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## Neuromarketing

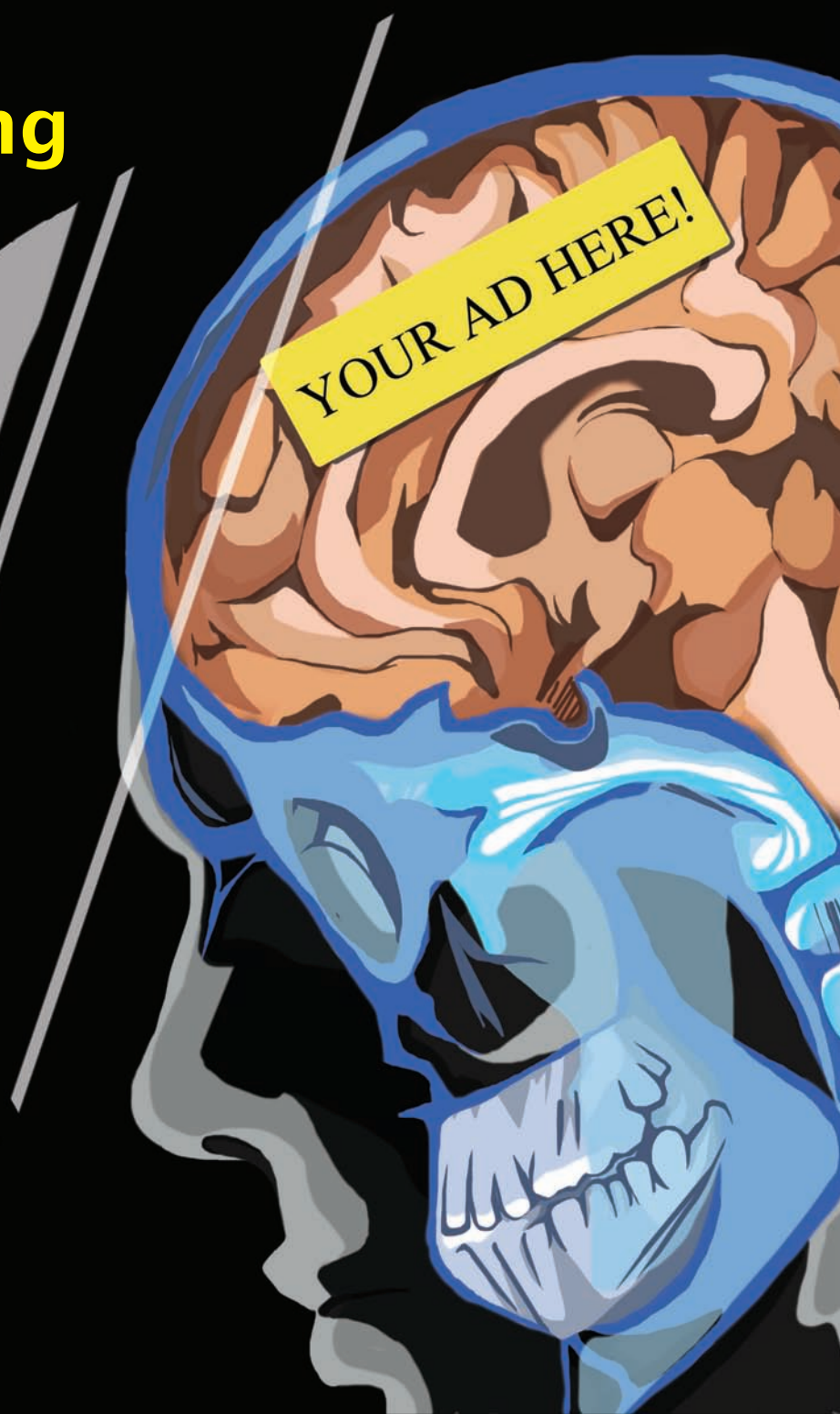
Who Decides What You Buy?

Romantic Roots:  
Shelley's Deep Ecology

From Bacon to Human  
Babies: Ethical Conflict in  
Pigs a Surrogate Mothers

Reclaiming Our Waste,  
Reclaiming Our Water: The  
Case for Composting

The Medical Sacrament  
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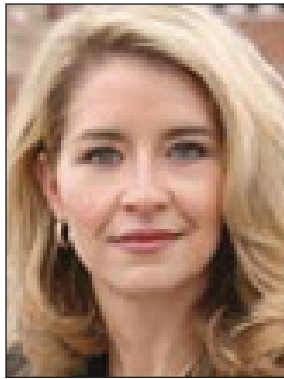




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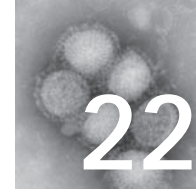




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ARIZONA STATE UNIVERSITY

# Message from the Chapter President



Dear Reader,

Without question, we are living in an increasingly globalized world. One consequence of this globalization is the larger number of partnerships between diverse organizations. Another consequence is the growing demand for interdisciplinary knowledge in the professional field.

As students at Arizona State University, the largest public research university in the United States, we have a responsibility to embrace these consequences. With over 60,000 students and 250 undergraduate programs, we have the unique opportunity to expand the traditional curriculum and conduct original, innovative research.

The Triple Helix at Arizona State University is meeting these challenges. Our objective is to encourage interdisciplinary research in science, society, business, law and ethics among undergraduate students. We have become one of the strongest and most prolific chapters throughout all international chapters. And we're only getting started.

For example, we already established ourselves as the first chapter to produce the Triple Helix Forum podcast series. But now we have partnered with ASU News, who agreed to feature our interviews on their website and digests of top stories circulated to thousands of students, alumni, and employees. This partnership is an example of our commitment to excellence and the wide applicability of our work.

I would like to thank our contributing writers, associate editors, and our executive board for making this issue of The Science in Society Review one of the largest and highest quality issues we have ever published. And we hope you agree.

Sincerely,

David Edwards  
President  
The Triple Helix, Arizona State University

## Chapter News

In February, we had eight contributing writers from our chapter present their original research at the AAAS National Conference, more than any other chapter. One of these writers, Daniel Brewer, won the 2010 Triple Helix Poster Competition against competition from over 50 international participants. We would like to congratulate Daniel and encourage you to read his article on page 6.

We have partnered with CETMONS, an organization designed to explore the social implications of emerging military technology. In April, we asked Dr. Brad Allenby, the Founding Chair, to speak to a group of interested students about the organization. Later that month, we invited three CETMONS professors to host a panel discussion on the ethical challenges of protecting national security. We would like to thank the Lincoln Center and Dr. Allenby for this unique partnership.

Furthermore, we created the CETMONS Scholar position, where one of our contributing writers will work one-on-one with a CETMONS researcher. We are pleased to announce that the Fall 2010 CETMONS Scholar recipient is Erik Chait, who will be researching peaceful alternatives for unmanned aerial vehicles.

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## Message from the CEO

Dear Reader,

Once again, we are at a time of change. This year, in tandem with the American Association for the Advancement of Science (AAAS) conference in San Diego, The Triple Helix hosted its Leadership Summit and Membership Workshop to bring together students throughout the world and plan our future. However, despite their startling creativity and surprising expertise, the most striking discovery was their raw passion for what lies ahead. Hours and days go by just in discussion. With such enthusiasm behind every idea, it is difficult to envision anything but overflowing success.



Before you look through The Science in Society Review issue awaiting you, I hope to share with you my insight into the level of work behind every word. The articles in the following pages are derived from an outstanding level of editorial and literary commitment. Each piece represents not only the work of the writer, but also the work of one-on-one associate editors, a highly effective editorial board, astute international senior literary editors, an impressive faculty review board, and an imaginative production staff that reinvents the journal every issue. As you read the following pieces, we hope you will come to appreciate the truly professional level of work that goes into every paragraph. And it is with that same dedication to improvement that every division of The Triple Helix creates progress everyday.

Over the last year, Julia Piper and TTH leadership redefined the limits of the organization yet again with our amazing progress in the Electronic Publishing, Internal Affairs, and Science Policy divisions. We have truly come a long way. However, our greatest accomplishment has been the new wave of global connectedness and communication. As we enter the next cycle, I hope to witness the next surge of interest and passion from every member as we strive to achieve the dreams we have always had for the organization. We invite you as readers and supporters to come forward and develop new visions that will push us to the next level. The opportunity is upon us.

Sincerely,

Bharat Kilaru  
Incoming CEO  
The Triple Helix, Inc.

## Letter from the Outgoing CEO

Even after a year as The Triple Helix's CEO, I find myself struggling to successfully communicate the singularity of TTH's management approach. I think the concept of a completely undergraduate-run international non-profit corporation is baffling to many because it depends completely on the effectiveness of 20 and 21 year olds with little free time and even less experience. But it works. It works because TTH takes the inexperience that other organizations consider limiting and turns it into an advantage. It is through the annual refreshment of our international leadership that TTH stays engaged and innovative. With this in mind, I'd like to welcome our new Executive Management Team, individuals who without bachelor's degrees are poised to lead an international team. In true TTH form, however, this inexperience allows them a fresh perspective, a fresh enthusiasm, and a fresh start to build a new team and a new future. Readers, stay tuned, as I think we will see great things to come.



Sincerely,

Julia Piper  
Outgoing Chief Executive Officer  
The Triple Helix, Inc.

# Neuromarketing: Who Decides What You Buy?

Victoria Phan

People who have found themselves indulging in clothing trends, jiving to mainstream music, or frequenting the local Starbucks can see that companies spend billions a year researching how to perpetuate such conformity. What people may not know is that the advertising itself is becoming far more scientifically advanced. Neuromarketing is an emerging branch of neuroscience in which researchers use medical technology to determine consumer reactions to particular brands, slogans, and advertisements. By observing brain activity, researchers in lab-coats can predict whether you prefer Pepsi or Coke more accurately than you can. Critics have already begun to denounce the idea for its intrusiveness; however, though the field is already highly controversial, there is no doubt that its continuing development will ultimately have a profound impact on consumerism and the overall study of human behavior.

In America's capitalist society, advertisements drive our everyday lives. While the idea of actual 'mind control' may seem far-fetched and unrealistic, the fact remains that the marketing industry has had a firm grasp over the American perception of everything from smoking to sex education. Our current concept of marketing, with its image-based ads, department store window displays, and catchy TV jingles, actually did not exist before the mid-1900s. Starting in the 1950s, fast food industries teamed up with processed food companies to shape the concept of what we now understand to be McDonald's and Burger King 'cuisine' [1]. In the 1980s, the invention of cable TV, VCRs, and remote controls revolutionized the advertising world, as it allowed the media to become much more easily accessible to average families [2]. These developments soon allowed advertising executives to cater to the public's general interests and subconscious desires.

Over time, the marketing industry has learned to exploit our responses to a wide variety of images and concepts. It is not difficult, however, to recognize and understand the methodology behind these marketing campaigns. The strategic placement of Victoria's Secret models into Super Bowl halftime commercials has an obvious sexual appeal. Celebrities are paid to endorse particular products, since their personal testimonies make any company just seem better. Even the catchiness of a jingle makes us more likely to pause when we see a bag of Kit Kats or Goldfish crackers. But somehow, despite the almost laughably obvious marketing methods, we still respond positively to popular brands and catchy slogans—tools crafted purposely by

marketing executives to catch our attention. This tendency to gravitate toward familiar symbols and phrases is the driving force behind the concept of neuromarketing. Scientists are focusing on these natural inclinations, using brain imaging techniques to gauge consumer reactions and expand upon more common, traditional methods, such as surveys and focus groups [3].

There are multiple types of brain-imaging technologies used in current neuromarketing studies: fMRI (functional magnetic resonance imaging), QEEG (quantitative electroencephalography), and MEG (magnetoencephalography). However, the fMRI method is currently the most popular amongst marketing companies, since it utilizes mainstream technology to produce clear images of real-time brain activity [4]. As an imaging technique, the process also translates results more

easily into layman's terms: rather than presenting data in strings of incomprehensible numbers, fMRI technology gives people the opportunity to actually visualize the activity patterns in their brains [5].

fMRI works by gauging amounts of hemoglobin, the oxygen-carrier on red blood cells, in certain parts of the body. For mental imaging, the machine "measures the amount of oxygenated blood throughout the brain and can pinpoint an area

as small as one millimeter" [6]. The harder a specific area of the brain is working, the more oxygen it requires; so when the fMRI machine scans the brain, it picks up on the areas with concentrated amounts of hemoglobin and displays them as regions of high mental activity on the computer screen. These computer images are what researchers use to identify the parts of the brain being utilized.

For neuromarketing, scientists use fMRI to observe areas of the brain that respond to consumer-based stimuli, such as particular brands, price ranges, and even taste preferences [4]. The researchers have found that the regions in the brain corresponding to the prediction of gain and loss (the nucleus accumbens and the insula, respectively) are indicators of behavior and reaction to finances and economics [3]. In other words, we make our decisions based on cursory judgments of whether we will gain or lose money when purchasing a product.

Though fMRI technology was first used for marketing purposes in the late 1990s, the actual term "neuromarketing" was only just coined by Erasmus University's Professor Ale Smidts in 2002, and the general premise of the research was not widely recognized until the first neuromarketing confer-

“**Despite the ongoing debate about the ethics of neuromarketing, ...results are leading researchers to believe that nobody currently has the power to fully alter our personal opinions and preferences.**”



ence in 2004. However, the potential results and subsequent discoveries about human responses to the media are causing this infant branch of science to rapidly gain popularity [4].

The infamous “Pepsi vs. Coca-Cola” experiment, in which scientists studied the motivation behind brand preferences, was what first put early neuromarketing in the spotlight. The researchers observed that although Pepsi and Coke are essentially identical, people often favor one over the other. They subsequently sought to investigate how cultural messages work to guide our perception of products as simple as everyday beverages [7].

The experiment was simple: there were two taste tests—one blind and one in which subjects knew which beverage was which—and the researchers observed the corresponding brain activity. When volunteers were unaware of which brand they were drinking, the fMRI showed activation in the ventromedial prefrontal cortex, a basic “reward center,” when they drank Pepsi. However, when the subjects knew which soda was which, the scans showed brain activity in the hippocampus, midbrain, and dorsolateral prefrontal cortex (which are centers for memory and emotion), in favor of Coke. So essentially, people actually liked the taste of Pepsi, but they were more inclined to believe that they preferred Coke, based off of nostalgia and emotional connections. From these results, the researchers determined that “a preference for Coke is more influenced by the brand image than by the taste itself” [4].

The outcome of these studies is intriguing and even a bit entertaining; however, upon a second glance, it can also be alarming. The fact that a series of ads could actually cause your brain to believe something that contradicts what the rest of your body thinks is unnerving, to say the least. Because of this, there is a growing amount of controversy surrounding the subject of neuromarketing.

One of the more paranoid views on this subject is that people may eventually fall victim to an uncontrollable force compelling them to think or act a certain way. While it is still too early for anyone to make definitive legal restrictions on the technology, people are already anxious about its subliminal undermining of free will. Commercial Alert, an organization protesting the development of neuromarketing, has expressed concern over the use of medical technology for advertising purposes, claiming that brain scans “subjugate the mind and use it for commercial gain” [6]. The group has argued that any power-hungry neuroscientist could use these studies to manipulate the public’s desire for specific products, or that the research could be used in the realm of politics and propaganda, dragging us down a slippery slope toward totalitarianism and war [6].

On the other hand, more optimistic observers contend

that the studies could in fact be beneficial for our society. For example, neuromarketing has the potential to be a great boon to public service industries by helping them understand how to improve anti-drug or anti-smoking campaigns [3]. By utilizing these new advancements in neuroscience, we could educate the public more effectively; we would know how to better present information to inattentive children, how to best impact teenagers having unprotected sex, and how to inform the public about conserving energy. The road toward understanding consumer responses opens paths to understanding human behavior in general, which could be invaluable to the development of our global community.

Despite the ongoing debate about the ethics of neuromarketing, the amount of research we have today is still minimal, and the results are leading researchers to believe that nobody currently has the power to fully alter our personal opinions and preferences. Most professionals are presently under the impression that this field is underdeveloped and that researchers are hyping it up using neuroscience, a current ‘hot topic,’ to elicit extra funding [3]. However, though there isn’t much evidence so far to prove that the imaging studies will have a drastic effect on consumers, researchers agree that even a slight edge in the competition to win the public’s attention would be worth the cost for many advertisers.

