not have such a developed sense of reason, instinct would be better suited. Reason allows us to consider the existence of other rational beings, with a will of their own; non-rational beings interact without consideration for other beings. Imperatives are a result of our rationality; because we can see that there is a choice to be made we must make one. There are two kinds of imperatives that Kant outlines.

The categorical imperative creates a principle that is thought to be good regardless of situation. The action must be done in the consideration of the good for the realm of ends. Kant further defines a universal imperative as to “Act as though the maxim of your action were by your will to become a universal law of nature.” (Kant, 39) The extension of moral laws leads to self-regulation, but this is necessary to maintain ones free will. A stipulation of free will is the assumption of freedom and what Kant calls the autonomy of the will. Thus no ones will, should be inhibited by the will of any other, so are formulated moral laws.

Because each will has its own sensory perception each values their desire and will act to satisfy its existence, whatever it defines it to be. The consideration of practical utility results in what is called, hypothetical imperatives. Practical law allows for every action to have the possibility of being good. This is called heteronomy, which is to will for something other than that which is out of duty, for subjective principles. Kant describes heteronomy as the root of all spurious principles of morality, and that to act contrary to the categorical imperative is to allow an object to define the law (Kant, 59).

Heteronomy is driven by the idea of personal perfection. This stems from the assumption that ones own perception of what is good is correct or better than someone else’s and allows incentives to undermine other rational beings. Due to human nature or circumstance, perfection cannot exist. Morality is made “special” to the individual and cannot be universalized, which causes the suppression of others and the autonomy of the will is ignored. Kant says this leads to cyclic behavior seeking glory, domination, might and vengeance (Kant, 69).

One aspect of this philosophy that can lead to misconception of the true ends is that to act on the behalf of all is to consider the greater good to be a summation of the individual state of people. The self must be considered as one of the whole and to neglect ones own well being detracts from the sentiment of the whole and can impede ones ability to realize ones duty. Another seeming contradiction of this philosophy is that some people derive pleasure from good deeds. If this person does not do such good deeds out of a sense of duty and merely for the self-satisfaction those acts, despite their outcome, are devoid of moral integrity.

The concept of Freedom is developed as a key concept for the autonomy of the will (Kant, 69). To be free is for one will to never be compromised by that of another. For these concepts to coincide outside of pure isolation, this requires that individuals must self impose regulation to preserve autonomy. These restrictions are formulated by the categorical imperative as universal laws. Kant says that respect for the universal law holds a worth that thwarts even our self-love (Kant, 11). The law represents will without personal influence, based on pure reason, being inherently good, and that we are obligated by our intelligence to act out of duty, for reverence of the law.

Deontological Critique

Deontological thinking attempts to avoid the subjectivity that is abundant in utilitarian views, but still falls short due to aspects of human existence. Kant states that our composition in turn defines our purpose, leading him to place the greatest worth on reason because ours is so developed. In light of our knowledge of ecological codependence we must embrace our unifying traits with the most worth, and consider our advantages to merely a tool to better the whole.

An apparent problem has arisen in the context of modern society, as to the definition of an entity. Kant speaks of rational beings as a definite distinction between humans and other animals, but those who do not see the inherent value of good will at times refute reason and even appear amoral. By the same token, it has been shown in other cases that animals show compassion and depth of character that could even rival that of the underprivileged human.

Therefore we have "reason" to question Kant's strict equivalence between moral value and a capacity for reason.

The essay "Persons and Non-Persons", by Mary Midgley, brings up the legal debate over animal rights of the 1970's where two men were charged for releasing two dolphins from a university research facility. The men were the caretakers of the animals throughout significant testing, during which the animals were subjected to social and physical isolation and manipulation. Through the course of the experiments, the condition of the animals noticeably deteriorated to the point where one of the dolphins eventually became "comatose" from depression. The animals once had enjoyed playing with toys, interacting with the trainers and each other, and were tortured for scientific research. Kenneth Le Vasseur was the first of the two on trial, and built his defense on the choice of lesser evils. The law states that an act that is otherwise objectionable is permitted if it is necessary to avoid a greater evil. For this to apply the action must be the only means of avoiding an imminent, and more serious, harm or evil to them or "another". In this case the intent of the action was to free a sentient being from further harm that was surely going to lead to death; there was no initiative for personal gain, the act was not to steal, but to free. The question is then posed, does a dolphin entail "another".

