SIX "FREE VENICE BEACHHEAD" ARTICLES BY SCFS AUTHORS

GLOBAL WARMING DEBATE HEATS UP

By Sheldon C. Plotkin, Ph.D., P.E.

The Southern California Federation of Scientists, SCFS, has been disseminating scientific information to the public since 1953. Our radio program, The Wizard Show, was on KPFK for 15 years attempting to explain technical phenomena to untrained people in terms they could understand. We claim that science is not wizardry, apparently complex matters are that way because a large number of simple and easily understood aspects are combined together which then makes the overall situation very difficult to understand. It is in that light that I have a few comments to make after reading the James Lovelock article about global warming in the February issue of the Beachhead.

Lovelock referring to the Earth as Gaia and then treating this physical entity as a living body with biological characteristics may provide some worthwhile analogies, but it also may provide some erroneous characteristics. It is true that much contamination will be cleaned up naturally once the polluting process ceases. However, phenomena like global warming requires the specification of necessary human actions beyond just saying we have to cease burning fossil fuels. Even the time scale is dependent on which course of action is taken, e.g. although the U.S. can cease burning coal with relative ease in my judgment, China appears to require a much more gradual cessation and probably a much different basic course.

Much of Lovelock's description of Gaia sounds like that of Native Americans with their references to Mother Earth. Violent treatment like stripping the earth of its natural resources needs more than just ceasing or being more gentle when extracting such basic minerals and the like. It might be noted that many strip mining actions in U.S. coal resource areas have been followed by elaborate replanting of needed forests and using good trees for the purpose, i.e. fast growing so they will consume as much CO2 as possible. That doesn't necessarily mean that we should continue the strip mining as compared with underground mining.

Addressing global warming in particular, it is noted that more than 90% of the greenhouse gases is CO2 from combustion of fossil fuels, i.e. petroleum, natural gas, and coal. While this is a self regulating problem in the long run, i.e. fossil fuels have a limited lifetime after which the atmosphere will gradually return to its original condition, we really cannot afford to wait that long.
A significant scientific problem is to confidently specify exactly what will happen along the way.

This is particularly applicable to predicting the likely weather effects of an increase in atmospheric temperature. Considering simply the melting of glaciers with rising water levels doesn't include effects on ocean currents, tornadoes and hurricanes, or weather conditions in general. The problem should be addressed before we know what is going to happen.

Analogies from Lovelock like humans being "the nervous system of the planet" may be helpful for some people but a distracting analogy for others, e.g. myself. Directly

addressing the deleterious situation, i.e. problem aspects and technical solutions, is probably better than using clever analogies which shift the focus. This rationale is also applicable to spirituality in general as applied to technical societal problems. It is generally hard enough to specify exactly what actions are needed without emphasizing the connection to philosophic spiritual beliefs.

While Lovelock looks at global warming and environmental pollution as being the result of a diseased earth, it might be more helpful to think of society as simply being in a dynamic state of flux. Human behavior follows the economic system, technical development, and long versus short range planning. I believe much of what Lovelock views as a diseased earth can be more specifically viewed as people behaving so as to achieve short term gain without considering the welfare of future generations.

This is essentially how we have created the present environmental mess we are in. It is not just global warming but ozone layer depletion, sustainable use of natural resources, and reducing of worldwide populations to levels adequate for sustainability that must be addressed. While most of our problems result from aggressive, greedy, and self-centered human nature, there is one potentially catastrophic problem, and perhaps more, that has occurred quite by accident.

I'm referring here to the atmospheric ozone layer depletion. When creating such a non-reactive refrigerant like Freon, a chlorinated-hydrocarbon that was easy and cheap to manufacture, there was no way apriori of knowing that the chlorine molecule would eventually be released in the upper atmosphere and produce such devastation with its catalytic destruction of ozone molecules.

In fact, it is indeed a bit of pure good luck in my view that the Ph.D. research project at UC Irvine years ago would have such an impact on the world. Very little basic research ever sees the light of day. Perhaps this is a part of the inherent dynamics within society. I prefer to look at this as an excellent example of why pure basic scientific research needs to be supported at the maximum level economically possible. The value of this one chlorinated-hydrocarbon research project is worth more than all unused basic research combined.