Like all new scientific advancements, neuromarketing is thus far merely a research tool. Marketing expert Martin Lindstrom views the area of study as “simply an instrument used to help us decode what we as consumers are already thinking about when we’re confronted with a product or a brand” [6]. In either case, the studies would reveal more intimate details about human thought-processing and decision-making on a broader scale.

So the question remains: Is neuromarketing a step forward in understanding the human mind, or is it an invasive marketing ploy geared toward demolishing privacy and personal opinion? As of right now, nobody seems to be sure. Though there is always the possibility that this technology could be exploited for immoral purposes, one could say that any scientific discovery has the same potential for misuse in the wrong hands. The best way to limit the media’s influence is to educate ourselves about the science and to be more deliberate with our decisions; a well-educated consumer is less likely to make rash judgments based on unfounded claims. Still, knowing that companies have people researching how our minds work probably won’t stop most of us from pining after all of the latest products—we will always have commercialism to thank for that. ■

*Victoria Phan is an undergraduate at the University of California, San Diego.*

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# From Bacon to Human Babies: Ethical Conflict in Pigs as Surrogate Mothers

Daniel Brewer

The Flu isn't the only thing swine could be giving us; they could also provide human babies. Few people have considered the possibilities of using pigs as surrogate mothers for human babies, but according to Krishna Dronamraju the idea was proposed as early as 1932 by J.B.S. Haldane [1]. It was further suggested as an alternative to abortion in 1984 by Peter Singer and Deanne Wells [2]. As absurd as it may sound, the possibilities are real. According to Stellan Wellin, not only is it practical, but a therapeutic imperative exists for the development of the technology [3]. Pigs have already been used to save human lives with transplanted pig organs ranging from heart valves to brain cells [4]. Extensive research has also been performed to create a transgenic pig that would more closely resemble human genetic makeup and allow for advanced success in organ transplantation. Although suggested decades ago the technology is still ahead of its time. Time, in this sense, refers not only to the feasibility of the technology to be implemented, but also for the ethical makeup of society to be in a position to accept it. Human baby transplantation is still premature in its ethical acceptance but with information and exposure it may be a real possibility in the 21st century.

New technology, especially when it pertains to human life, unequivocally brings with it new moral dilemmas. Society's acceptance of possible technology often influences how quickly, and even if, a technology will ever be explored. Radical new technologies are often first rejected, then

accepted, then embraced. Because of unease and ethical questions regarding pigs as surrogate mothers, the idea has been strictly monitored and restricted in its development. The unease is nothing new either. Persecutions and killings

have arisen over ethical controversies. According to John Fletcher in 1642 in one of the New Haven colonies, fear of human animal relationships had grown to the point that a one eyed man with a large nose was executed when a one eyed pig with a large snout was born [5]. Modern genetic understanding proves the deformed pig's birth was a result of coincidence and one would like to believe that society has progressed since then. However, given that less than a year ago an abortion doctor was gunned down and killed while in church, there are still those who seek to take the life of those who they feel have broken their code of ethics [6]. Singer and Wells' suggested that babies destined for abortion could be saved by transplanting them to surrogate pigs to be gestated to term and adopted. This may help solve the abortion issue, but will humans born to surrogate pigs be persecuted and potentially executed because of their involuntarily performed alleged crimes against ethics?

In order to answer these questions some information as to the acceptance of

the technology is pertinent. Because of the obscurity surrounding the technology arising from the ethical controversy surrounding pigs as surrogate mothers very little research has explored the ethical opinion of, or its possible acceptance in society. In relation to this lack of



Reproduced from [10]

“  
**Radical new technologies  
are often first rejected, then  
accepted, then embraced.**  
”

“

**Some respondents stated that they felt it threatened the inner sense of human superiority in the perceived hierarchy of life.**

”

exploratory information I formulated research to look at both the current acceptance of this possible technology and how information can influence ethical decisions. The subject of animals as surrogate mothers was chosen because it is an issue that most people have not considered, and it intertwines pertinent issues relating to the rights of humans, animals, and fetuses.

In order to explore the acceptance of using pigs as surrogate mothers for reproductive ectogenesis (the gestation of a fetus outside the mother), and to investigate the influence of information on ethical acceptance, two separate surveys were generated. Each survey contained three identical yes or no questions regarding aspects of the technology. The questions were formulated to touch on some of the main arguments surrounding reproductive ectogenesis.

Question 1: If possible, would you support a technology that could allow implanting of prematurely born human babies into surrogate animal mothers until grown to term?

Question 2: Would you support development of a machine that could keep prematurely born babies alive by essentially performing the same functions as a mother's body even if less effective than an animal surrogate mother?

Question 3: Would you support using a machine or an animal surrogate mother to be used in place of abortion for mothers who did not want to carry a baby to term so that the baby could then be adopted?

The varying factor between the two surveys was that second survey contained a brief introduction outlining pertinent information to the imperative need for such a technology and background information such as that 1 in 8 babies are born premature [7] and that over a million die worldwide each year [8]. It also described how pig kidneys and brain cells have already been successfully transplanted to humans to save human lives [4] and how this technology could save lives of fetuses. Over one hundred individuals of varying demographic backgrounds were given one of the two surveys to complete.

The percentage of people who said they would accept the technology in each question are shown in figures 1-3 below.

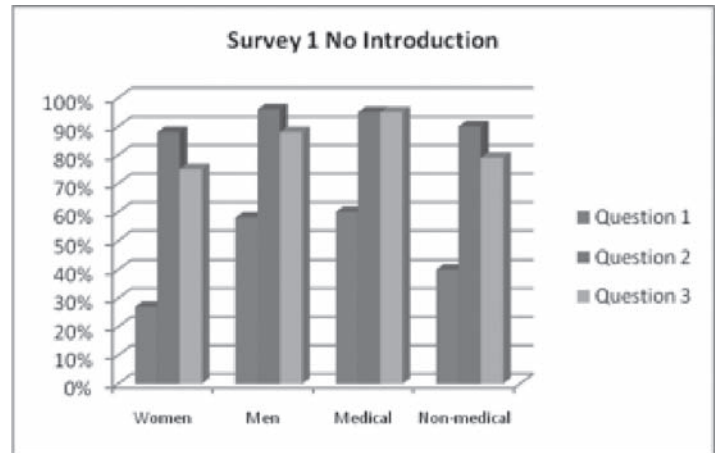


Figure 1

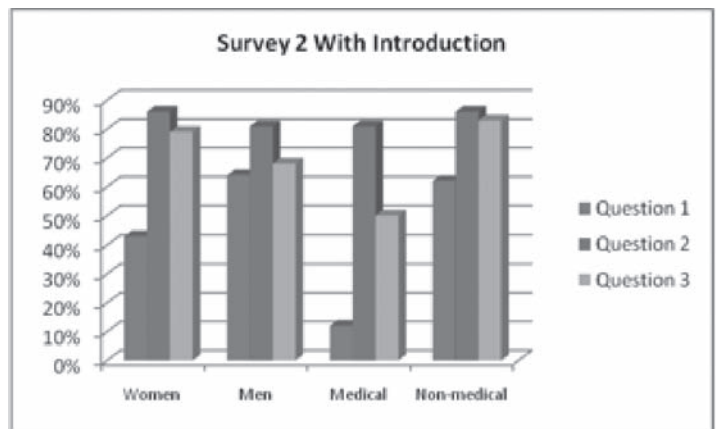


Figure 2

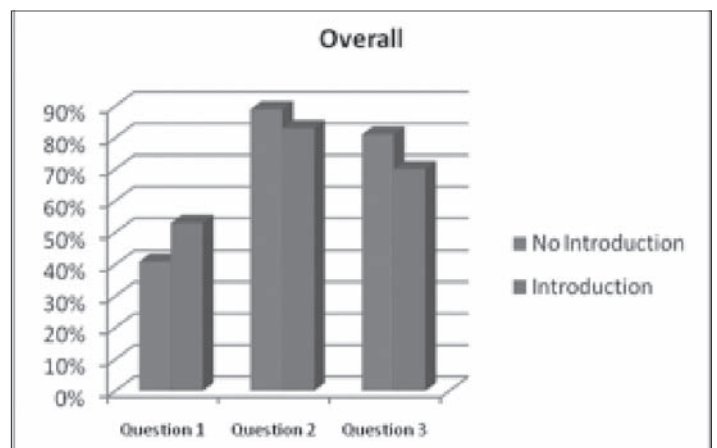


Figure 3

Despite the controversies associated with the subject support for reproductive ectogenesis was higher than predicted with 41% accepting it even without any background on the subject. Results for the survey with the introduction showed a 29% increase in the number of people who would accept the technology of using

animals as surrogate mothers. This portrays the value that information can have on ethical debates. Males also showed, on average, to be significantly more likely than females to accept the idea of animals as surrogate mothers. Possible reasons for this trend could be because women view this technology as threatening their maternal roles of providing life support to the developing fetus and intimate connection with the fetus.

Results for the second question show the general acceptance of machines in medical technology and in both surveys people were far more likely to accept a machine as a solution than an animal. This could have risen from concerns for the animal, but some respondents stated that they felt it threatened the inner sense of human superiority in the perceived hierarchy of life. We as humans often like to envision ourselves at a level higher than the animals around us and the idea of being able to exchange parts with them somehow makes us feel less human. Also machines have been used in medicine for decades where as animals use is a more recent possibility. Increased use and success with human-animal transplantation will likely correlate to increased approval. However, like other emerging technologies the acceptance may not completely come until a generation has grown up with the new technology.

Question three shows how forming correlations to already existing ethical questions can influence decisions on new technologies. Most people have some opinion on the abortion issue and it is widely debated in the news. However, few have probably thought about animals as surrogate mothers and how this might be a possible solution to the abortion issue. Interestingly enough, multiple survey participants answered no to questions one and two but yes to question three. This shows that they wouldn't have accepted the technology until the correlation was drawn that showed a compromise to an already existing moral issue. If they could take the survey again they might change their answer to one or both of the first two questions.

Another interesting trend is that medical professionals were more likely to support the technology than the other categories without the introduction but significantly less likely when given the introduction. The sample size was

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**The technology would have been not only scientifically impossible, but ethically impossible in any other century.**

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smaller for medical professionals and more extensive research could help to discover the validity and cause of this trend.

As time tests the acceptance of human ectogenesis further research in this area could include looking at how trends change, especially if human ectogenesis progresses and receives more recognition in the next couple years. The race for medical breakthroughs is a 95 billion dollar endeavor in the United States alone and ethical acceptance of those technologies is often crucial to their success in the market place [9]. The power of information, as shown by the increase of acceptance in the second survey, explains why the medical advertising field has grown exponentially the last couple decades.

The answer to how the technology and the human products of it will be accepted will never be fully known until the technology comes to fruition. However, as shown by the surveys, the subject remains controversial, but the knowledge that can provide momentum to the project is already starting to form and replace inhibition to new ideas. If human ectogenesis is put into practice it will still be years before the first human baby will be thanking a pig for carrying it in the womb. However, the winds of change are blowing towards a technology that would have been not only scientifically impossible, but ethically impossible in any other century. ■

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# African Development and ICT: Narrowing the Global Digital Divide

Michael Seese

In 1925, a Soviet economist by the name of Nikolai Kondratiev argued the existence of economic supercycles: periods of high production and increased economic growth sparked by a particular innovative technology. Although both Soviet economists and contemporary orthodox economists rejected Kondratiev's theories, it seems clear that we now live in an age wherein economic growth is contingent upon one particular technological artifact: the Internet. In the past decade, the Internet has revolutionized the international political economy by creating a complex "network of individuals, firms and countries that are linked electronically and in interdependent relationships" [1]. These networks allow for the exchange of knowledge and information at a global level, resulting in new ways of conducting business, increased commerce between states, and the development of entire new industries based on knowledge creation and transmission [2-4].

In this emerging economy, the ability to transmit and receive knowledge and information becomes paramount in terms of comparative and competitive advantage. Thus, many of the world's wealthiest nations, and indeed many developing nations, have invested substantial capital in the mechanisms of knowledge and information exchange. These mechanisms, known collectively as Information and Communications Technologies (ICT), include such technologies as Internet backbone, as well as telecommunications and network infrastructure like cell towers and satellite links [3]. Essentially, ICTs are "the pipes and mechanisms through which knowledge and information are packaged and transmitted" [5].

Due to a variety of factors, some states have been more successful in developing a sophisticated ICT infrastructure than others; this 'international technical dualism' is widely known as the Global Digital Divide [6]. The economic effects of this technical disparity are obvious when one considers that the Global Digital Divide is roughly coterminous with North-South Divide. This seems to imply that the more sophisticated a state's ICT infrastructure is, the

more advanced its economy is likely to be, and vice versa. In fact, there is a growing body of research in the social sciences that highlights these effects; many scholars have pointed out a strong, positive correlation between technological and economic development [7-10].

While the Global Digital Divide affects a number of developing nations, it is most evident on the African continent; Africa has the lowest penetration of ICT per capita in the world [11]. Given the momentum behind the emerging digital economy, and the growing importance of global integration, it is no surprise that African states consistently rank the lowest on the United Nations Human Development Index, a matrix that measures nations' relative development in terms of life expectancy, educational attainment and Gross Domestic Product [12].

Africa's relatively primitive ICT infrastructure has hindered economic development on the continent, putting African states at a significant disadvantage in developing modern industries and drawing foreign direct investment. In order for African states to narrow the socioeconomic gap between themselves and more developed nations, their primary consideration must be to overcome the technical

deficit that constrains economic development.

African states must make critical decisions on how to best allocate scarce resources in order to promote economic development [10]. Given the immense costs associated with developing a modern ICT infrastructure, it is understandable that many African policymakers have chosen to focus their development efforts elsewhere—on education, health-care, anti-corruption measures and security. These policy decisions are based on a body of research in political science and other disciplines that attribute Africa's economic issues to structural problems. Scholars such as Sandbrook and Barker [13], Diamond [14] and Englebert [15] argue that African states will be unable to assert themselves in the global economy until they first reach a level of political stability that encourages active democratic participation in government and discourages the political violence and ethnic strife that have been prevalent on the continent for the

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past five decades.

Policy decisions designed to overcome these challenges are certainly valid; however, they fail to take into account the strong relationship between ICTs and economic development. Jipp was among the first scholars to notice this trend; in 1963, he demonstrated that there exists a positive correlation between teledensity (telephone lines per capita) and the wealth of nations (as measured by GDP). Although traditional Jipp Curves plot the number of telephone landlines against GDP, recent scholarship expanded this metric to include mobile phones and Internet connectivity, and subsequently found the same positive correlation between these ICTs and economic development [3, 11]. Alleman et al [10] note, "Recent statistical tests... show that the growth of telecommunications investment or penetration is a statistically significant predictor of economic growth." Further, Madon's analysis [16] concludes, "wider connectivity within developing countries would improve the overall information infrastructure in these countries and thereby promote positive changes in socio-economic development." Overall, recent empirical studies and cross-national analyses suggest, quite convincingly, that the sophistication of a state's ICT infrastructure is a primary indicator of economic performance.

Africa is the poorest inhabited continent in the world. The continent's current economic status is clearly representative of its technological deficit. The question that emerges, then, is whether or not Africa has any hope of overcoming this deficit and reversing the trends of economic stagnation and increasing poverty [1]. Before we can begin to answer this question, it is important to have a sense of the status of Africa's ICT infrastructure. Africa's ICT infrastructure is best conceptualized in terms of Internet penetration. This measure is multifaceted; it includes qualitative data such as the status of Internet infrastructure, and quantitative data such as the total number of Internet users measured in teledensity. Based on these metrics, Africa is the most digitally isolated region

in the world [11, 17, 18]. In terms of Internet infrastructure, the entire continent is dependent on two competitive high-bandwidth connections (the SAT-3/WASC and SEACOM cables) to the Internet backbone, while there are more than 160 fiber optic cables connecting North America, Europe and East Asia [18]. To put these figures into perspective, consider them in terms of bandwidth: African bandwidth per capita is 1% of the world average, and .2% of that of that of the United States [17]. Juma and Moyer point out a very clear example of this inequity: currently, the entire nation of Senegal has a total available fiber bandwidth of 1.2 gigabits per second, which it shares with neighboring nations—this is basically



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one tenth of available bandwidth of Harvard University [17]. In terms of teledensity, as of 2000, there were an estimated three to six million Internet users on the African continent—this works out to roughly 40 to 80 Internet users per 10,000 people [19, 20]. More recent estimates put African Internet-teledensity at 111 users per 10,000 people, compared to 2,444 per 10,000 in America and 3,333 per 10,000 in Europe [11].