The judge thought not. His sentiment was that if we extend rights to dolphins it will then be other animals, and there will have to be a line drawn. A dolphin, in his opinion and the eyes of the law, is considered a possession. To extend the rights of inclusion under the penal code to any other species than human would bring the task of defining what level of intelligence would justify inclusion. The judge stated that his opinion was independent of consideration for the animal's intelligence. He has defined the system to preserve the rights of humans. This is based on the assumption that all of nature is at the disposal of humans for their prerogative. The author brings up the hypothetical situation that if a being of higher intelligence were to come to the planet. The judge may very well decide to exclude aliens from legal representation. What Midgely conveys is that which is respectable, is compassion. It is not the intelligence of a being that defines their worth, for then one would say that to expose mentally handicapped people to extraneous testing would be all right.

Midgley criticizes the judge for his assumption that 'person' only applies to humans and refers to the jargon of biologist when referring to an individual within a herd to have 'personal identity'. This line would be a judgment of intelligence to place animals on the same moral playing field as humans and the judge refused to extend the penal code to any animal.

This seems to be in contradiction to many legal proceedings so far, for there are entities recognized by the law that are not human individuals, such as businesses, colleges and political organizations that still are allotted legal status. The word person comes from a term for "a mask", in its basic dramatic sense, any having a role in a story. Through history we have seen several groups fight to be recognized as persons within the society, among them blacks and women. Before their liberation movements they had been considered objects with a secondary role and not worthy of consideration. Midgley uses the example of an 1890 Supreme Court case concerning a woman's right to practice law. Prior to the Women's Rights movement, men considered women not to have influence over official matters, that women only affected the home life, and that the two were separate. It is also illustrated that in ancient Roman and Greek culture that genius or insightful slaves often played roles in theater. In the case of animals, it is a matter of accepting the role that they play in our existence. Kant too seems to be of the assumption that animals and other life are involved with the existence of humans; he draws his line for respect at those beings with rational capacity.

The scope of earthly existence other than that of humans has of late been exposed more and more to our rational conception. Octopus, whales and other animals have shown incredible communication skills and situational deduction. The sentience of animals has been known for many ages, the mere physical similarities are enough for most people to recognize the range of feelings that animal's experience. Speech would make their capacity fully apparent. The further science probes into the animal existence, the more and more similarities it finds between them, and us but reason is still what prevents us from respecting animals.

Reason is not the only quality that calls for consideration. A computer can be programmed to have a rational capacity to some extent, but it does not cause angst in most individuals to break a computer, or use it for monotonous testing, in fact that is why we have them; but to use mentally disabled people for experimentation is considered deplorable. The handicapped individual may not have rational integrity but humans are compassionate to their sentience; and ought to be.

Kant states that nature is such that we do not find organs for no reason, our reason helps define our purpose; if our ends were to satisfy desires we would not have developed such a refined reason. Kant continues to say that reason is a practical faculty, not able to guide us completely, but that is meant to influence the will; that the proper function of reason is to produce a will good in itself. Nature does not proceed unprepared; our compassion and our reason are necessary components of our existence. Kant fails to see the depth of conception that animals are capable of experiencing. Due to our current understanding of living beings moral consideration is due to all sentient beings. Rationality does not control ones ability to feel, an abused dog is still dangerous, though it has no reason; it has the emotion. There is no surprise if an abused animal is deranged, the animal may not have the ability to choose between refined differences, but they can certainly act according to the laws of compassion that they experience. Sadly, the will of the dog has been tainted by the prior abuse. A truly good will would wish no pain or suffering on any sentient being despite the hardships one may experience. Our reason gives us the ability to objectively critique our situation.

What Kant fails to recognize is the worth and depth of our sentience as it too is highly refined as our reason and that calls for respect and has inherent value. The ability to observe a right and wrong is what separates us from the amoral, and gives all beings with the choice a duty to act according to their observations so that their actions if extended to all beings they would be applicable as a universal law. The sentience of all beings is deserving of autonomy, which entails freedom. To ensure autonomy we must live in harmony with all sentient beings and the systems that support them.

Similarities of concepts and flaws are apparent in the philosophies of Francis Bacon when compared to Kant. Francis Bacon (1561-1626) worked his way up the British legal system to Lord Chancellor of England and was tried and found guilty of taking a bribe while as a judge. Much of his influence was made through books. His manner is pungent with the sexism and arrogance, which was prevalent in aristocratic society at the time. He considered animal existence as that of a machine, devoid of inherent value. In his writings his ideas were embraced as an articulation of the inquisitive philosophies that so kindled the scientific revolution of the time. The *New Atlantis* embodies a great amount of Bacon's ideas on human reason.