In this case, if we had to wait until the ultra-violet rays from the sun getting through the ozone layer begins killing the plant life on earth and, therefore, our food supply, it would probably be too late to take corrective measures. As it is, we discovered the atmospheric ozone layer depletion problem (as distinguished from local air pollution from combustion apparatus) soon enough to take corrective action, and we will probably be able to stop further ozone depletion very shortly. At that point we can expect a very slow recovery, perhaps 100 to 150 years for the full recovery process.

In conclusion, with regards global warming, it essentially makes no difference at this time what the effects are really going to be. The real problem now is to motivate the masses of our society, politicians, government bureaucrats, industrial leaders, etc. to take immediate action to stop the release of greenhouse gases, particularly CO2 from combustion processes. We cannot wait for fossil fuels, i.e. petroleum, natural gas, and coal, to run out which automatically stops the major source of these greenhouse gases.

Long-range planning coupled with immediate action toward establishing alternate sources of energy, electric energy specifically, should have been done yesterday. The

specifics of what's available and what's on the horizon is another article for the Beachhead. Needless to say, conversion from petroleum fueled transportation can be switched to electricity but it will take many years to develop and construct the system of trains, electric buses, and electric passenger cars.
Convenient, efficient, and inexpensive mass transit is possible for the Los Angeles area. Small short range electric vehicles would then be quite convenient. The sooner we start such development of a future long range transportation system, the better off we are going to be. e

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STAR WARS SEQUEL: FIRESTORMS AND NUCLEAR WINTER FROM MISSILE LASERS

By Taylor Trowbridge

Evangelists of the Strategic Defense Initiative -- more appropriately known as Star Wars -- paint for us a picture of an idyllic heaven-on-Earth in which the great powers have military defense and no military offense. They paint a world of nations safe within shields like the force-fields of science fiction, with no ability to commit nuclear aggression upon one another.

Returning to reality, it is known that even if Star Wars is possible, which remains extremely controversial, every Medieval knight in his suit of "defensive" armor knew that defense is a powerful aid to offense, even though indirectly. But beyond even this myth of benign defense, evidence has emerged that a Star Wars system of infrared lasers can be used for offense directly. And that offensive use would be as destructive as a nuclear attack itself -- even to the point of initiating a "laser winter."

Under a "Defense" Department contract, two scientists, Latter and Martinelli of the research firm R & D Associates of Marina Del Rey apparently had shown that such a Star Wars system of lasers in space could be used to start 100 million fires on the surface of the Earth. Little news of the study had become public when the Defense Department censored it.

However, the study is not difficult to perform and does not require a big expense account. Dr. Caroline Herzenberg of Argonne National Labs, and a number of other scientists experienced with analysis of laser weapons, have performed the calculations on their own.

One of these is your author who has the experience of 15 years with the Defense Department analyzing the performance of a variety of laser weapons systems. He has been told that he has gone even further than the Latter and Martinelli study -- his study additionally considers how much the laser beam deteriorates as it passes down through the Earth's atmosphere -- which could have invalidated all previous studies.

But you don't have to be a weapons scientist to imagine the offensive potential of a fleet of hundreds of space-borne lasers each the size of a football field. And equally awesome and deadly would be its pointing abilities. It would have to be able, within minutes, to zap thousands of missiles rocketing at thousands of miles per hour from thousands of silos across the endless steppes of Asia.

Our studies confirm that such a Star Wars system could easily be designed to include the capability to start fires on the Earth's surface. And with such incredible pointing capability, each laser beam could strobe over a city leaving dozens of separate fires every second. The result, hundreds of thousands of precisely located individual fires spread over hundreds of cities, is an awesome offensive threat.

But we find much more than even that. Closely spaced individual fires in large numbers can become much more than their sum. As few as 500 fires in a city may start what is called a firestorm. In Dresden and other cities during World War II, thousands of fires from Allied incendiary and high explosive bombing united to form a single vast fire. The firestorm generated hurricane winds to fan its own flames and united all of the fires to form a single, gigantic column of flame and smoke extending into the stratosphere.