These measures of Internet penetration illustrate a vast technical disparity between African states and more developed nations. If a sophisticated ICT infrastructure is indeed a necessary precursor to economic

development, as the above research suggests, it seems logical for African states to update their ICT infrastructure and further develop their information technology industries. Unfortunately, this process is easier suggested than implemented. As Oshikoya and Hussain [1] point out;

[S]tarting from an initial position of poverty, African countries would not be able to finance the investments in information infrastructure and computer hardware and software required to access the information technology age. This would, in turn, mean that they would risk increased marginalization in the global economy with severe competitive disadvantage for their goods and services, and hence for their development prospects.

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As these authors suggest, the primary obstacle to bridging the growing digital divide is access to capital. In order for Africa to overcome this digital handicap and compete in today’s information economy, vast capital investments in ICT infrastructure are needed; at the present, however, this capital is simply unavailable. Faced with the current economic downturn, many multinational corporations and development agencies are unwilling or unable to provide African states with the foreign direct investment or development capital needed to fund ICT projects. Additionally, the demands on available finances are great. Many African states have adopted fiscal policies that emphasize pressing social problems such as education, the AIDS pandemic, political violence and ethnic discord, and rampant

governmental corruption.

Given the dearth of available capital and the current state of ICT infrastructure on the continent, Africa’s technological and economic future seems bleak. It is unlikely that Africa has much hope of overcoming these technological disadvantages, and emerging as a strong competitor in the global information economy. This, however, does not mitigate the necessity of technological advancement—African nations will continue to lag behind other states in terms of economic development until there is some change that allows them to compete more effectively in the international economy.

It may benefit African governments to learn from other developing states such as India and China: two nations that prioritized ICT growth and information technology industries and subsequently positioned themselves as emerging economic powers [21]. Although India and China did not begin at the same level of relative poverty as most African states, these two nations, while developing their ICT infrastructures, were faced with similar fiscal choices: whether to focus governmental spending on social issues, or to prioritize information-led development. India and China both took a middle route, investing in the technical education their citizens as well as relatively cheaper ICTs such as mobile telephony [22]. These investments seemingly paid off, as both nations are among the most prosperous developing nations in the world [12]. If African states follow India and China’s lead by prioritizing some of these “in reach” technological development policies, it may go a long way towards leveling the digital and economic playing field. ■

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# The Ominous Words of Thomas Malthus: Technological and Sustainable Developments Do Not Prevent Malthusian Catastrophe

Kara Davis

**I**n 1959 the world population was three billion people. By 1999 the population had doubled to six billion people. According to the U.S. census bureau this trend will continue with the population reaching nine billion by 2050 [1]. With 1.2 billion people already malnourished world wide, in order to accommodate the growing population food production will have to double [2,3]. Should food production not keep up with population growth, the world could very well be headed towards a Malthusian Catastrophe.

The Malthusian Catastrophe was fashioned by Economist, John Malthus who first published his theory on population in the late 1700s. In his *Essays on Population* Malthus stated “that the power of population is indefinitely greater than the power in the earth to produce subsistence for man.” Influenced by popular early theorists such as David Hume, Robert Wallace, Ben Franklin and Adam Smith, Malthus based his theory on two assumptions: food is necessary to the existence of man, and that passion between the sexes is necessary and will remain in its present state. Population, Malthus contended, grows geometrically (i.e. 1, 2, 4, 8, 16) when left unchecked. Food production, on the other hand, grows arithmetically (i.e. 1, 2, 3, 4, 5), meaning that population has the ability to grow at a faster rate than food can be produced. Malthus saw this as a problem, for if population growth was not kept in check, man would revert back to a subsistence state [3].

Malthus believed that there were natural checks on society that worked to keep population at or above subsistence level. The first check relied on man’s intuition to only start a family if he perceived that there was enough food and resources available to provide for them. Additionally, man would not want to lower his standard of living by starting a family he could not provide for. Both checks relied heavily on the availability of food. To support his theory, Malthus referred to two historical references, the barbaric state of the Roman Empire and the civilized nation of Europe. The barbaric state demonstrated that where means of subsistence are no longer available and emigration is an option, man will move to where high levels of subsistence exist. The civilized nation of Europe, on the other hand, illustrated that where low levels of subsistence exist and emigration is not an option, man will utilize industrial means to make larger levels of subsistence available. Analyzing these situations Malthus concluded that population cannot increase without means of subsistence. However, population invariably increases where

there are means of subsistence available [3]. Since large emigration movements are not feasible in the world today, the problem clearly becomes that of creating and maintaining a level of subsistence suitable for the growing population.

Malthus’s theory on population is not without its shortcomings. Economists have long criticized that Malthus did not take into account advancing technology. For instance, Malthus could not foresee the use of chemicals, advanced machinery and biotechnology, all of which have made agricultural production more efficient. They have also contributed to the ability to increase crop yield, resulting in higher, quicker food production [3]. These surely undermine Malthus’s theory because the continuing development of means to manufacture food ensures that man will continue to have means of subsistence available.

Others contend, however, that despite the fact that use of chemicals and machinery has increased efficiency, increasing crop yields may be approaching their limit. In 2001 the United Nations Population Fund reported, “food production capacities in many poor countries are deteriorating due to soil degradation, chronic water shortages, inappropriate agricultural practices and rapid population growth.” Other experts have supported this with the opinion that yield increases are no longer compensating for the elimination of land. Lester R. Brown contended that in areas of the world such as Ethiopia, India, Iran, Nigeria and Pakistan, grain land is quickly shrinking. By 2050, Brown contends that there will be less than one-fourth of an acre of grain land per person. Sustaining the world population will require the ability to produce and distribute high quantities of produce to poor countries. While, modern use of chemicals and technology may help do this, the results are largely short term and unsustainable. Chemicals and machinery are some of the main causes of land degradation and depleting natural resources [3]. This goes to show that while modern science has increased agricultural abilities it does not ensure that land will be available for future crop production ultimately, leading back to Malthus’ catastrophe.

Sustainable agriculture, on the other hand, offers a viable solution. Sustainable agriculture aims to solve ecological problems due to modern agriculture by promoting environmental sustainability to ensure that future generations will have equal access to food production [4]. Focusing on the preservation of natural resources means that the problems associated with modern chemicals and machinery are mini-





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mal, if not obsolete. According to the University of California Davis Sustainable Agriculture Research and Education Program, sustainable agriculture aims to protect the natural resources of water, energy, air and soil. Certain plant production processes can be adapted to ensure continued production. These include selecting plant species that are well suited to the site and conditions of the farm, managing the soil to enhance and protect it and humane use of inputs, such as synthetic chemicals. Prevention of land degradation is another component of sustainable agriculture [4].

Masanobu Fukuoka, author of *One Straw Revolution*, offers a unique perspective on natural farming as a means of preserving land for sustainable agricultural use. Fukuoka's distinctive process of using straw to fertilize land has not only proven to produce high quality crops, but to replenish and keep soil fertile. Fukuoka's natural farming is based on four principles: no cultivation, no fertilizer or compost, no weeding by tillage or herbicides and no dependence on chemicals. Fukuoka claims that this process of "natural agriculture is the well spring of agriculture" [5]. There are more benefits to Fukuoka's method of natural farming than sustained soil. While, crop yields may not be as high as those where chemicals are used, his method aims to naturally maximize crop production. As a consequence environmental and economic costs are also minimized. Fukuoka's method would dramatically cut down on agricultural pollution diminishing runoffs into water and dependence on large machinery, which require oil to operate. Additionally, naturally produced crops have higher nutritional value, making supplements less necessary and allowing for more people to be fed on a lesser amount of food [5]. This ensures that food will be plentiful for generations to come, so long as population remains in check.

Despite developments in agricultural sustainability and Fukuoka's promotion of natural farming, the Malthusian Catastrophe still proves as a real problem. For one, there is

an inherent challenge in implementing Fukuoka's methods due to the negativity attached to natural farming and it's perception of being "primitive" and "backward." There is convenience with modern technology and most economists would agree that the use of chemicals and machinery is efficient. But even if the entire world were to adopt sustainable methods, according to Malthus, as long as food production continues to increase, population will also continue to increase. While, there are clearly long-term benefits and a need to adopt sustainable methods, the answer to preventing a Malthusian catastrophe will never be to change the amount of food supplied because the "constant effort towards population, increases the number of people before the means of subsistence are increased." [3,5] Thus, more checks need to be placed on the population, because population will continue to rise. The real problem the world faces is not one of increasing food production to keep up with the growing population, but to prevent the population from outgrowing food production.

In the words of Thomas Malthus, "it has been said that the great question is now at issue, whether man shall henceforth start forwards with accelerated velocity towards illimitable, and hitherto unconceived improvement, or be condemned to a perpetual oscillation between happiness and misery, and after every effort remain still at an immeasurable distance from the wished for goal" [3]. Malthus' theory may have failed when he elected to ignore the possibility of technological and sustainable development. However, advancing methods have not been perfected and the population problem has yet to be solved. Developments in production technology and sustainability have thus, so far, thwarted the Malthusian catastrophe, but it still remains a viable threat for the future. ■

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# Creativity as a Function of Madness: The Enigmatic Relationship Between Creative Aptitude and Mental Instability

Lindsay Weinick

**T**he mad scientist, depressed writer, and delusional painter are stereotypical perceptions of the creative elite; could there be truth behind such characterizations? In what has become known as the “Sylvia Plath Effect,” many members of the scientific community and the general public have formulated a connection between psychosis and creativity [1]. Recent research conducted around the globe is showing a correlation between delirium and ingenuity that had previously been suggested in response to the notoriously erratic behavior of visionaries such as Vincent van Gogh, Sylvia Plath, and Virginia Woolf. Despite newly surfaced research advocating such a relationship, there are still many ethical implications circumventing society’s periodic association of creativity with mania.

Society often relates creative skill to mental instability, but a previous lack of research had proven solid evidence elusive. Contemporary studies may help justify such a theory. Never the less, the suggestion that creative people owe their genius to the presence of mental illness is an ethically and socially precarious topic. The science allows us to ask questions such as: Does creativity spawn from mental illness or does creativity cause mental illness? Each proposal has societal implications that could change the way we view our artistic innovators.

One study, done by Jordan Peterson of the University of Toronto and Sheeley Carson and Daniel Higgins of Harvard University, analyzed the tendency of creative people to discern stimuli from their surroundings further from what is needed to carry on with day-to-day life. In contrast to this intuitive population, the study showed that uncreative people block out unwanted stimuli. This phenomenon, known as “latent inhibition” may explain the enigmatic relationship between creativity and madness. The unusually lithe minds characteristic of people with low latent inhibition allows for those people to either accept the extra stimuli as limitless possibilities or as sources of discontent [2]. Another study, conducted by researchers at Stanford University, supports the vague line between positively applied latent inhibition

and negatively applied latent inhibition, suggesting that “discontent is the mother of invention. [3]” This proposes that the creativity of the mentally ill arises from emotions originating from the negative energy used to resolve conflicts in their day-to-day lives. This negative energy could be the result of the inability to sort through excess stimuli. In efforts to prove this theory, the researchers noted that patients at the bipolar clinic were often highly intelligent people that led compelling lives [3]. Following this observation, the researchers conducted a study that showed personality parallels between artists and individuals that are bipolar. During the study, patients, many of whom were on medication, were given psychiatric examinations before

taking the Barron-Welsh Art Scale. The BWAS is used to measure a person’s creativity based on whether or not the patient “likes” or “dislikes” various images. The results of the study suggest that the more creatively attuned disliked the straightforward and symmetrical figures, or in other words, the images that many artists would also dislike [3]. While the two investigations can be used together fittingly to support the theory

of creativity being related to madness, they advocate opposing origins. The first study suggests that creativity and madness are rather interchangeable, depending on what a person, by nature, does with given conditions. The second study, on the other hand, suggests that creativity is born of mental illness. The later illustrates some of the profound ethical implications relevant to this topic. Is it fair to imply that successful figures in the creative industry acquired their success compliments of a handicap provided by a history of psychosis?

However, historical figures make the connection between creativity and madness seem not only plausible, but probable. Scientific evidence strengthens society’s previous perceptions of the creatively attuned. Vincent van Gogh is world renowned for being an artistic visionary and pioneer while he is also known for depression and the notorious mutilation of his left ear. It seems that even van Gogh him-

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**Is it fair to imply that  
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self acknowledged his ever questionable lucidity, stating, while in the hospital, “my health is good, and as for my brain, that will be, let us hope, a matter of time and patience [4].” He describes his most famous piece, “Starry Night,” as a place where, “one can ruin one’s self [5].” Is van Gogh’s success then, due, in large part, to his lunacy? Can the same be said of people such as Virginia Woolf, who like van Gogh, suffered from mental instability? Woolf, a bipolar writer, is said to have, “identified with the fringe, with those on the margins, with the silenced, the mute, and the mad [6].” It seems that her mental illness made her more relatable to readers, and therefore more successful. In her essay, “Modern Fiction,” Woolf critiques writers of her time, asserting that it’s impossible to know what is going on inside one’s head by simply observing what’s going on in their surroundings [6]. This implies that she believes that her depression was not a product of her surroundings but a product of her impression of her surroundings. It also allows one to wonder whether or not it is correct to perceive one as mentally ill simply because they are creatively inclined when, according to Woolf, such assumptions are futilely related to action.

In contrast, studies conducted at the University of Oxford and the University of Hungary show that the expression of mental diseases such as schizophrenia and bipolar disorder, as well as creativity, is genetic. Researchers at the University of Oxford observed Icelandic, Scottish, Irish, British, Dutch, and Asian populations for specific variations of expression for the gene Neuregulin 1. Neuregulin 1, abbreviated *NRG1*, is a gene, often linked to schizophrenia, that plays several roles in the development of the brain and determining the capability of the brain of coping with changes in its environment [7]. The researchers concluded that there is a link between schizophrenia and *NRG1* by tracking specific mutations that occur at a specific place on the gene. They back up their research with evidence that mice carrying the mutated gene display behavior comparable to rodent equivalents of human schizophrenics. The study conducted at the University of Hungary found the link between *NRG1* and creativity. Researchers measured the creative capacity of a group of volunteers who “considered themselves to be very creative,” and compared the results to each volunteer’s specific discrepancies of Neuregulin 1. The results of the study suggest an obvious correlation between a person’s variation of Neuregulin 1 and their creative ability. Participants with a specific form of Neuregulin 1 had higher scores on creative evaluations and boasted more “lifetime creative achievements” than those expressing a different form of Neuregulin 1 [8]. Like the researchers from Stanford, one of the Hungarian researchers noted that the variation coding for mental illness can be somewhat beneficial in terms of helping the subject think more creatively.

Ultimately, research is strengthening the relationship between creativity and madness, though how the correlation came to be remains ambiguous. The affiliation could result from a person’s ability or inability to separate various stimuli, a person’s perception of their surroundings, or from genetic discrepancies. However, regardless of origin, scientific evidence supporting such a connection creates interesting ethical and societal dilemmas. How will society view and accept their creative members knowing that their creativity may be abetted with, or a result of, a psychotic counterpart? Is it ok to credit artistic prosperity to what many would view as a socially unacceptable ailment? For now, the answer rests in society’s own ability to sort through the creative environment to develop an opinion. ■

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# A Clean Energy Revolution: A Solution to the Imminent Energy Crisis

Christos Makridis

**P**olicymakers have a tendency to hyperbolize legislation by attaching “green” onto their broader policy based initiatives. Though the intent of the word “green” is precise, referring to the practice of growth and renewal, today, nearly every legislation that is marginally different than status quo energy practices qualifies as environmentally friendly [1]. Initially applauded by environmentalists in an attempt to curb the United State’s unrelenting addiction to fossil fuels, the federal government passed the Energy Independence and Security Act in January of 2007. Yet, this legislation, among others, has failed to address the root cause of the nation’s dependency on fossil fuels – a market failure perpetuated by a perverse framework of incentives. In this sense, the federal government has continued to subsidize one of the oldest existing industries in the United States with cash transfers amounting to over \$40 billion annually, which has, therefore, maintained the companies’ competitive edge in the energy industry [2].