Bacon quickly brings up that he does not follow Plato, especially when Plato says that all knowledge is inherent and that we simply must remember it, and that life is more a mystery to be unlocked. He writes that great kings and minds have gone together and attributes this to the great resources and teachings available. Bacon also says, "That knowledge has in it somewhat of the serpent."(Bacon, 3) The flaw in our knowledge is attributed to the placement of absolute definition to observable based on our limited perspective. But still, due to Bacon's faith in the human intellect, "that nothing parcel of the world is denied to mans inquery," (Bacon, 3) only under the stipulation that "The learner should believe what he is taught," and "The educated man should exercise his judgment," (Bacon, 14) alluding to the idea of a pure good.

"God hath framed the mind of man as a mirror or glass, capable of the image of the universal world…" (Bacon, 3) But it seems lost that we are still looking at a two dimensional representation of what is a three dimensional object; only to infer the true depth of being through reason alone, as opposed to searching with our entirety for true depth. Science is a construct of approximations, each approximation is like a card in a card house, carefully placed it can act as a support for greater approximations, but at some point the structure lacks the integrity to continue making approximations and the defined constructs become inadequate.

Bacon cites the impediments of the human mind as, "Shortness of life, ill conjunction of labors, ill tradition of knowledge over from hand-to-hand," But at the same time Bacon has faith in the human intellect. He says, "the true bounds and limitations, whereby human knowledge is confined and circumscribed… that we do not so place our felicity in knowledge, as we forget our morality… that we make application of our knowledge, to give ourselves repose and contentment, and not to distrust and repining… that we do not presume by the contemplation of nature to attain the mysteries of God."(Bacon, 3) In other words we should not lose the fascination with our natural abilities and tendencies but to beware of the limitations of our viewpoint. We are not capable of answering the big questions, because we ourselves are not big. Our lives are so short that we cannot comprehend the scope of the answer that we seek, so much so that we could have had "the answer" long ago and we probably wouldn't know it, more probably we laughed at it or killed the person saying it.

Bacon states that learning can make a man soft, by making him lose sight of objectives and priorities (Bacon, 4). We get lost in our minds, so that we fail to recognize our association with the world, which we contemplate. Humans become alienated from their animal, natural existence, while ignoring the compassionate nature of animals. We must bring our knowledge down to the plane that we live on, within the realm of our animal existence. But this does not seem so in politics. The political intellect seems to call to be held in the most ideal light, striving to attain the utopian society. Bacon points out how he does not like Lawyers for their lack of grounding in their books. This same rationale extends to science and politics. Bacon says that in science we must maintain and improve our understanding of our definition within the topics of science to prevent our progress from becoming to detached from our nature that we do not know how to use it safely and in politics that we must realize that unlike science, politics is the forum for the application of divine assumption. The science is an introspective search for truth of existence; politics is where we allow one of our own to be a representative authority to enforce the ethics of a people. Either pursuit should be sought with the same affirmation for the means and ends appropriate for such a position. "That a blind man may tread surer by a guide than a seeing man by a light." (Bacon, 7) We must accept the natural guide and not steer by our own light. All of our actions are subject to our rational interrogation as well as our compassionate consideration.

We must expand within the existence of our irrefutable existence. We will be brought down by the rot from within, "for we see that it is the manner of men to scandalize and deprave that which retaineth the state and virtue, by taking advantage upon that which is corrupt and degenerate”. In light of this consideration we must hold ourselves with moral reverence, “So a man may truly say of the schoolman ‘they broke the solidity of the sciences by the minuteness of their questions.’” (Bacon, 13) Science seems so justified and noble but in sphere of human existence we are contingent on the sentient beings around humans and the ecologies that support them.

Deontological Critique Conclusion

Deontological ethics places the only true worth on good will. Our will is that much more refined than the rest of nature concurrently with our reason. Because we have the ability to recognize other intelligent beings, for individual freedom we must develop the idea of autonomy. To prevent the inhibition of a will by that of another we must use universal maxims that impose self-restriction. Acting according to universal maxims despite the self-restriction is one’s duty as an intelligent being. Our actions must not be subverted by the analysis of hypothetical outcomes. Our perception is limited in its physical existence by its scope of observation and circumstance such that any subjective postulation has no inherent value. Moral actions are demanded by our intelligence via the categorical imperative.