The "nuclear winter" studies show that smoke from cities ablaze from a nuclear attack would darken the skies for months or years and turn summer into winter. Massive crop failures and environmental chaos would threaten possibly the survival of the human species. The nuclear winter studies also show that the most dangerous smoke is that injected into the stratosphere by firestorms in cities. They find that the burning of as few as 100 cities (with only 5% in firestorms) would trigger nuclear winter effects. Our studies find that the Star Wars system could initiate firestorms in more than one thousand cities. This shows that Star Wars could indeed be capable of bringing on a "laser winter."

The idyllic world that Ronald Reagan fantasized in his Star Wars Speech would be vulnerable to a Star Wars war of equally severe consequences -- immediate consequences comparable to a nuclear exchange, followed by a laser winter. After some trillions of dollars, rubles, marks, franks, and so on, the world would be no better off it is than now.

Actually, it would be worse off. Now the world benefits from some nuclear "stability" because each side knows that if it attacks first the other side can retaliate. There is some stability because there is a disincentive to attack. In contrast, if both sides were to have Star Wars systems, one system could attack the other system at the speed of light and destroy it utterly. Each side would know that if it presses the button, then poof, the other side would be disarmed, could not retaliate, and would have to surrender or face a nuclear like annihilation. Incentive to attack would be infinite and stability zero.

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THE WORLD OIL CRISIS AND MASS TRANSPORTATION

By John Bachar

If a frog is placed in a pot of water that is slowly brought to a boil in such a way that the imperceptible heat change is not noticed by the frog, then it will not jump out of the pot. If a frog is dropped into a pot of boiling water, it will immediately jump out. In which state are we traffic-choked, urbanite frogs?

Only one trillion barrels of petroleum reserves are left on Earth, and only one new barrel is found for every four used. With over 30 billion barrels consumed annually worldwide (2004) and rapidly increasing, there is less than 34 years left. Then it's all gone! Of the 48 petroleum-producing countries, only 15 can supply their own internal needs; the remaining 33 must supplement their internal needs with imports. The US domestic reserve supply is only 22 billion barrels (it imports over 60% of its annual consumption), and if there were no imports, US oil would run out in less than THREE YEARS (7.4 billion barrels consumed annually – 25% of the annual world consumption)! The US transportation sector alone consumes two-thirds annually (4.9 billion barrels), and the US fleet of 235 million highway vehicles uses 3.9 billion (53 percent of annual US consumption).

Clearly, a sustainable energy source must soon be found to replace the impending worldwide petroleum exhaustion. Undoubtedly it will be solar, but MUCH TIME is needed to develop the technology for this transition. The most effective means for buying time is by drastically reducing the use of petroleum in the transportation sector. Since most (over 90%) of highway vehicle petroleum use is in urban regions, it follows that the solution is the implementation of very extensive urban mass transit systems. Even if there were an INFINITE supply of petroleum, it is critical that urban mass transit must be used to eliminate our ubiquitous urban traffic quagmire (24/7 gridlock virtually everywhere in the US, and especially in California and the LA region). Urban mass transit is the only logical method that can vastly reduce urban highway petroleum usage, thereby buying critical time for solar technology development, and that can eliminate the traffic quagmire, simultaneously (see below: "FUMTS" can reduce traffic volume in the six county Southern California region [SCR] by 90%!).

In the current urban transportation situation, there is:

(1) enormous waste and a staggering exhaustion of the rapidly diminishing nonrenewable petroleum resources on Earth;

(2) unhealthful air quality, resulting in death and impaired health for tens of thousands, and contributing heavily to global warming;

(3) pervasive 24/7 gridlock traffic conditions resulting in millions of wasted hours daily by millions of passengers;

(4) high accident occurrences, resulting in death and injury and extensive, expensive property damage and medical costs for tens of thousands;

(5) staggeringly expensive vehicle insurance, maintenance, operational and acquisition costs for the hundreds of millions of licensed drivers who own hundreds of millions of vehicles;

(6) enormous road/street maintenance costs and waste of fossil energy for road construction and maintenance;

(7) ubiquitous parking space/parking lot congestion and expense for millions;

(8) unhealthful high and constant noise pollution, especially damaging to those in the vicinity of freeways and main roads.