With growing energy demands, continued support for economically dangerous and environmentally unfriendly policies could have serious social and political ramifications, including the erosion of the U.S. economy and a failure to mitigate the worst effects of climate change. According to John Ritch, director of the World Nuclear Association, energy consumption will double or even triple within the next 50 years, implicating the projected increase in greenhouse gas emissions [3]. Despite the onslaught of uncertainties presented by the impending energy crisis, it simultaneously offers a window of opportunity for the federal government to exercise substantial leadership in formulating an efficacious energy policy. Revisiting the Energy Act of 2007 through the elimination of subsidies will allow the clean energy industry to thrive. As such, a flourishing clean energy industry will function not only as a vital mechanism for the mitigation of global carbon emissions, but also as a crucial impetus for economic recovery – both domestically and abroad.

This article will examine the various dangers associated with climate change and its resulting geopolitical and eco-

nommic implications. Additionally, the article will analyze the economic rationale for the elimination of subsidies for the fossil fuel industry. By restoring a level playing field to the energy sector, the market will escalate the development of wind, solar, nuclear, and other clean energies, through the efficient allocation of capital.

Overwhelming scientific evidence concludes that anthropogenic climate change is rapidly escalating in severity [4]. A defense report, conducted by top U.S. officials, notes that absent a substantive shift in policymaking, the effects of climate change could transform the world into a breeding ground for interstate conflict [5]. Perhaps the most frightening consequence of global warming is its potential to ignite greater destabilization in already volatile regions. Visions of

massive floods and entire coastlines disappearing in Europe will no longer be mere fiction, but reality [6]. Other geographic regions will also experience alarming climatic changes as their terrain transforms into Siberian-like habitats [6]. The worst case scenario does not even capture the horror that would be endemic to humanity; warfare and bloodshed would once again define human life [6]. Scientists have also indicated that climate oscillations could significantly reduce the

world’s agricultural supply; major reductions in agriculture would collapse the world’s economic system “like a house of cards,” putting billions of lives in immediate jeopardy [7]. Although the aforementioned scenarios have the potential to create significant geopolitical and agricultural hurdles for the international community, they also threaten the economic stability of the world economy. Escalating interstate conflict will force an unexpected conclusion to globalization and free trade by creating an incentive for protectionist policies [8]. Without the existence of economic interdependency perpetuated by the current capitalist and liberalist framework, countries will likely default to warfare.

Despite the grim scenarios simulated by climatologists, various entities, including the Intergovernmental Panel on Climate change, argue that “a path yielding energy independence and a healthier environment is, barely, still possible” [4]. However, such a path will only be feasible through

“**By restoring a level playing field to the energy sector, the market will escalate the development of wind, solar, nuclear, and other clean energies, through the efficient allocation of capital.**”



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an unwavering commitment to a free market economy. In this sense, growth in the clean energy sector will not begin earnestly until the federal government ceases its detrimental subsidization of the fossil fuel industry [9, 12]. Currently, renewable technologies – nuclear, wind, and solar power – are not cost-competitive enough given the unequal energy playing field. Specifically, nuclear reactors face very high upfront costs, averaging a total of \$10 billion per reactor [10]. Similarly, wind and solar energy have been unable to be deployed on a large and efficient scale [3]. As a result, renewable energy development has remained modest.

Yet, renewable energy – if examined holistically – remains the most salient option for diversifying energy supplies in the international marketplace, particularly in the U.S. However, subsidies mask the true cost of carbon intensive energies by providing the industry with unearned revenue, deceiving consumers and policymakers from examining fossil fuels for what they really are – a negative externality; there are various costs – hidden from public scrutiny – involved in the fossil fuel supply-chain process that allow consumers to purchase products, such as oil and electricity, from coal-fired power plants. Some of these costs include: an annual outflow of \$20 billion used to protect the

flow of oil [11]; 3 million annual deaths world-wide as a result of excess amounts of atmospheric CO<sub>2</sub> concentrations [3]; and, the United States technological foundation has declined, negatively impacting its energy competitiveness in the international marketplace [12]. Because of billions of dollars in federal subsidies, fossil fuel companies are able to keep the price of oil and electricity low relative to the cost of renewable energy – solely because the government continues to cushion many of the costs that the fossil fuel industry would otherwise face. However, “leveling the playing field,” through the elimination of excess subsidies, would enable the market to decide what technologies are most cost-effective [12]. Therefore, an accurate price structure would provide a suitable environment for the successful evolution of the alternative energy sector.

A growing alternative energy industry will not only foster a sustainable environment capable of exceeding international standards relating to greenhouse gas emissions, but also act as a stimulus for the American economy. The current economic climate is bleak; job growth is stagnating as unemployment rates reach new heights of 10.2%, a level not seen for 26 years [13]. Despite the adversity inherent in the current crisis, studies show that the nation could generate

up to three to five million jobs over the next decade through the adoption of sustainable technologies [14]. Employment opportunities in the clean energy sector could serve as “green pathways out of poverty,” thereby reducing current poverty and unemployment levels [14]. More important than the magnitude of jobs that will be created is the quality of the labor force that a renewable energy based economy will demand. The fossil fuel industry has set a low threshold for innovation by limiting employment opportunities to tasks such as coal mining, manufacturing, etc. In contrast, the integration of renewable energy into the nation’s economy will spur demand for engineers, scientists, educators, manufacturers, etc, thus necessitating a higher demand for human capital [15]. As such, improving the quality of the labor market will enable the United States to maintain its competitiveness and technological superiority in the international arena.

Although proponents of the current framework for energy policymaking argue that an abrupt shift would drive fossil fuel firms out of business, which would, therefore, have a net-negative effect on the economy, oil companies have publically stated their willingness to comply as long as the government provides stable investment expectations. Their uncertainties, however, pertain to the government’s current market signal; “Most oil firms seem profoundly uninterested in disrupting a business model that is delivering substantial returns” [16]. In essence, although firms recognize the opportunities latent in a clean energy revolution, they are waiting for the federal government to espouse and implement a cogent energy policy. In this sense, hyperbolized rhetoric on Capitol Hill is meaningless without supplemental concrete action to catalyze investment in the clean energy industry.

The rapid development of the United States’ clean energy market is directly correlated with the nation’s ability to cope with efforts to curb carbon emissions. Scientists cal-

culate that countries must substantially reduce their carbon consumption by a total of 50% by 2050 in order to avoid the worst effects of global warming [4]. The elimination of subsidies for the fossil fuel industry would provide a crucial incentive for clean energy firms, particularly the nuclear power industry, to innovate and develop cost-competitive energy solutions. For example, Thomas Cochran, a senior nuclear scientist, testified in Congress and argued that the federal government should abandon its current policies of subsidization and, instead, allow the free market to efficiently allocate capital [17]. That said, nuclear power remains one of the most efficacious mechanisms for power production within the U.S., therefore, making it uniquely suitable for facilitating an energy revolution due to its cost-effectiveness per kilowatt hour [3].

Given the preceding information, eliminating the gross subsidization of the fossil fuel industry remains all too important to continue inaction. Rather than attaching “green” onto ineffective and inefficient legislation, policymakers should seek to acquire a holistic understanding of energy by considering all the costs and benefits associated with the different energies’ production and distribution. Despite the reality of such a daunting task, a transition to clean energy is not only possible – but necessary. If the international community, especially the United States, continues to harbor carbon intensive fuels, the world risks entering into a new Dark Age resulting from the harmful effects of anthropogenic climate change and further economic decay. Yet, signs of hope exist. As the international community gathers to discuss paths forward, a commitment to a free market economy – devoid of distortionary subsidies – will force the adoption of efficient and effective forms of power production and distribution. ■

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# Indoor Tanning: Risks to Health vs. Risks to Freedom

Charlie Pokora

**T**he growing popularity of indoor tanning among teenagers has led to a conflict between the competing interests of teenagers' health verses their freedom of choice. Our cultural values and societal pressures, coupled with the advancement of indoor tanning technology, have created emerging legislative and healthcare issues. Proposed and enacted legislation has worked to limit teenagers' right to choose by restricting their ability to frequent tanning facilities. This legislation has been prompted by the goal to safeguard teens from the risks of ultra violet rays as well as their own naivety, being unaware of the long-term health consequences of prolonged UV exposure. Ultimately, while minors should be entitled to the choice to visit tanning salons, the reality is that they can only focus on the perceived benefits with the subsequent consequences too remote to grasp at an early age. Until teenagers come to realize that their social motivation for tanning does not outweigh the health consequences, legislation restricting their choice to tan is justified.

When did tanning become so important to teens? Did tanning beds one day begin to be manufactured and provide everyone with magical health benefits that no one could live without? The reality is quite the contrary. Many suggest that tanning among teenagers became important because society dictated that it was a key aspect of teen culture. It became a trend; a way to become more attractive; an activity that every popular teen wanted to join in on. Today, despite many known health risks, tanning salons have become a frequented hot spot for numerous teens.

Spawned by increasing demand for the artificial rays, in addition to free standing tanning locations, tanning facilities are in a wide range of venues including: athletic clubs, recreational centers, beauty salons, apartment complexes, and even private homes [1]. The industry of indoor tanning arose in the 1980s, starting "with [a mere] 50 facilities per large city" [1]. In 2003, approximately 50% of college-aged [survey participants] reported current use of indoor tanning over a 12 month period [1]. More recently, in 2007 a staggering "2 million Americans [reported using] indoor tanning beds each day, with the number of US individual users having doubled

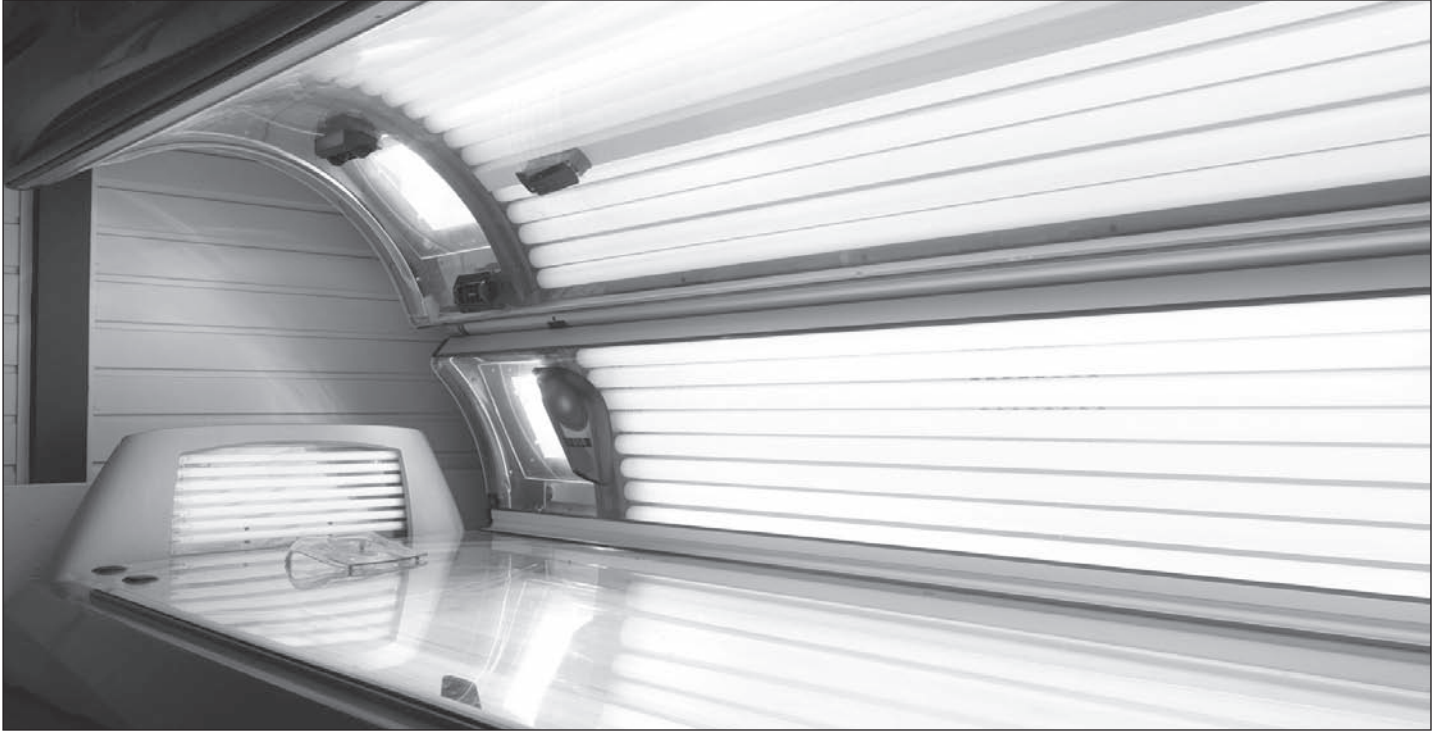
to nearly 30 million in the past decade" alone [1].

Each day in the United States, over one million people currently visit tanning salons [1]. This statistic was released by the Academy of Dermatology to show growing concern and caution [2]. This warning has had little effect on younger age groups, since indoor tanning is particularly popular among teenagers. "In a national sample of non-Hispanic white teenagers, 24% of respondents [or 2.9 million teens] between the ages of 13 to 19 reported using a tanning facility at least once in their lives" [2]. Nationally, "more than 25% of teenage girls have used tanning salons three or more times in their lives" [2]. Generally, teenagers are frequent targets of the tanning industry's highly visible marketing tactics, attracting teens through coupons and media outlets, even going as far as placing ads in high school newspapers" [3]. It is difficult for a teen to resist offers for free tanning trial periods, membership deals, steep discounts, or "unlimited tanning" promotions [3].

It is difficult to quantify what a "moderate" or "non-harmful" indoor tanning frequency would be, if at all for teens. According to the Indoor Tanning Association, the tanning industry has taken the position that "moderate exposure to the sun can be a benefit" [2]. This biased statement, driven by the hope of future profits, was also accompanied by boastful statistics including the industry's "25,000 professional indoor tanning facilities in the United States and 30 million customers" to date [2]. With competing interests and a heavy debate between free enterprise and health precautions, who is to judge or be the deciding force regarding who should frequent indoor tanning salons and what amount of exposure to ultraviolet rays is safe?

**Proposed & Enacted Legislation: Technological Pessimism** Motivated by the many well-known health risks to indoor tanning, dermatologists and legislators have begun the daunting task of making a change in our societal norms in hopes of protecting teenagers. It is no secret that ultraviolet radiation exposure can lead to "premature aging and, more importantly, skin cancer, including melanoma – the deadliest form of skin cancer" [1]. "Research has shown that in-

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Reproduced from [13]

door tanning is dangerous, and there should be laws to protect children from engaging in this activity as there are for other unhealthy behaviors such as drinking and smoking” [1]. These sentiments are shared by many state law makers who have worked to pass legislation which implemented restrictions on teenagers’ ability to visit tanning facilities [3]. In 2007, 16 teenage tanning restriction bills were introduced with only four becoming enacted, indicating hesitation among lawmakers to curtail teenage freedom of choice [3]. Despite a slow start, today 29 states currently have tanning regulations in place limiting use by minors [4].

State legislation has developed varying degrees of restrictions and control throughout the country. Some states prohibit teens from tanning under the age of 14, while others have raised the age restriction to 15 or even 16 years old [3]. A few states have implemented a complete ban on teenage indoor tanning until the minor has reached the legal age of 18, unless the minor provides “written parental consent[;] written consent with the parent present at the facility or a doctor’s prescription” [3]. California Legal Code states:

Before any person between 14 and 18 years of age uses a tanning device, he or she shall give the tanning facility a statement signed by his or her parent or legal guardian stating that the parent or legal guardian has read and understood the warnings given by the tanning facility, consents to the minor’s use of a tanning device, and agrees that the minor will use the protective eyewear that the tanning facility provides [1].