One thing that Kant fails to acknowledge is the role of non human beings. The current understanding of the human condition is such that our science is extending to encompass our ethical ideal. Understanding animal sentience inevitably leads to the respect of their worth. DNA represents a basis for the inherent value of all living creatures, by embodying a unified physical reservoir of expression, the summation of which encompasses the entire biological world. We have also developed an understanding of the fact that inanimate matter is the building blocks for all living beings and that the chemical system around us is affected by our actions.

We must avoid endeavourers that taint the integrity of the realm of ends; at the same time we must remember that we cannot be afraid to expand that realm.

According to Kant the limit to practical philosophy as to live to ones maxims as best one can and make sure not to stray from the path of duty, though the tendency to waiver is always present (Kant, 84). That our duties include respect our being, to not lie because it is out of self love and contrary to duty, to live to ones fullest potential in regards to natural gifts and not dwell in self indulgences, and to help others in need when it is within our means to do so. Though the latter could be reversed, no rational will would choose such a thing (Kant, 39).

From our observations, our approximations approach closer and closer to the truth, but due to the fallacy of human perfection truth can never be seen through our subjective senses; only through pure reason can truth be obtained. Reason would never allow the practical manipulation of genetic material out of fear of the side affects associated with the hegemony of hypothetical imperatives. Our development must incorporate all of our gifts, including but not limited to our reason and compassion for all. Since we have the ability to make such refined distinctions we are obligated to act according to them.

VI. CONCLUSION

Through the adaptation of utilitarian and deontological ethical systems, in light of what is known in modern science, neither framework could morally permit the pursuit of GMO technology. Manipulation on mass genetic populations questions the inherent worth of the fabric of our being. To advocate such technologies would be to weigh the entire existence of life on earth against the proposed benefits from the marketing department of a budding industrial revolution.

Our existence is a symbiotic development with our environment and by creating mass industry we have expanded our scope of influence to a global scale. Inherent risks of industrial application of genetic technologies jeopardize the natural ecology, which all organisms are dependent on. Applications with such universal implications should not be developed by an entity, which does not itself apply to such universal application as that of moral law; otherwise the integrity of our individual existence is diminished. Both, benefits as well as the possibility for major risks are known, it is a matter of time before they are incorporated into our society. The current invasive techniques being pursued manipulate organisms with object-orientated motivation. The proposed benefits are weighed against the proposed negatives, when the true extent of either of which can never be predicted. Due to the universal nature of DNA through, not only what are currently considered sentient and rational beings, but all of life on this planet, we need treat DNA technology with the prudence it so obviously deserves. Despite meticulous calculation the scope of impact that an action may entail cannot be foreseen. The will of those inclined inward towards the universal properties of being could cause negative implications for many and calls for serious moral consideration.

The acceptance and understanding of the theory of evolution leads utilitarian ethicists to consider the inherent worth of the entire ecosystem. Human development has been contingent on specific conditions in a slow process since the beginning of our universe. We ought to love and respect all things that are involved in the life process.

Kant and his development of a deontological ethical framework, through slight modification in light of our current knowledge to encompass sentient beings and ecological stability, comes to similar conclusions; that natural development and biological diversity are worthy of moral consideration. The sentience of animals calls for them to be given freedom and thereby autonomy. While our undisputable connection to the inanimate world around us leads us to respect the integrity that has endowed us so with the very reason that allows us to make objective postulates, being the source of the one true good, the good will.

The limitations on both systems stem from the same roots; first, that human observations are limited by their nature, and secondly that any ethical system is only as strong as the intellect using it. For the utilitarian, any influence not previously considered or random happenstance can alter the outcomes to possibly alter the utility of ones actions, this is due to its basis on subjective calculation. The deontologist is limited by the individuals' acceptance of the roles of non-human beings and objects. Commercialization of genetic material represents the utmost disregard for the autonomy of the will, limiting ones genetic freedom. Our reason has led us to a state of ecological awareness; we no longer can limit inherent worth with human reason, but must focus on the proven constants of nature. To blindly our subjective desires into the age of genetic manipulation infringes on the freedom of all of life. For moral change to occur great considerations must be discussed in depth to refine the moral law, so, "Argue as much as you will, and about what you will, but Obey!" (Kant, 87)

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