The implementation of the FARELESS URBAN MASS TRANSIT SYSTEM (FUMTS) solves the aforementioned problems. This system provides an optimum model for any large urban region. The features of FUMTS will now be described (go to "http://www.scfs-la.org/" and click on "World Fossil Energy Crisis and Fareless Urban Mass Transportation" - author John Bachar - for the complete detailed analysis).

(1) No fares will be charged to any user. FUMTS will be financed by a net-wealth tax on the upper 1% of the appropriate adult population, so that 99% of the citizens will bear no cost. (In California, the wealthiest 1% of the California adult population has over $2.5 trillion in net wealth; in the US, the figure is $25 trillion).

(2) In SCR, 25,400 buses would comprise FUMTS at an annual cost of $5.6 billion; in the urban regions of California, 48,000 buses are needed at a cost of $10.5 billion; in the US, 324,000 buses are needed at a cost of $71 billion.

(3) In California, the wealthiest 1% of the adult population would be assessed annually only 0.42% of their net wealth to yield the required $10.5 billion; in the US, the figure is only a 0.28% assessment to yield the required $71 billion.

(4) Annually, for the SCR, California and USA urban cases:

(a) The cost of FUMTS is only 10.5% to 11.1% of the current cost of the essentially all-auto mode (only 2% of all passenger travel is by public transit)! For every $1 spent for the FUMTS mode, the average motorist spends $9.03 to $9.50!

(b) The fuel consumption for FUMTS is only 8.7% to 9.5% of that of the current essentially all-auto mode! For every one gallon of fuel used in the FUMTS mode, the all-auto mode requires 10.5 to 11.5 gallons!

(c) The fuel savings that accrue by use of FUMTS are 5.24 billion, 9.04 billion, and 56.96 billion gallons, respectively; the savings in equivalent barrels of crude petroleum are 276 million, 476 million, and 3.05 billion barrels, respectively; the 10-year savings are 2.76 billion, 4.76 billion, and 30.5 billion barrels, respectively!

(d) The pollutants from FUMTS are 10.1% to 10.2% of those for the current essentially all auto models.

(5) The travel time using FUMTS is vastly less than using one's personal vehicle for almost everyone.

THIS IS ABSOLUTE: Ever-increasing gridlock is ever-increasing gridlock, enormous petroleum waste is enormous petroleum waste, enfeebling wasted time is enfeebling wasted time, and staggeringly expensive costs are staggeringly expensive costs by any other euphemisms.

If we rigorously use our human reason both to discover and acknowledge the facts about our current transportation quagmire, and if we follow the logical implications for effective human action that such knowledge entails, then we can free ourselves of our plight. Failing this, we are doomed by mindless apathy, irrationality, ignorance and the stranglehold of the powerfully entrenched corporate interests to suffer our endlessly worsening transportation afflictions.

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IS THERE A NUKE IN YOUR FUTURE?

By James C. Warf

HOW NUCLEAR REACTORS WORK. – In the U.S. today, about 22 percent of our electricity derives from nuclear reactors, which consume uranium as fuel. To understand how nuclear reactors work, we need a brief introduction to uranium and how energy is derived from it.

The periodic table identifies families of similar chemical elements. Each atom consists of a nucleus (positive charge) and planetary electrons (negative charge). The nuclei consist of protons and neutrons (zero charge). Currently, 110 elements are known. The number of protons in each nucleus is the atomic number, and the total number of protons and neutrons is the mass number. The heavier nuclei are extremely energy-rich.

Examples of important elements with light atoms and their atomic numbers are hydrogen (1), carbon (6), and oxygen (8). Some in the middle elements of the Periodic Table are iron (26) and copper (29) and toward the end of the table heavy elements such as uranium (92) and plutonium (94) are found. All elements have several isotopes; this means that, using iron as an example, all iron atoms have 29 protons in their nuclei. The number of neutrons is variable, depending on the isotope; its mass numbers range from 46 to 68 for this element.

Thus a given element consists of a mixture of atoms which have a range of masses. This occurs because some atoms have more neutrons in their nuclei than others. Uranium-238

is the common variety, and uranium-235 is the more scarce variety (0.7%). This is the one which supplies us with nuclear energy.