The parent or guardian must be present in order to sign an “initial consent” form to be renewed each subsequent year [3]. Similarly, in Florida, any teen between 14 and 18

years of age must obtain permission in writing before being allowed to use any tanning facility [4]. This Florida law may potentially be even stricter since “[a] proposed bill would [additionally] ban anyone younger than 16” and “require parents of 16- and 17-year-olds to give consent in person” [4]. Among the most restrictive laws, both Vermont and Texas have made tanning under the age of 18 illegal unless a doctor’s note is supplied [4].

This nationwide inconsistency in regulation has created debate over whether the enacted legislation is effective. Vermont State Representative Janet Ancel, working to be a voice for changing tanning legislation, has argued that “requiring parental consent isn’t good enough. It isn’t healthy for a young person to be in a tanning booth, so allowing it with a parent’s consent isn’t going to protect them” [4]. Another contributor, Dr. James Spencer, former co-chair of the National Council for Skin Cancer Prevention, has struggled with slow progress stating, “I think we have gotten the word out, but they just don’t care” [1]. With new legislation emerging, “a mix of regulation and education” is needed to successfully alter the tanning industry standards and norms as well as enable Americans to change their view of indoor tanning from once being a social activity to now a harmful problem to confront together [7]. The decision-making process should take into account the views of each stakeholder, especially those of minors, understanding the impact on their freedom to choose.

#### **Right to Choose: Technological Optimism**

For the patrons of tanning salons, melanoma is not typically in the forefront of their mind as they frequent these establishments for more socially motivated reasons [1]. Indoor tanning is motivated by many positive factors, as data



from questionnaires administered to patrons spanning nine months has revealed [8]. The top four reasons that people submitted their bodies to harmful tanning lights included the time saving aspect of a quick tan, the belief that achieving a bronzed tan is appealing, the atmosphere of the salon being a pleasant place to frequent, and the hope that receiving an indoor tan would prevent burning outdoors [8]. In addition to the positive association with indoor tanning, it is ironic that many of the questioned patrons were convinced that the tanning bed cured them of health problems such as acne [8]. While some patrons are naïve to the health risks indoor tanning beds pose, others prefer to divert the blame elsewhere by pointing out the heightened likelihood of people who use indoor tanning to also achieve their bronzed look outdoors as well [1]. This relationship between indoor and outdoor tanning in skin cancer patients in general has been argued to make it difficult to determine which exposure actually caused a resulting melanoma [9]. Finally, there are groups such as the Indoor Tanning Association who outright deny the risks. When asked about the risks versus the benefits they have stated, “[t]he protective benefits of UV radiation are undeniable” and that “[w]arnings about limited and sensible exposure to the sun or UV radiation are exaggerated” [1]. Additionally, the Association has denied the relationship between indoor tanning and an increased incidence of melanoma explaining that the connection is too complex in nature [10].

Clearly, the Indoor Tanning Association has been one of the largest supporters of teenagers’ right to tan indoors with their mission to “protect the freedom of individuals to acquire a suntan, via natural or artificial light” [3]. This Association also promises to “ensure that this freedom is not restricted” [10]. Tanning salons have become an extremely prevalent aspect of American culture, and many argue that the opponents of the new restrictive legislation have gone too far [2]. Refusing to vote for the age restriction in tanning salons in North Dakota, Senator Nick Hacker has referred to indoor tanning as a “personal right” and even equated tanning bed use to the use of a cellular phone [2]. There are strong arguments on either side of the teenage indoor tanning debate, but the reality remains that teenagers’ health is at stake.

### Psychology Behind the Problem Points to Solutions

State legislation in various states has made tremendous progress towards the goal of protecting adolescents from skin damage before they realize the dangers of indoor tanning. But the risks are still present for teenagers in states with no regulations in place and the motivations of sun worshipers are much deeper rooted than simple restrictions can remedy, and extend into the teenagers’ adult life. Attaining a bronze look has become glamorized through the media resulting in a disorder termed “tanorexia” [11]. It is easy for proponents of indoor tanning to promote the importance of the vitamin D provided; however those who most commonly frequent the tanning salons do not fall into high risk groups commonly prone to vitamin D deficiencies [12]. Teenagers who have regularly tanned indoors from a young age have been shown in studies to “show signs of having a substance-related disorder . . . with respect to UV light” personally admitting to their inability to stop [12]. The dependence resembles an addiction resulting from the endorphin release that results from UV light exposure or from body dysmorphic disorder that is “a condition involving excessive pre-occupation with a minor or imagined defect” [12]. The media has placed pressure on young girls in particular to be attractive, making this group especially vulnerable to future tanning dependence [12].

Not only should state law makers place age restrictions on young adults ability to tan, but they should also follow the example of the tobacco campaign in not only restricting positive advertising for indoor tanning, but using media outlets to portray tanning salons as a health risk as it truly has been proven to be [12]. To create healthier lifestyles for our youth, the public perception must be changed to increase UV light safety measures and prevent the harm that may continue beyond the point that teens reach the statutory tanning age [12]. While minors should be entitled to the choice to visit a tanning salon, the reality is that they can only focus on the perceived benefits with the subsequent consequences too remote to grasp at an early age; and hopefully in the future they will come to realize that their psychosocial motivation for tanning could be easily satisfied through more healthy activities [8]. ■

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# The Medical Sacrament of Baptism: A History of Vaccination and its Application to Pandemic H1N1 Outbreak

David Edwards and Cameron Crockett

**I**n March 1918, an incoming dust storm combined with suffocating heat and nauseating fumes from burning manure, blackening the skies over Fort Riley, Kansas [1]. It was in this portentous environment that the Spanish Flu pandemic began spreading around the world and decimating global populations. Since then, three other major influenza pandemics have occurred: the Asian flu, which killed approximately 1 million people from 1957 to 1958; the Hong Kong flu, which killed approximately 1-3 million people from 1968 to 1969; and the pandemic H1N1 outbreak, which began in 2009 and has reportedly killed 2,328 people in the US and 14,286 people worldwide as of January 18, 2010 [2,3]. Ultimately, despite the panicked rhetoric surrounding the recent pandemic H1N1 outbreak, the mortality rate of this outbreak is significantly less than other twentieth century pandemics [4]. Moreover, while medical advances like prompt vaccinations have reduced the worldwide threat associated with the outbreak, a majority of the population still rejects the unequivocal benefits of vaccination.

This rejection has primarily occurred because the current influenza pandemic has attracted the attention and imagination of journalists, political pundits, and television personalities. Many have misleadingly emphasized that this particular virus strain had never been encountered before, calling pandemic H1N1 a “growing medical mystery,” while failing to mention that all viruses constantly undergo biological changes [5]. Contrary to popular opinion, although pandemic H1N1 spreads quickly across populations, the severity of the outbreak is substantially less than previous outbreaks [6]. Ever since the Spanish Flu pandemic, where doctors tried unsuccessfully to develop vaccines against the disease, researchers have repeatedly concluded that vaccinations are the most effective method of combating influenza [7]. The importance of vaccinations was perhaps expressed most poignantly

by Samuel Butler, the Victorian author and critic, who wrote that “[v]accination is the medical sacrament corresponding to baptism” [8].

## History of Vaccination

Despite reservations about the current pandemic H1N1 vaccines, the science behind vaccinations is well established. Essentially, vaccines are designed to induce the production of antibodies from the immune system against particular disease antigens or substances that induce an immune response

[9]. These disease antigens are carefully monitored to ensure that the immune system is triggered without harming the individual. This methodology has been used for thousands of years, originating with Chinese smallpox inoculation around 200 BCE [1]. The first modern vaccination was developed in 1796 by an English physician named Edward Jenner [10]. Jenner observed that in nearby farming villages, milkmaids who had been infected with cowpox remained immune to periodic outbreaks of smallpox that spread through the community. Knowing this, Jenner inserted pus from cowpox lesions into patients through the process of variolation, where small amounts of infected sub-

stance from a diseased individual are transferred to a healthy patient to induce immunity without severely infecting the patient [11].

While these experiments were unprecedented and revolutionary, Jenner’s manuscript describing these experiments was ultimately rejected for publication by the Royal Society in London because the results were “in variance with established knowledge” [11]. The Council of the Royal Society recommended that “he had better not promulgate such a wild idea if he valued his reputation,” prompting Jenner to publish the results himself [11]. Eventually, Jenner’s discovery was determined by formerly skeptical physicians to be so significant

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**Ultimately, despite the panicked rhetoric surrounding the recent pandemic H1N1 outbreak, the mortality rate of this outbreak is significantly less than other twentieth century pandemics. Moreover ... a majority of the population still rejects the unequivocal benefits of vaccination.**

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that, in 1840, the government made Jenner's the only acceptable method for smallpox inoculation [12].

Vaccine production has become increasingly simple due to advances in medical technology. While the practice was initially expensive because viruses could only be grown in live animals, E. W. Goodpasture developed a method in 1931 of using the chorioallantoic membrane of chicken eggs as more appropriate sources [13]. This is the current method of acquiring human viruses for vaccines, although it is not preferred because egg vaccine production is expensive and takes many months [14]. Growing viruses in cell cultures is being explored as a promising alternative, and has been demonstrated in a 2009 study to be equally effective in producing quality vaccines [14].

#### **Modern Vaccines: Injection vs. Spray**

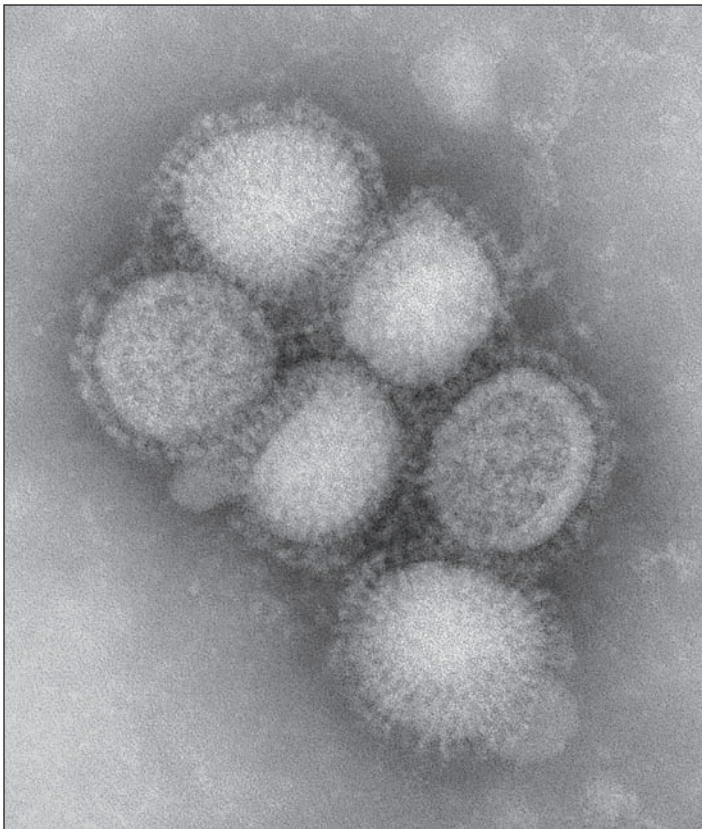
Since first developed in the early 1900s, intramuscular injections have been the most common way to deliver influenza vaccines. Intramuscular injections are given most frequently for the seasonal flu shot, which is a combination of three influenza strains that are predicted to be most prevalent globally by international influenza surveillance centers [15]. Vaccines that are injected intramuscularly are usually produced using two varieties of attenuated viruses. One variety uses the entire virus to provoke an immune response; this method of vaccination was developed first and has a high efficacy rate [15]. The second variety, called subunit vaccination, uses only a specific portion of the virus, which produces a lesser immune system response and might not be sufficient for combating a pandemic [15].

Another way of delivering influenza vaccines is through a nasal spray, a method that was first introduced by MedIm-

mune, Inc. through FluMist and was approved by the Food and Drug Administration (FDA) in 2003 [16]. While the exact mechanism of protection conferred by the nasal spray vaccine is unknown, many clinical trials have proven its effectiveness, particularly in children [17]. Additionally, data presented during a meeting of the Pediatric Academic Societies showed that intranasal vaccination of children was more cost-effective than traditional methods [18].

Viruses for both delivery methods are developed using similar processes, although unlike the injected vaccines, nasal spray vaccines use a weakened, attenuated version of the influenza virus. Using the attenuated virus enables a robust protective immunity because all antigenic qualities of the virus are preserved in the vaccine. Both vaccine manufacturing methods involve incubating the virus in chicken eggs for 2–3 days, harvesting and purifying the virus, and testing for quality assurance [15].

Studies comparing the relative effectiveness between these two methods of vaccination have been inconclusive. Two studies comparing the antibiotic response of FluMist with injected vaccine enabled researchers to conclude that nasal spray vaccines provided a more complete immune response [17,19]. However, a study published in the *New England Journal of Medicine* concluded that nasal spray vaccines were 50% less effective than injected inactivated vaccines in reducing laboratory-confirmed cases of influenza [20]. Moreover, the method of distribution for injected vaccines is more established, and groups like pregnant women and those with chronic conditions like asthma and diabetes cannot take the nasal mist vaccine [21].



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**The anti-vaccine sentiment sweeping across America could have far-reaching implications for the future prevention and management of influenza pandemics.**

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### **The Panic of Pandemics**

Throughout recent history, each influenza outbreak has been accompanied by senseless panic and mass hysteria. For example, at the beginning of the Spanish Flu outbreak, vigilantes patrolled the streets of Albuquerque, New Mexico, ensuring that people wore protective masks and punishing those who did not [22]. While the hysteria surrounding the current pandemic H1N1 outbreak has not escalated to this intensely, most outbreaks have been associated with a mistrust of government officials and the media [22,23].

Many people fear that the pandemic H1N1 vaccine was prepared too quickly and without following established lab-

oratory techniques. However, the production of this vaccine exactly parallels that of the standard seasonal flu vaccine, only with the replacement of standard seasonal flu antigens with pandemic H1N1 antigens [24]. This similarity of methodology allowed for rapid FDA approval and passage of clinical trial phases which, while obviously important for quickly distributing the vaccine to affected areas, proved worrisome for the general public [25].

A primary concern among some Americans involves the method of inoculation. Although FluMist has been proven harmless and efficient, many people still fear using vaccines with live attenuated viruses [26]. Several have cited concerns that receiving this vaccination might lead to infecting others around them. In response, Dr. Anne Schuchat, the director of CDC's National Center for Immunization and Respiratory Diseases, has repeatedly emphasized that the nasal spray is a weakened virus—unless you have a compromised immune system, the vaccine can only protect you from influenza, not infect you with it [27,28].

Moreover, concerns have been raised about specific components of the vaccine, concerns that seem rooted more in hysteria than in scientific fact. One of these concerns is that the vaccine employs a dangerous adjuvant—squalene—to enhance immunological activity [29]. The practice of adding adjuvants to vaccines when the demand of those vaccines will exceed the supplies is commonplace; according to Marie-Paule Kieny of the World Health Organization, “[w]e have always argued that using adjuvanted vaccine would leave more vaccine for poor people” [30]. However, American concerns about additional adjuvants in their vaccines are unfounded because, while adjuvants may be prominent in European and Canadian vaccine manufacturing, American pandemic H1N1 vaccines do not contain any adjuvants [29].

Another concern among Americans against pandemic H1N1 vaccination involves the use of the preservative thimerosal. This concern might have resulted from the campaign by the American Academy of Pediatrics in 1999 to remove the additive from all single-dose vaccine vials after suspicions were raised that autism or mercury poisoning could result from exposure [29]. However, subsequent studies have found that children and infants could receive as much as eight times the mercury present in the pandemic H1N1 vaccine with no significant health concerns [29]. Ultimately, doctors and researchers have suggested that the fear regarding the preservative is baseless altogether. Regardless of these unjustified opinions about thimerosal, the nasal spray vaccine for pandemic H1N1 is not manufactured with this additive [31]. Furthermore, the injected pandemic H1N1 vaccines are packaged in both multi-dose and single-dose vials, the latter of which may be requested and contains only trace amounts of the chemical [31].

### **Media: Injecting Fear, Not Vaccines**

Most concerns and anti-vaccination sentiments have been propagated by media personalities. Political commentators like Glenn Beck, Bill Maher, and Rush Limbaugh have rec-

commended that their audience avoid receiving the pandemic H1N1 vaccination [32]. Perhaps the most derogatory claims were circulated by Glenn Beck, the controversial host of Fox News's Glenn Beck Show, who claimed on his program that the vaccine was an attempt by the Obama administration to control Americans' health, even concluding, "If somebody had the swine flu right now, I would have them cough on me. I'd do the exact opposite of what homeland security says" [33].

Beck also identified the supposed hazards of the vaccine, declaring on his radio show *The Glenn Beck Program* that Americans "don't know if this is gonna [sic] cause neurological damage like it did in the 1970s" [34]. This comment refers to a governmental immunization effort mounted after a US soldier died from an outbreak of swine influenza in New Jersey's Fort Dix [34]. However, the virus never spread beyond the fort and reports soon emerged that approximately 500 individuals had contracted Guillain-Barré syndrome, an autoimmune condition that can lead to paralysis [35]. While follow-up reports indicated a relationship between the immunization effort and the prevalence of Guillain-Barré syndrome, there have been no subsequent cases of any neurological disorder caused by vaccinations [34]. Beck's selective and misleading statements about the H1N1 pandemic vaccine further propelled the anti-vaccine sentiment to the forefront of American consciousness.

As the H1N1 pandemic outbreak has progressed, the greatest impediment to inoculation has been the number of available vaccines, not concerns about the vaccination process. Supplies of the swine flu vaccine did not reach the target quantity of 100 million doses until mid-December, much later than the original estimate [36]. Early reports of underproduction increased the severity of the problem as concerned individuals rushed to obtain the vaccine wherever available, thereby causing a temporary shortage of vaccines in the US [37]. Dr. Mary Zwelling, an American pediatrician, said these shortages were "an abomination," echoing the frustrations of many individuals unable to receive vaccines for themselves or their children [38]. These vaccine shortages coincided with President Barack Obama's official declaration that the H1N1 pandemic outbreak should be classified as a national emergency, which would enable overwhelmed hospitals and health care providers to transport patients to alternate places for treatment if their facilities became overwhelmed [39]. Since then, however, vaccine production has increased sufficiently to meet and even exceed expected demand. Despite a recall of nearly 800,000 vaccine doses in the US resulting from the absence of thimerosal, many states have obtained enough vaccines to eliminate all restrictions on individuals who want to receive the vaccination [40,41].

The CDC has warned that individuals should still obtain vaccinations despite the possibility that new cases of pandemic H1N1 might be decreasing [42]. However, a majority of Americans remain hesitant about receiving the pandemic H1N1 vaccine; a recent poll found that while more than 70% of people believe the vaccine is harmless, 52% still have no plans of re-

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**Unfounded concerns about vaccinations perpetuate the unfortunate truth that the rejection of scientific fact has been a recurring theme throughout history.**

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ceiving the inoculation [43]. Ultimately, these statistics suggest that efforts by the CDC to overcome the baseless apprehensions about pandemic H1N1 vaccine proved to be somewhat unsuccessful. A report released in mid-January by the CDC revealed that while 18% of Americans had been infected with pandemic H1N1, only 20% of the population had received the vaccination [44]. The number of vaccinated individuals—approximately 61 million Americans—was considered "very successful" by CDC officials, although those individuals accounted for only 27.9% of the initial target group, 37.5% of the prioritized groups, and 29.4% of children between 6 months and 18 years [45,46]. Furthermore, the CDC continues to emphasize that cases of pandemic H1N1 are still occurring and has proceeded with efforts to vaccinate a greater number of the population [44].

### **Implications of Vaccine Panic**

The anti-vaccine sentiment sweeping across America could have far-reaching implications for the future prevention and management of influenza pandemics. Concerns by parents about vaccinating their children have resulted in massive reductions in vaccinations; in some areas in the US, certain children's diseases are approaching pre-vaccine occurrence rates for the first time in history [47]. A 2008 study found that while only 2% of California kindergartners remain unvaccinated, their disproportionate grouping among the population leads to increased risks of outbreaks from previously eradicated diseases like measles, mumps, and whooping cough [48]. With the increased anti-vaccine sentiment from the pandemic H1N1 outbreak, the number of susceptible individuals will likely increase, leading these diseases to become even more prominent [47].

Unfounded concerns about vaccinations perpetuate the unfortunate truth that the rejection of scientific fact has been a recurring theme throughout history [47]. Moreover, the perception that television personalities can provide sound medical expertise is perhaps best summarized in a statement by American science journalist Michael Specter: "It's shocking. We live in a country where it's actually a detriment to be an expert about something" [47]. It is not merely disappointing when people make important medical decisions based on instructions from partisan ideologues—it is dangerous. Hope-

fully, living in a world defined by scientific advancement and accessible information will make it impossible to continue to ignore the truth.

However, the question still remains: can we successfully vaccinate the general population against such insincere medical misinformation before the next pandemic inevitably strikes? Or will our society, in rejecting the ever-important

medical sacrament of baptism, find itself relegated to a purgatory in which previously eradicated diseases can reemerge with potentially devastating results? ■

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# Complications With H1N1 Politics and Public Consent

Brendan Tugnao

The H1N1 virus has created much panic in the United States, forcing some citizens to hastily receive their vaccines in order to prevent serious illness. In opposition, other citizens refuse to take the inoculation entirely due to the possible risks involved with the new H1N1 vaccine. Between these competing choices it is difficult to discern which choice is the right choice. Does a right choice even exist? The answer, sadly, is no. This ambiguity to discern which risks are important, leads to a fundamental issue in which policy attempts to handle these complicated decisions for the public. In doing so, governmental policies make situations complicated by negating public choice in favor for their own beliefs in what they believe is important and what is not important. This fundamental issue gives rise to a more individual approach in which the public must be the sole negotiator for their health. That is, as long as the individual consents for which risks are appropriate for him or her, then the correct choice is the choice for the individual. From this, we are encouraging a need for the citizen to conduct research in selecting the appropriate risk. As oppose to having policy which selects the risk for all individual.

For example, the Washington State Department of Health (WSDH) has temporarily suspended the limit of thimerosal allowed in the H1N1 vaccine [1]. Thimerosal is a mercury compound that is used as a preservative to kill bacterial contaminants in vaccines [2]. In the United States vaccines contain only trace amounts of thimerosal. But in third world

countries thimerosal is still found vaccines, as they are cheaper and easier to produce [2]. Removal of thimerosal-containing vaccines in the US was announced in a statement in 2000 by the Center of Disease Control (CDC). This was due to recent studies

that examined potential associations between exposure to thimerosal-containing vaccines and negative side effects [3]. In cases where there is a vaccine shortage, the CDC deemed thimerosal usage 'acceptable' since they believed isolating a flu to prevent further death or infection out weight the possibility of vaccine related adverse effects [3].

As Washington state law grants the Secretary of Health the ability to allow mercury in vaccines in times of shortage, the mercury limit suspension was enacted to compensate for the vaccine shortage, effective September 23, 2009, through March 23, 2010 [1]. Although policy can help distribute the amount of vaccines in Washington, the fundamental issue arises in which policy makes the choice of risk for the individual. The suspension should not be overlooked due to competing evidence that connects thimerosal exposure to severe neurological disorders. One review writes, "According to new research from Northeastern University pharmacy professor Richard Deth and

colleagues from the University of Nebraska, Tufts, and Johns Hopkins University, there is an apparent link between exposure to certain neurodevelopmental toxins and an increased possibility of developing neurological disorders including autism and attention-deficit hyperactivity disorder" [2]. Even though



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much speculation exists regarding this link, the research concluded that heavy metals such as thimerosal potentially interrupt critical factors to the proper brain development in infants [2]. This research also notes that compounds like thimerosal at vaccine concentrations effectively inhibited neurological stimulation [2]. Professor Richard Deth states, "Scientists certainly acknowledge that exposure to neurotoxins like ethanol and heavy metals can cause developmental disorders, but until now, the precise mechanisms underlying their toxicity have not been known" [2]. A study by the University of California Davis discovers for the first time, profound evidence that directly correlates thimerosal to neurological dysfunction. The study concludes that dendritic cells, which are the important components of neuronal function, "show unprecedented sensitivity to thimerosal, resulting in fundamental changes in the immune system's ability to respond to external factors" [4].

With compelling evidence that links neurological disorders to thimerosal contained vaccines, are the decisions of our leaders during this time of panic and vaccine shortage appropriate for the public? Should the Washington state department of health (WSDH) settle with thimerosal-vaccines -at the risk of inheriting lifelong neurological damage- to compensate

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**This ambiguity to discern which risks are important, leads to a fundamental issue in which policy attempts to handle these complicated decisions for the public.**

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the vaccine shortage? The WSDH is continuing to push this national immunization program despite the shortage and the research that links thimerosal-vaccines to neurological disorders. As H1N1 continues to spread, WSDH is not the only state department making controversial decisions for the public's well being.

The New York State Health Department will be the first to make seasonal and H1N1 vaccines mandatory for all hos-



pital, home health and hospice workers [5]. The 'No shot [vaccine] your fired' policy has caused outrage in local unions as they were not consulted before the policy was enacted [6]. "Health care workers on the front lines of providing care deserve the dignity and respect of thoughtful consideration before a regulation like this can just be rushed through and put into effect" stated George Gresham, president of New York's largest health care union, 1199SEIU United Healthcare Workers East [5]. Are public health care workers allowed to resist mandatory vaccinations despite that most US citizens don't believe the vaccine to be safe? According to a recent survey by Harvard's Department of Public Health, only 33% of the U.S. believed the vaccine to be very safe "generally for most people to take" [7].

The demand for vaccination remains high while distribution of the dose is continually low. Why has there been a shortage despite the promises made by the CDC? The CDC Control Director Dr. Thomas Frieden stated, "We'll have on the order of 40-plus million doses of various types of vaccine by mid October or late October," but production has fallen short of expectations by delivering only 13 million doses, due to production problems [8]. "I think they have done the best they could do, under the circumstances," said Dr. Randy Wexler, an assistant professor of family medicine at Ohio State University. "The CDC has no control over vaccine production" [8]. Some government sources blame vaccine shortages and delays on the manufacturers, saying they were being overly optimistic [8]. Regardless of who's to blame for the shortage, politicians are beginning to settle for the highly controversial thimerosal while forcing health workers to take the vaccine in hopes to slow the spread of pandemic.

In addressing the predicaments of pushing the H1N1 immunization program, we must not forget 1976's US National Influenza Immunization Program (NIIP). History reminds us that a nationwide vaccination can lead to severe adverse events such as Guillain-Barre syndrome (GBS) [9]. GBS is a rare immune disorder of the nervous system. Symptoms include paralysis and sensory changes [9]. One review discusses the aspects of the 1976 NIIP and correlates the well-documented association between GBS and flu vaccination [9]. The review indicates that "The consensus at the time [1976] was that the

number of GBS cases was in excess of background incidence, and although background data on GBS incidence were not firm, a political decision was taken to end swine influenza vaccination" [9]. The possible existence of vaccine related SAE's of 1976 serves as a valuable case study in addressing the concerns for implementing a national immunization program for today's H1N1 virus [9].

Both New York's and Washington's State Departments of Health have shown what lengths they will go to slow the swine flu pandemic. New York's policy of coercing health-care workers to take the H1N1 vaccine lays an intimidating foundation for other policies to follow. This political rationale suggests that during times of panic, institutions can implement radical policies that violate the freedom to make healthcare decisions for oneself. During such times, it important to have freedom to make healthcare decisions as there are risks involved with implementing mass vaccination policies, as noted with 1976's Guillain-Barre syndrome or neurological disorders linked to thimerosal [4,9]. At the same time, Washington's mercury limit suspension underlines another policy that compensates the vaccine shortage by settling with mercury contained vaccines that could cause more complications. By lifting the mercury limit, is Washington allowing precedence for more policies that could further complicate the ethics of 'immunization to protect with the risk of possible adverse effects' or are these policies appropriate to prevent further H1N1 related deaths.

The issues involved in promoting a national immunization program for H1N1 are controversial. That is, in order to slow the pandemic, vaccination is required with as many participants as possible. But, since people refuse to take the vaccine, government officials are beginning to force vaccination. There is no clear way to discern which risks are deemed admissible for the sake of public health, but it is clear that the public should understand all risks regarding the vaccine.. These recent policies highlight the need for government officials and the public to conduct individual research to understand the risks involved with the H1N1 the vaccine. ■

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# Romantic Roots: Shelley's Deep Ecology

Elizabeth Koebele

Scenes of introspective poets wandering through vast natural landscapes in search of meaning in an ultimately holy Nature characterize the Romantic period in England, a reaction against eighteenth century Enlightenment ideas. However, the life of one of the most prevalent Romantic poets, Percy Bysshe Shelley, paints a very different picture. While he, too, shared a deep commitment to nature, philosopher Alfred North Whitehead claims, "What the hills were to the youth of Wordsworth, a chemical laboratory was to Shelley" [1]. Shelley's youth was filled with scientific exploration, making him infamous for things such as burning holes in his Oxford dorm room with his chemistry experiments [2]. His enthusiasm for investigating scientific phenomena grew throughout his life, eventually providing the basis for his much of his writing. Many of Shelley's ideas, which intertwine ecological appreciation with literary expression, are now resurfacing in modern environmental movements. Advocates of sustainability, and particularly those who endorse an ideology called deep ecology, share ideas that Shelley promoted, which include recognizing the social and psychological implications of environmental consciousness and asserting the inherent value of nature.

Identifying the power of these cornerstone "green" concepts in literature is not only reviving interest in Romantic ideals, but is also rediscovering the mutually beneficial relationship between the sciences and the humanities.

One of Shelley's early lyrics entitled "Mont Blanc: Lines Written in the Vale of Chamouni" provides some of the most fundamental iterations of his ideas. "Mont Blanc" relates Shelley's encounter of the highest mountain in Europe in July of 1816 in the form of a mental journey. Shelley visually surveys the mountain, beginning with the "Ravine of the Arve" running under his feet as he stands on a bridge. He then ascends through the "piles around [Mont Blanc], ice and rock," whose only inhabitants are "the eagle [who] brings some hunter's bone / And the wolf [who] tracks her there." Ultimately, he reaches the summit: "Mont Blanc yet gleams on high:—the power is there / The still and solemn power of many sights, / And many sounds, and much of life and death" [3]. Only at this zenith can Shelley truly articu-

late the terrifyingly beautiful cycle of life and death that is so fundamental to natural processes, an idea that functions as the basis of his conception of the relationship between human and environment.

While Shelley makes myriad allusions to scientific concepts, some are particularly essential to understand his integration of environmental consciousness and literature, and how important this type of thinking is to our modern day behavior. Primarily, Shelley remains intimate with the natural phenomena surrounding him. He categorizes the setting in an almost phylogenetic fashion, creating the illusion of a journey not only physically "up" the mountain, but also one of evolutionary growth. He opens the poem by pondering how the "everlasting universe of things...rolls its

rapid waves, / Now dark—now glittering—now reflecting gloom" [3]. Here, Shelley metaphorically engages the concept of light in his poem as a guide and simultaneously alludes to contemporary speculations on the composition of light. Carl Grabo, a Shelley scholar, claims, "Shelley was either familiar with Newton's Opticks or later works derived therefrom," [2] which explore the idea that light is composed of particles rather than of

waves; yet, this issue became critical during Shelley's lifetime when the work of scientist Thomas Young, who discovered important gaps in Newton's theory, "erupted forth into the pages of periodic literature" [4]. Although Shelley is not known to have any firsthand experience in this area of physics, his application of such information in the poem provides a look into Shelley's methods: his knowledge of light serves as a guide through his poem, suggesting the importance of scientific principles a guiding factor in experiences of nature. Shelley exhibits a mystified consciousness of the things that make up the earth on even the smallest scale, which leads him on a quest to uncover their beauty and importance in the larger scheme of nature.