Lise Meitner was a brilliant Austrian physicist who worked with Otto Hahn and Fritz Strassmann in Berlin. In 1938-1939, they discovered that the nuclei of uranium-235 undergo the process of fission, in which bombardment with neutrons causes their nuclei to split into two fragments with the liberation of extra neutrons and an astonishing amount of energy. This makes a self-sustaining chain reaction possible.
In 1940, the Italian Enrico Fermi and his colleagues built the first nuclear reactor at the University of Chicago. It consisted of fission of U-235 (that is, chain reaction), which liberated huge amounts of energy and generated more neutrons. The new-born neutrons were too energetic to cause fission of additional uranium, but after being slowed down (moderated) by collision with carbon atoms of graphite could cause continued fission. These new neutrons kept the process going via chain reaction until the supply of U-235 ran too low.

To date, at least 100 kinds of nuclear reactors have been constructed. Commercial American reactors employ fuel which is uranium in the dioxide form and which is enriched to 4 or 5% in the lighter isotope, U-235. The fuel elements are clad in zirconium, a high-melting point metal with suitable chemical and nuclear properties. Commercial reactors generating electric power are cooled by water under pressure.

Reactors are controlled by inserting rods of materials which strongly absorb neutrons, such as boron. A giant American reactor produces more than 1.35 billion watts of electricity. Some Canadian reactors are cooled with heavy water (deuterium oxide). Special reactors make isotopes for medical purposes.

Experimental reactors using a molten salt coolant have been made. Some reactors are cooled using molten sodium metal. Breeder reactors make fuel from abundant uranium-238. The worst reactor accident so far was that at Chernobyl, Ukraine, in 1986.

NUCLEAR WASTE – The principal shortcoming of nuclear reactors is that their waste is extremely radioactive and poses a challenging disposal problem. The most promising technique so far to cope with this is to vitrify the solid waste. The glass immobilizes the waste and makes it much safer for disposal in geological repositories. Vitrification is, however, rather expensive. Various techniques to simplify the problem by separation of the most radioactive components have been studied. One of these is called pyroprocessing. It is hazardous and costly. Both France and Japan recycle spent fuel and have plans to vitrify the remaining waste.

SAFETY – Two serious accidents with nuclear reactors were those at Three Mile Island (U.S.) and at Sellafield (U.K.) but the worst ever was at Chernobyl in Ukraine in 1986. The greater the level of safety, the higher the construction and operational costs are.

Los Angeles area residents are generally unaware that the first nuclear meltdown in the world occurred in Simi Valley at the Rocketdyne Santa Susana Field Laboratory in 1959. At that time 14 fuel rod bundles melted out of a total of 43, ionizing radiation being released into the atmosphere. Only now is the effect of that accident being investigated.

NATURAL NUCLEAR REACTORS – As strange as it seems, uranium ore occurring in Gabon, in West Africa, has been found to contain only about half of the normal 0.71%

uranium-235. Research indicates that at 15 sites where uranium ore is found, the uranium-235 is deficient. At these sites, there are residues containing the fission products identical to known fission products of uranium-235. The evidence is convincingly strong that at each site was a natural nuclear rector. There was plenty of uranium fuel, and water served as the moderator. This was roughly two billion years ago.

CONCLUSIONS – The issue of whether or not new nuclear reactors should be built today is controversial. While some people agree with government and nuclear industry views that nuclear power should proliferate based on acceptable handling of waste and safety, other people believe that the severe waste disposal and safety issues must preclude the building of any new nuclear power reactors. In fact, the latter group believes that those plants already in operation should either have stricter oversight or be shut down completely.

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A SCIENTIST LOOKS AT EVOLUTION VERSUS INTELLIGENT DESIGN

By Paul O'Lague, Ph.D

In 1859 Charles Darwin published The Origin of Species, his theory of evolution by natural selection.
Since then our world has not been the same. Chance and necessity became the new driving force in biology. Design and purpose, parts of Aristotelian metaphysics, were no longer necessary.

The Origin of Species was an immediate success, selling out in a few weeks, and raised the shackles of proper English society. One Victorian lady upon hearing that a new theory said she was descended from apes, replied (my paraphrase)," Oh, dear, let's hope it's not true, but if it is, let's hope it doesn't become widely known."

Today Darwin's theory is widely known and his name is forever linked to the idea that species, including us, arise by descent with modification: descent through the blue print of deoxyribonucleic acid, DNA, and modification through random mutation.

Organisms are selected because they evolve mechanisms to survive and procreate successfully in their environment. Obviously such a god-less notion would never sit well in a world created by the gods of organized religions. In the Judaeo-Christian religion, for example, the Bible is the final arbiter of the creation of the world and its creatures.

This is 'Creationism', which recently has become dressed in a new pseudo-scientific cloak, called Intelligent Design (ID), which rejects evolution in favor of a grand designer and, in fact, is considered by most scientists to be nothing more than a form of 'Neo-Creationism.'

On the other hand, Vatican II has emphasized that science is also a creation of God and thus there should be no conflict between religion and in the findings of science.

In this country with its present conservative and fundamentalist atmosphere, ID has become politicized and recently several school boards have tried to get ID taught in their public schools as a serious scientific alternative to Darwinian evolution.

However, in a well-publicized decision in Tammy Kitzmiller, et al, versus The Dover Area School district, et al, of Pennsylvania (2005) Judge John Jones concluded, after much testimony, that "…ID is not science and the only real ID policy is in the advancement of religion." Clearly this is a welcome vote for the separation of church and state (and religion and science), a notion originated by Jefferson. Despite such court decisions, ID continues to be pushed by certain religious and 'scientific' circles as a viable alternative to Darwinian evolution.

Today school children are taught the scientific method: do experiments, and collect results (facts), develop a scientific (that is falsifiable, meaning it can be proved false) theory used to explain the facts, and then test with more experiments.

One needn't even do physical experiments to devise a theory. Einstein didn't! He did gedanken (thought) experiments and came up with some pretty good theories. The key is to think up a testable theory that makes predictions about how the world works. Being testable also means that it takes only one experimental result (usually confirmed by others) to prove it false.

For example, my theory is that the Moon is made of green cheese. This is a scientific theory. Now for the test: I find that light reflected from the surfaces of the moon and green cheese has different spectra, i.e. different frequencies of light waves. Therefore, my theory is false.

Results in agreement with a theory continue to strengthen, but never prove, it. A theory that hasn't been proven false continues to be useful within the edifice of science. Evolution by natural selection is such a theory and Intelligent Design is not.

But before discussing both, let's see what is means to test a theory, especially one about evolution, a one-time event. Critics of Darwin's theory, especially ID ones, draw a distinction between 'origin science' and 'operation science.' The latter deals with ongoing, regular operations of the natural world where repeated experiments are possible and the former with scientific questions involving singular events such as evolution and the Big Bang. IDers narrowly define science only as 'operation science' thus reject evolution as non-science.

However, Ernst Mayer deals with this in his book, "This is Biology" (1998). In essence, biological questions about unique occurrences such as " Why are there no humming birds in the Old World?" or "Where did Homo sapiens originate?" cannot be answered by causal-law explanations, i.e. using logic, mathematics, or physical sciences. To study these and other similar questions, biologists must study all the known facts about a question, infer many consequences from the facts, and then try to construct a scenario to explain the facts.

In other words, the biologist constructs a historical narrative. This narrative has explanatory value because earlier events in a historical sequence often make a causal contribution to later events.

For example, much physical evidence indicates that a giant asteroid plowed into Earth at the end of the Cretaceous, killed the dinosaurs, which in turn caused the rise of the age of mammals (leading to you and me) during the Paleocene and Eocene. So the singular task of the historical narrative is to uncover causal factors that are crucial to the occurrence of later events in a historical sequence. Darwin's theory is science in the above sense.

Furthermore, the results of many present-day molecular biological experiments on how speciation occurs and other predictions are consistent with Darwin's historical narrative. In fact, most biologists think that the results of their experiments make sense only in light of evolution.

Even accepting the role of chance as the ultimate designer, it is quite challenging to see how it led to the riot of diversified and utterly complex biological mechanisms that exists today.