As a consequence of emphasizing this link between small and large, Shelley changes scale quite rapidly. As he continues his climb, he traces how the Arve cuts into the base of Mont Blanc, explaining how the water rushes down "From the ice gulphs that gird its secret throne / Bursting

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purely vacant, unimportant,  
or unworthy of care.”



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through these dark mountains like the flame / Of lightning through the tempest" [3]. This passage provides insight into one of Shelley's many "geology conscious" moments, where he pays particular attention to the physical features and underlying patterns in natural formations, portraying the as-

tonishing aesthetic qualities of the landscape.

Shelley's geological scope likely included works such as James Hutton's 1788 *Theory of the Earth*, which argues that the earth changes uniformly through processes that have always occurred and continue to occur today. Jonathan Smith, a literature and science scholar, suggests that this knowledge heavily influenced Shelley's perspective on his quest, making it inherently "a geological one, but [one] about catastrophic rather than uniformitarian forces" [5]. Similar to when Shelley reaches the summit of Mont Blanc, he recognizes the persistently morphing nature of the earth—a progressive geological stance for his time, yet one that is integral to most sustainability philosophies today. Shelley's background causes him to consider, and poeticize, factors such as the violent geological formation of Mont Blanc. He questions,

Is this the scene

Where the old earthquake-dæmon taught her young  
Ruin? Were these his toys? or did a sea

Of fire envelope once this silent snow? [3].

Shelley grapples with the origins of Mont Blanc by provoking a mythological scene that alludes to both seismic and volcanic forces. He first mentions the power of an "earthquake god"—perhaps the Roman god Vulcan of fire and volcanoes—as a possible source. However, Shelley secondarily questions if the cause is a more secular "sea of fire," connecting his allusions with more straightforward geological thought. Once again, Shelley employs his unique schema of scientific knowledge to move seamlessly from the massless, in his discussion about light in the first section of the poem, to the massive geological forces of earth.

Yet, why does Shelley include such scientifically oriented observations in his poetry? These insights into his ideas on light dynamics and geology are, after all, just a few of the references in this poem that display a distinct awareness of contemporary science and its place in his environment. Shelley's consciousness about these matters seems far more pervasive: the "science" of the mountain ultimately becomes the driving factor in "Mont Blanc." This phenomenon is exactly what makes poetry like Shelley's particularly integral to the science and culture behind the sustainability movement, where art can serve as a catalyst to the process of creating methods to better preserve the earth.

In order to illuminate this connection, we must begin with one of the most well-known definitions of sustainability. The "Brundtland definition" defines "sustainability" as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [6]. Although this definition seems focused on the future of human development, it contains an important facet: making a long-term effort to preserve the earth. Shelley's poetry addresses this idea and makes even more explicit connections to the sustainability movement by asserting the inherent value of nature. Best evidenced in the final lines of the poem, Shelley questions, "And what were thou, and earth, and stars, and sea / If to the human mind's imaginings / Silence

and solitude were vacancy?" [3]. Basically, Shelley wonders what may occur if humans continue to perceive anything silent—such as a mountain—as purely vacant, unimportant, or unworthy of care. Scholar Christopher Hitt makes the claim that what Shelley suggests “is that [recognizing this] ‘vacancy’ is the key to rediscovering ‘wonder’ or to behaving ethically,” [7] providing important insight into Shelley’s views about the planet and its preservation.

When compared to other Romantic poets such as Wordsworth, who was often accused of creating an anthropocentric, “egotistical sublime,” Shelley discovers agency in nature by assessing its qualities according to contemporary science and assuming that it inherently possesses a unique semiotic system capable of genuine communication. This type of thinking represents one of the core concepts of deep ecology, a term that has recently become familiar with the popularization of sustainability. Often used in opposition to terms such as “reform environmentalism,” deep ecology refers to “the process of grounding ourselves through fuller experience of our connection to earth.” Arne Naess, the Norwegian philosopher who first coined this term in 1972, promoted principles such as the intrinsic worth of human and non-human life, the value of diversity, and the need for political and ideological change devoted to the salvation of the biosphere [8]. In other words, deep ecologists support a “biocentric stance [that] may be understood as focusing evolutionary theory and the science of ecology onto the idiom of humanism to expose and overcome the unwarranted claim that humans are unique subjects and speakers” [9]. While this philosophy often works hand-in-hand with environmentalism and sustainability, it ultimately reaches beyond those ideologies—which often focus on sustaining the environment for human purposes by reversing harmful actions—to promote the idea that the environment is inherently worth protecting.

Thus, when Shelley refuses to force a linguistic system on nature and essentially makes it an independent character in his poem, he is articulating early ideas of deep ecology. Shelley’s question about nature’s vacancy promotes an ethical and ecological consciousness by accepting nature as a partner in human discourse, and works to recognize the depth and importance to its seeming vacancy rather than relegating it as something “lesser.” Ultimately, Shelley recognizes the mountain’s agency, and therefore, embraces a recognition, as well as a complete re-thinking, of the voice of Nature.

We can now see how Shelley’s knowledge of contemporary scientific issues leads him to a unique understanding and appreciation for nature. Shelley’s science gives him the ability—and perhaps the encouragement—to take a closer look at his environment, to wonder how things work for nature’s sake and not simply for what they mean to humans. Yet, the eloquent way in which Shelley weaves these ideas into his poetry goes beyond simply creating art. It has the power to inspire and impassion those scientists and advocates who possess the knowledge to create more sustainable ways of living. Jonathan Bate, in a particularly stunning passage from *The Song of the Earth*, summarizes the deep connections between artistic appreciation and recognizing the inherent importance of nature:

When we contract ourselves to respond sympathetically to an artwork, we are following the same logic as when we let ourselves go and inhale a breath of fresh air in the park or the country. Even as it is a cry against the commodification and instrumentalization that characterize modernity, contemplation of the beauty of art and nature is a strong and necessary deed [10].

While the rift between the humanities and the sciences has drastically widened since the Romantic Era, we can see direct ties back to thinkers such as Shelley, who seamlessly integrated these two disciplines to create unique, informed ideas about the world. Shaped by both his distinct scientific background and his Romantic sensibilities, Shelley questions the real dangers that could arise from continuing to enlarge this disciplinary divide, such as perceiving our natural surroundings as vacant, potentially leading to the collapse of our ecosystem. Shelley’s science obviously influenced his own poetry, and in turn can work to inspire those with the power to transform human treatment of the planet, whether they are scientists, those with a passion for the environment, or even those without one yet. Thus, by examining examples such as Shelley’s of the ways in which science and the humanities mutually inform and influence each other’s agendas, we can earnestly further our own quest toward discovering the inherent value in our natural world and devising the best methods to protect it. ■

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# When Language Is Not The Barrier: Assessing Communication in Health Care

Joshua Niska

In the current effort towards health care reform in the United States, a central question has been largely overlooked: If we strive to extend healthcare to all Americans, to what medical perspectives and practices should patients have access? The U.S. medical system has only begun to define the range of diverse acceptable practices and understandings in medicine. Currently, two quite different groups of healthcare providers co-exist. The first group, which will be denoted as allopathic, includes providers within mainstream medical practice, often referred to as Western, allopathic, peer-reviewed, or evidence-based. With allopathic medicine as the dominant medical model in the United States, healthcare providers seek to extend the best possible medicine to all people affected by illness regardless of culture. This can sometimes result in an ideological clash between allopathic medicine and a second group comprised of traditional, complementary, and alternative medicines (TCAM). TCAM includes practices not in the mainstream of the American and allopathic medical establishment, including cultural, traditional, indigenous, complementary, and alternative medicines. By encompassing all non-allopathic medical practices, TCAM embodies a health paradigm vastly different from allopathic medicine [1]. In order to reach the best health outcomes, physicians must communicate effectively across cultures and strive to integrate the perspectives and practices of patients' cultural healing traditions and the allopathic care of the mainstream medical establishment.

When cultures with health paradigms that vastly differ from the allopathic ideology interact with the mainstream medical establishment, the complexity of communicating across allopathic and cultural medical traditions becomes apparent. Research at the Columbia University College of Physicians and Surgeons estimates the usage of complementary and alternative medicine in the U.S. population at between ten and fifty percent [2]. Dr. David M. Eisenberg of Harvard Medical School reports 42% of people in the U.S. use medical practices outside the mainstream [3].

In developing nations, the figure rises to about 80% [1]. Even more, reports have suggested that the utilization of non-allopathic medicine grows at a rate near 30% per year [4]. In order to better treat patients who seek TCAM treatment while also receiving allopathic care, physicians have made efforts towards the understanding of alternative methods of healing. For the purposes of this paper, further analysis will focus upon efforts to understand and work with traditional and cultural medicine rather than the broader spectrum of TCAM.

Due to the increasingly common occurrence of interactions across medical traditions, medical education and practice in the U.S. emphasize complementation and respect for the medicine of diverse cultures. Efforts to understand diverse healing modalities and cultures have led the American Association of Medical Colleges to establish guidelines for "cultural competence education" [5]. Despite efforts for better understanding, mere respect towards the cultures of patients may not be enough to provide the best care. By allowing alternative medicines to complement their own allopathic medicine, physicians assume coexistence of various forms of medicine. Under some circumstances, physicians

could improve medicine for culturally diverse patients by building a new understanding of diverse medical practices and integrating successful aspects of each medical tradition to synthesize a new and truly integrated medical paradigm with better results. This integrative approach towards the treatment of culturally diverse patients has already shown initial success in Merced, California, where Hmong shamans work closely in the hospital with medical doctors [6]. Although respect and understanding towards various cultures and integration of the healing traditions of a patient's culture can improve patient care, first-hand accounts of interviews among the indigenous population of the Ecuadorian Amazon, as well as the current medical literature, demonstrate that understanding differences in communication across cultures comprises another important piece of patient care for diverse populations.

**Once physicians have a clear grasp of the best strategies by which to communicate with patients of different cultural backgrounds, they can approach how to integrate allopathic medicine and cultural healing traditions.**

Researchers at the Andes and Amazon Field School of Arizona State University conducted interviews among the Quichua people of Ecuador that illustrate the complexities of communicating across cultures. The following two first-hand accounts provide illustration of the efforts to survey the Santo Urco community.

This morning we worked on the questionnaire we will use for the census and other data collection. [...] We added questions regarding the last illness in the family. What was the illness? Did the ill family member see someone for treatment? If so, who did the person see for treatment? How much did he or she pay for services and medicine? The data resulting from these questions may prove to be useful. The methodology for the questionnaire is mostly from Dr. DeWalt's previous published research.

The most interesting encounter of the day was an impromptu interview with Mama Carmen. We were trying to figure out how to survey the community's opinion of the various medical services available to them. Dr. DeWalt has experience in surveying communities, and she thought a visual analog scale [Figure 1] might work with the Quichua. In order to test the method before adding it to the questionnaire, we asked Mama Carmen to answer some questions for us. When comparing yachaj [shamans], pharmacists, nurses, doctors, and curanderas [folk healers], she simply told us that they were all great and placed an "X" directly between "muy malo" and "muy bueno" on our linear scale. She also rated all of them ten on a one-to-ten scale. However, when we probed deeper for whom she would [actually] see for help when ill, we received a wealth of opinion through conversation and narrative.

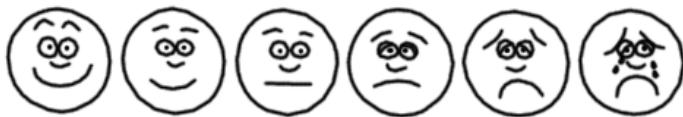


Figure 1. A visual analog scale. Reproduced from [7]

Following the creation of the census form, researchers tested it during the first census interview within the community. The following account demonstrates the difficulty found in quantifying Quichua opinions.

Today we conducted our first census interview. The questionnaire we filled out was the existing questionnaire Dr. DeWalt has previously used because we are still in the process of revising and adding questions. We still have not figured out how to ask opinion questions, so we [again] tested the visual analog scale on the woman we interviewed. She did not grasp it any more than Mama Carmen and still rated everything nearly identical despite her preferences that were apparent in conversation.

Through the interviews, the researchers aimed to formulate an effective method for surveying the community's opinion of medical services available to them. However,

communicating through traditional American surveying methods proved unsuccessful. Unsuccessful attempts to use a visual analogue or one-to-ten scale in the community showed the difference between American notions of communication and the communication styles of other cultures. The quantitative lens through which Americans learn to view the world shaped the researchers' methods of communication. To the surprise of the researchers, following unsuccessful attempts at traditional surveying methods, when questioned further, the community members expressed strong preferences through conversation and narrative.

The results from surveying the Quichua parallel the findings of a recent study on the diagnosis of depression in people of different cultures. The study found that although physicians can effectively diagnose patients of similar cultural backgrounds, depression in many minority patients goes undiagnosed or misdiagnosed. During interactions with minority patients, the use of "dialogue about patients' illness narratives and social context are crucial" [8]. Due to the various means of expression used in many cultures, physicians may miss an important piece of the answer to the patient's illness without the use of dialogue. At the same time, physicians should not profile patients in attempts to understand their cultures and communication styles. Physicians need to be aware of their own conceptions when evaluating patients. For example, several physicians in the study reported a "suffering woman" of Middle Eastern descent. In their attempt to use their intuitions to diagnose the patient, they misconstrued the different cultural gender order of Middle Eastern culture to indicate suffering by the woman. The manner in which the women interacted with the physicians was reflective of Middle Eastern culture norms rather than the mental health of the women. In the end, physicians in the study made the correct diagnosis despite their biased observations [8]; however, other studies discuss misdiagnosis due to misconceptions regarding Middle Eastern culture [9].

Once physicians have a clear grasp of the best strategies by which to communicate with patients of different cultural backgrounds, they can approach how to integrate allopathic medicine and cultural healing traditions. Despite patients' apparent desires for physicians to treat them with allopathic medicine, many patients also display the desire to maintain traditional indigenous healing practices, as demonstrated by the following first-hand experience.

The physician guiding our tour of the hospital told us the hospital staff must honor cultural beliefs regarding snakebites, such as a ban against pregnant women in the presence of snake bitten people; regional cultural belief asserts that if a snake bitten person sees a pregnant woman, the snake bitten person will experience tremendous swelling. We saw an elderly woman who a snake had bitten. She waited to come to the hospital for more than a week



Reproduced from [12]

after the bite occurred and her leg became terribly infected. She sat in the crowded hospital room with minimal anesthesia while a nurse cut necrotic, infected skin off her ankles and feet. The nurse bandaged the wounds, and we left the room before I could see whether the staff sent her into surgery. The old woman was clearly native, and I could not help but wonder whether she had waited to come to the hospital because she was relying on shamanistic medicine [alone]. Judging by the advanced nature of her wounds, utilizing the hospital was clearly her last ditch effort.

Although an isolated incident, the woman who arrived at the hospital in Ecuador hoping to receive treatment for her leg exemplifies a common occurrence in medical systems worldwide. Many patients use medicine familiar to their cultural heritage until the traditional treatment clearly fails, necessitating a different approach. Such patients largely turn to the approach of allopathic medicine. However, while hoping for allopathic medical treatment, patients want to preserve their cultural identities and viewpoints. The benefits of an approach involv-

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ing communication between patients and their allopathic physicians and cultural healers can be illustrated by an experience with the illness of a young Ecuadorian boy.

After our conversation with Bartolo, we made a house call in which Dr. Agosta was to collaborate with him. The patient was a young boy with a fever and four ulcers on his left leg. The ulcers started a week ago when the boy thought he was bitten by bugs. In the U.S., Dr. Agosta would give oral antibiotics and topical antifungal in order to treat the ulcers. However, [after discussion regarding how to approach the boy's treatment], Bartolo treated the boy using natural remedies. Bartolo collected leaves of aji del monte, yagu caspi, caballo kiwa, veneno leaf, chilco, and chilluayusa, which acts as a painkiller and fever reducer. He also used the pulp from the chilco stem. In a plantain leaf, the six ingredients were mashed, mixed, and cooked. After cleansing the ulcers with the juice of leaves called mountain soap, Bartolo applied the cooked juices of the plants he picked, while the boy held his foot over a large leaf. Later, he will give the boy the powder of the six plants he picked to apply to his ulcers. Bartolo will also make churiyuyu tea, of which the boy will take a teaspoon three times a day.