Two favorites of ID critics are the eye in mammals and lower down the evolutionary tree, the flagella of bacteria. Each consists of a multi component system (40 proteins in the flagella complex) and removing one component causes each to cease functioning. So the argument goes how can evolution select for one component (not functional) without selecting for all at once (functional), highly unlikely.

This has led IDers to the concept they call irreducible complexity, which is that certain biological systems are just too complex to have evolved naturally from simpler, or "less complete", predecessors. The concept is generally used as an argument for 'intelligent design' and as a counterargument (also used by creationists) against the theory of evolution.

However, they offer no way to substantiate their claim and ID makes no predictions, which may be tested. In fact it is difficult to see how ID, which posits a 'Grand Designer' might ever be tested. Therefore ID is not falsifiable and, as Judge John Jones concluded ID, is more akin to an idea to advance religion.

In contrast, evolution has testable answers to how complex organs and mechanisms arose. The late Stephen Gould referred to it as the 5% solution. During evolution the function of a protein may shift from playing one role to a completely new and different role. This most likely happens by the gene duplication followed by chance mutations. In that way, the protein made from 'good' gene still functions and the one from the duplicated 'mutated' gene is left to find other functions.

For example, in eye evolution, photopigments, integral parts of visual systems, may start out in energy transformation of light to chemical energy and only later become part of light detection system, which eventually joins other systems so that light now controls behavior like movement toward light. The same arguments can be brought to bear when considering the evolution of flagella or other complex biological systems.

In the end evidence that evolution through natural selection is sufficient to shape the diversity we see today is overwhelming. The universality of the triplet genetic code used by all animals implies descent with modification.

Many proteins coded by genes such as HOX genes, which specify body axes and by genes of the nervous system, for example, found in animals from flies to humans are highly conserved, meaning DNA sequences as well as amino acid sequences are very similar.

In fact, certain human genes for cell division carry out similar functions quite well when placed inside the lowly baker's yeast.

The great recent surprise is that the newly sequenced chimp genome differs from human by 1% when protein sequences are aligned. This translated into about a two amino acid difference in an average protein.
Somewhere these differences are giving rise to the traits that make us uniquely human. Genetic variations revealed by sequencing DNA is the raw material that will help unravel human evolutionary history, not an untestable search for a Grand Designer.

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STEM CELL RESEARCH
By Paul O'Lague

Dateline: Earth 2176 A.D
Longevity in most countries is now allowed to reach 250. Most of the years are lived in good health. The major killers – cancer, heart disease and many genetic diseases - are gone, The use of gene and organ replacement therapy, using modified DNA and RNA viruses, and the use of bioengineered repair cells and in vitro grown organs are the major tools for longevity. DNA data banks now allow typecasting as to individual behavior patterns, inherited talents, susceptibility to diseases, and criminal tendencies. This in turn has allowed more efficient use of public funds in the education, medical treatment, and civic control of the world's populations. Control of population is now back to snuff with new worldwide termination stations. The future continues to look quite rosy- End.

Science fiction scenario? Of course. A possible future? Maybe. No one can predict the future with any certainty (it violates the second law of thermodynamics). But because of the enormously important biological and genetic revolution that is now taking place, we are in a good position to consider possible future lifestyles offered by ongoing discoveries in biotechnology. These discoveries are poised to impact significantly on health, aging, longevity, disease eradication, and medicine in general. The sky may be the limit. Of course, whether the fruits of biotech discoveries become commonplace in society depend not only on their effects on our general well being, but also on ethical and economic factors.

Among the recent discoveries that appear to hold great promise to treat human disease and that have captured the public's attention and national debate is in the use of stem cells. These esoteric cells, found in a variety of biological sites, offer great promise in repairing or replacing damaged or diseased cells and thus restoring normal function. Some have even viewed them as a possible 'fountain of youth'. Damaged heart? Squirt in some stem cells capable of differentiating into heart muscle cells and voila! Good as new. Results in mice already bear this out. So what are stem cells, where are they found, how are they used, are there any disadvantages, and what's all the recent fuss about using them? This short article touches on these questions.

Like other animals, humans start life as a single fertilized egg cell programmed in part by a mixture of maternal (egg) and paternal (sperm) DNA. This egg divides into two then four, and so on, developing into an embryo eventually leading to the adult with trillions of cells organized into about two hundred types of differentiated tissues such as skin, muscle, liver, brain, and so forth. Those who study early animal development have known for some time that cells (called blastomeres) isolated from the two cell-stage (i.e. a two cell embryo), or four cell- or eight cell-stage embryo can, like the intact embryo, each give rise to an adult when reimplanted back into the mother. This spectacular result with isolated blastomeres occurs in a wide variety of animals including humans. Thus blastomeres are said to be totipotent, that is, they contain all the information and materials to produce a complete organism. This important result begged the question of whether there are cells in embryos of all stages even in adults that might retain this ability in one form or another. Today we know there are. These cells are the stem cells (It's been known for over twenty years that bone marrow contains cells that make all the blood cells). These cells, isolated from various sources, range from those found in differentiated tissues and that form only one cell type (termed unipotent) to those forming multiple cell types (multipotent) to those forming most of the differentiated cell types (pluripotent), and finally those stem cells that are totipotent. Can these stem cells used to replace a wide variety damaged or diseased cells? Theoretically yes. Thus the great enthusiasm for stem cell research. In 1998 an important advance in this research was made by James Thompson at the University of Wisconsin-Madison. He and colleagues demonstrated that large numbers of human pluripotent stem cells could be obtained by growing late stage blastomeres in cell culture (essentially in a plastic dish with warm broth). These cells divided and remained undifferentiated for months, but maintained the developmental potential to differentiate into a rather wide variety of cell types from the three germ layers of the embryo including gut cells (endoderm); cartilage, bone, smooth muscle, and striated muscle (mesoderm); and neural epithelium, embryonic ganglia, and stratified squamous epithelium (ectoderm). Since then many sources of stem cells have been demonstrated including both embryonic (e.g. isolated from 5-7 day embryos and called embryonic stem cells, ES, which are pluripotent), fetal, adult, and teratocarcinomas, germ cell tumors. The hope is that one or more of these types of stem cells can be manipulated to restore cellular functions in human disease. In theory ES derived brain cells could be used to treat neurodegenerative diseases such as Parkinson's and Alzheimer's, muscle cells produced to treat muscular dystrophies and heart disease, haematopoietic stem cells to treat leukaemias and AIDS. Thus far results have been few and all in animal models of diseases or injuries. ES cells have formed stable heart graphs, formed sheath cells in rats with myelin disease similar to multiple sclerosis, differentiated into supporting cells in spinal cord injuries and promoted motor recovery, and lastly, caused partial recovery of diabetic mice by forming insulin-producing cells.

To treat human diseases with stem cells, however, several formidable challenges have to be overcome. Human stem cells, which usually grow slow in cell culture, will be needed in large quantities; they must be able to differentiate in a controlled manner to form homogeneous populations; and lastly, but mostl importantly, these populations must be histocompatible with the recipient (this latter problem is encountered in transplant recipients today that require they take immunosuppressant drugs for life.). Experiments are under way to create such cells.

In spite of the tremendous potential of stem cells, their use, especially those derived from embryos (ES cells) and those from fetuses, have proven sensitive areas. This has arisen because certain segments of the public (e.g. pro-life movement) are uncomfortable with a technology that destroys human embryos to remove embryonic cells to create stem cell lines or uses therapeutic cloning. The latter they state is uncomfortably close to reproductive cloning. This is claimed to violate the sanctity of life. On the other hand, one can counter these moral and ethical concerns by pointing top the potential therapies that can be expected to derive from stem cell research. A future middle ground is the use of one's own adult stem cells or other sources like umbilical cord blood cells tailored to treat human diseases. Despite these objections, which are mirrored by President Bush's recent veto of the Stem Cell Bill, many states especially California, with its passage of Prop.71 establishing the California Institute of Regenerative Medicine (CIRM), are ignoring the President's (politicizing?) stance and establishing a forefront of stem cell research. One can only wonder if President Bush would have vetoed the Stem Cell Bill if stem cells were found to produce crude oil.