The boy was [initially] very hesitant to show us his sores. When first asked how he was doing, he responded that he was fine and had nothing beneath the bandage on his leg. However, after Bartolo [spoke to him, he] removed the bandage from his leg, [and] the boy opened up to us. He has lived with his grandma for almost a year, and he often does not have breakfast, lunch, or dinner. Walking is painful for him. The school year is ending at his high school, and he is missing exams, because he cannot make it to school with his ulcers. The boy may even be held back because he is missing all of his exams.

A week following his treatment by the shaman and

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## Tolerance and ‘cultural competence’ alone will not yield the best medical outcomes for patients.

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the allopathic physician, the boy’s ulcers had almost completely healed and he was ready to return to school. In this instance, the shaman took the lead, but communication between physicians and cultural healers determines the best path to take on a case-by-case basis. Not only broader treatment options but also greater comfort levels result when patients receive collaborative care from physicians and cultural healers who speak their languages and are recognizable as caregivers in their cultures.

Even when the healing modalities of allopathic and cultural medicine approach a level of integration, physicians may still find difficulty approaching patients of different cultural worldviews. Health providers from allopathic backgrounds often use different communication styles than do providers of cultural medicine. While in allopathic medicine the therapeutic relationship between physician and patient may play a minor role in comparison to the goals of diagnosis and treatment [10], the therapeutic relationship represents a central focus of alternative medicines, including cultural healing traditions [11]. Dialogue and narrative play a major role in such a therapeutic relationship. American reliance upon surveying techniques, such as a one-to-ten rating, often may not produce accurate results. Alternative methods of communication may be necessary to facilitate communication with patients from worldviews apart from the perspective adopted by allopathic medicine. In order to provide effective treatment, even treatment personalized to the patient’s own cultural identity, physicians must understand the manner in which worldviews other than their own communicate. Once physicians establish lines of communication, successful integration of cultural healing traditions and allopathic medicine may be possible. Lessons

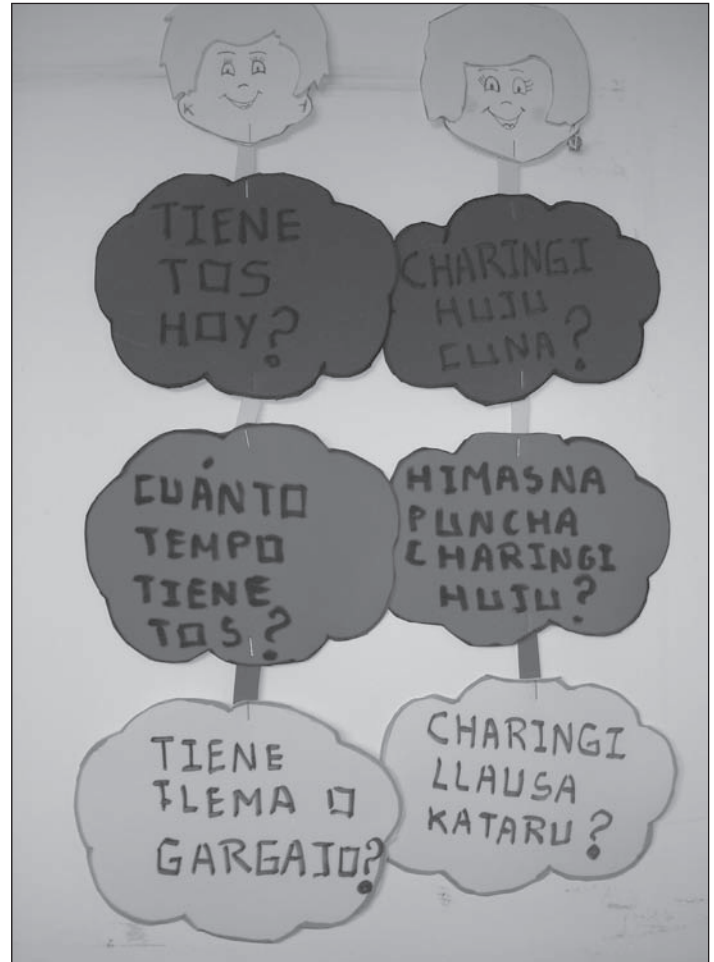


Photo by Joshua Niska

learned from Ecuador’s effort to provide healthcare to a multilingual, multicultural population may serve to inform the United States in its struggle to provide the best healthcare possible to all members of society, regardless of culture and medical beliefs. Tolerance and “cultural competence” alone will not yield the best medical outcomes for patients. By communicating effectively with patients and their cultural healers and striving to include the patients’ own healing traditions, physicians can provide the best possible care to all patients. ■

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# Reclaiming Our Waste, Reclaiming Our Water: The Case for Composting

Vanessa Kiernan

**I**f I urinated and defecated into a pitcher of drinking water and then proceeded to quench my thirst from the pitcher, I would undoubtedly be considered crazy. If I invented an expensive technology to put my urine and feces into my drinking water, and then invented another expensive (and undependable) technology to make the same water fit to drink, I might be thought even crazier. It is not inconceivable that a psychiatrist would ask me knowingly why I wanted to mess up my drinking water in the first place [1].

So begins the foreword to the 1978 book *The Toilet Papers: Recycling Waste and Conserving Water*. Although it is primarily a how-to manual for people wishing to build their own composting toilets, the author also devotes a significant amount of space to why anyone should want to do such a thing. Composting toilets are a hard sell to those of us in living in the modern world. The flush toilet has become so ubiquitous and so integral to the basic infrastructure of our society, it has become virtually synonymous with civilization itself [2, 3, 4, 5]. Yet the flush toilet and its accompanying sewer systems are arguably the single most wasteful and destructive technology ever devised prior to splitting the atom. Both the quality and quantity of potable water on our planet is steadily decreasing, and our waste disposal systems are largely, if not entirely, to blame. As the subtitle of *The Toilet Papers* suggests, recycling human waste and conserving water are two sides of the same coin; if we are concerned about the latter, then we must undertake the former.

But first, we should inquire into how our current infrastructure of flush toilets and sewers came to be. How did we find ourselves saddled with a “sanitation” system that appropriates billions of gallons of water every day for the mere purpose of carrying away our waste and collecting it in enormous billion-dollar treatment plants that then spend billions of dollars attempting to separate the waste from the water? Were there any historical competitors to the flush toilet and water-based sewer systems? If there were competing technologies, why were they not adopted? And why is any alternative method for dealing with the end product of our metabolism now practically inconceivable?

To answer these questions, we must begin with our ideas about water itself. Or, more specifically, with our historical mis-

conceptions regarding the nature of water. Not so very long ago, “[r]unning water [was] presumed to purify itself,” therefore, it “was not considered to be at serious risk from sewerage” [6]. This notion seems incredible to us today, given all we know about the dangers of contamination and water-borne diseases, but “[r]ivers carried things away . . . a bucket of slops thrown into the current would (appear to) disappear; so too a pail of urine. When people were few and discharges were limited, rivers seemed capable of absorbing and removing items thrown into them without suffering irreparable harm. . . Moreover, because all rivers eventually run to the sea and the sea is enormous, it is not difficult to regard the assimilative capacity of the hydrological system as infinite” [7]. Add to this the fact that we have since time immemorial used water to wash and cleanse everything from the food we eat to our own bodies, and the

subsequent extrapolation that water can wash and cleanse itself, while devastatingly erroneous, no longer seems quite so patently absurd.

The problem, however, is not only that we were wrong about the self-purifying abilities of water, but that we continued to treat water as if it was self-purifying long after the accumulating evidence made clear that it is not. The technological momentum behind the long-accepted waste-management

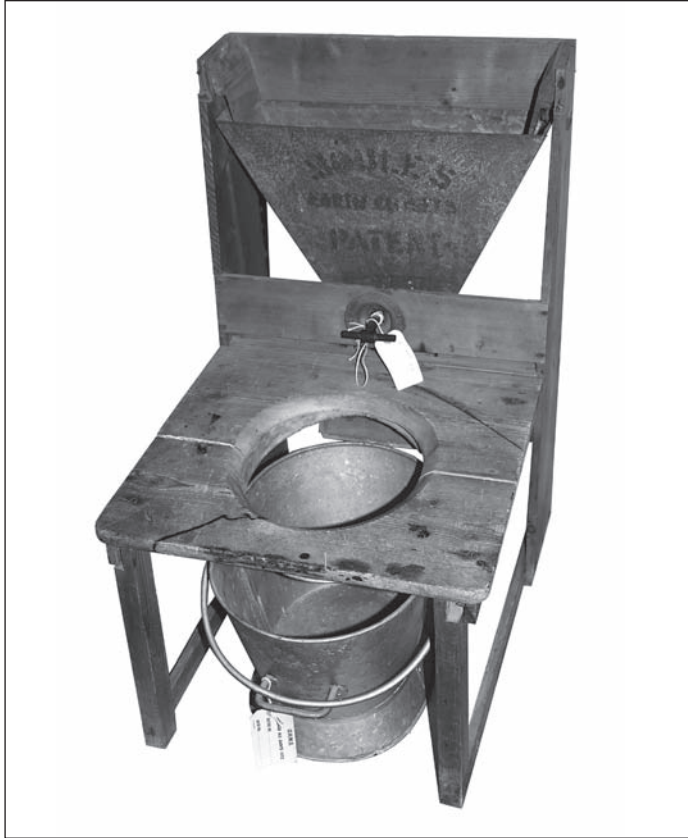
system of dumping refuse into large bodies of water was so great, by the time it revealed itself as a serious health and environmental issue due to the twin factors of massive increases in urban populations and industrialization, we had already passed the point where we could even imagine doing it any other way. By the mid-19th century, the common belief “that it was the function of a ‘public river’ to carry off waste” had been in many places legally validated and defined. The rapidly escalating degradation of streams, rivers, and their surrounding ecosystems was heartily lamented by many Industrialization-era poets and wilderness advocates, but even in their laments they seemed to view such destruction as the unfortunate but ultimately unavoidable price of civilization and progress [6]. “The solution to pollution is dilution” became the guiding motto of sanitation engineers from the 1800’s well into the 1980’s, with some still stubbornly adhering this maxim today [5].

There is no doubt that sanitary conditions in the 19th century were less than desirable in the best of cases, and downright

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**Recycling human waste and conserving water are two sides of the same coin; if we are concerned about the latter, then we must undertake the former.**

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horrific in the worst. Cholera, typhoid, and dysentery were constant problems for all large population centers in the 1800's. Cholera alone killed hundreds-of-thousands worldwide, with massive outbreaks occurring in Paris, New York City, Havana, Quebec City, and Sacramento, just to name a few [2, 5]. But it is London's rash of cholera epidemics that is perhaps the most famous illustrative example of the worst-case scenario; the single most deadly outbreak in 1849 killed 15,000 [5]. It was also London that suffered through the unendurable stench of a summer in 1854 that is still referred to as "The Great Stink." The Thames had become so polluted, and the mere smell of it so overpowering, it actually drove people to emigrate from the city and prevented Parliament from holding session [2]. Sadly, despite the deaths of many tens-of-thousands of individuals from cholera, it was "The Great Stink" that finally caused Parliament and the Victorian elite to admit something had to be done about the sewage situation. "[T]hey appointed Joseph Bazalgette, a noted civil engineer, to create an entirely new sanitation system." Bazalgette's brilliant and "entirely new" plan? "[Send] the sewage much farther downstream than ever before" [2].

Sim Van der Ryn notes that "[e]very tenderfoot camper knows not to shit upstream from camp" [8]. Part of the trouble with Bazalgette's system, of course, is that it fails to take into consideration the basic fact that there is no town or city in existence that is not upstream from someplace else. In simply dumping London's sewage farther outside the city limits, Joseph Bazalgette merely shifted the sanitation, health, and environmental problems onto the shoulders of downstream communities such

as Beckton and Crossness [2]. But this is indeed only part of the trouble. It is a 'surface' trouble born of a far deeper and more radical trouble, namely our use of water as a dumping ground and waste disposal system in the first place.

Thankfully, we have come to realize that it is simply not a good idea to flush raw sewage directly into our lakes and rivers. But what do we do, then, with all that sewage? We "treat" it. We use an enormous variety of giant filters, centrifuges, mechanical aerators, and potent chemicals to separate from the water that which we intentionally put into it. And the irony is that at the end of this ridiculously expensive "treatment," we are right back where we started. Well, almost. We now have solid stuff and liquid stuff once again, but they are very different from the ingredients we started with.

The solid stuff is now called "sludge," or sometimes "bio-solids." But this sludge has been corrupted beyond any recognizable relation to bios. It now bears only a passing, odiferous resemblance to the fecal matter that first entered the sewer system, and it has become dangerously contaminated with the toxins and inorganic compounds present in everything else that winds up in our sewers, both legally and illegally: laundry and dish detergents, drain cleaners, bleach, motor oil, paint and paint thinners, pharmaceutical compounds, heavy metals, and a shocking assortment of industrial chemicals [5]. The liquid stuff, the newly "decontaminated" "water," has been heavily dosed with chlorine to kill microbes and bacteria, infused with sodium hypochlorite for odor control, and injected with sodium bisulfite to neutralize the chlorine [2]. Most of the inorganic compounds get concentrated in the sludge, but the "treated" "water" also contains not insignificant amounts of these potent toxins. The "water" coming out of even a state-of-the-art sewage "treatment" plant is so chemically laden it can eat through metal grating [2]. Additionally, most of the nitrogen and phosphorous present in our urine and feces winds up in the "water," not in the sludge. High concentrations of nitrogen and phosphorous in the rivers, lakes, and harbors receiving "treated" "water" cause algae blooms and the overgrowth of certain aquatic plants. The overgrowth uses up the oxygen supply in the water, which kills off the animals and other plant species living there [8]. So now, after this long and enormously expensive process, the "water" more closely resembles a kind of chemical soup than water-as-such, and we still have this huge amount of solid material, the toxic sludge, to dispose of.

The most common ways to dispose of sludge are either incineration, or dumping at sea. Despite increasing bans against ocean dumping, many cities and countries continue to do it, either illegally or by applying for waivers. The city of London was still dumping its sludge in the ocean up until 1998, when it was finally forced to conform to the European Union's ban on such practices. London now uses the incineration method, which produces large amounts of methane and other "greenhouse" gasses [2]. A small percentage of sludge is put to use as fertilizer. This would be the perfect solution if it were not for the presence of toxins and industrial compounds in the sludge. It is possible, through the application of lime, to maintain a particular pH balance in the soil "that binds the toxins

in the ground, keeping them from moving up to accumulate in plants or the animals that eat them, or down to accumulate in groundwater.” That’s all well and good so long as there is someone available and willing to apply the lime and monitor the pH balance, but what happens if the farmer or landowner is negligent? What happens when the farmer retires? Or sells the land to a development company? [5].

Our only way out of this dilemma is to stop using water as a means to store and transport waste. I say “store and transport” because that is all water really does. It does not eliminate waste. It does not actually dispose of it. And while water is a fairly efficient means of moving waste around from one place to another (unless you need to make it move uphill), as a transport and storage medium for human excrement it is an exceptionally poor choice. Remember the cholera outbreaks mentioned earlier? It was, ironically, the very use of water-based disposal systems and the resulting contamination of the water supply that led to the epidemics of water-borne disease so prevalent in the 1800’s. Fecal matter does not decompose in water; it just sits there. And any bacteria, virus, or parasite present in the

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fecal matter is now present in the water. The water “gives the bacteria feet [8],” as it were, and the sewer becomes a breeding ground for infectious diseases. It is only through a combination of increased vigilance concerning the separation of sewer lines and water supply lines, vaccinations, and the liberal use of harsh chemicals such as chlorine that we have been able to keep many water-borne illnesses in check. We must take vaccinations into account because chlorine, as powerful as it is, is completely ineffective against viruses like hepatitis and polio, which can survive a full “treatment” unscathed [8].

It is a testament to the power of technological momentum that early sanitation engineers such as Bazalgette felt that the solution to the problem of water-borne disease was more flush toilets and more sewers. There were some who saw the irrationality in what was occurring, but their suggestions and warnings went largely unheeded. And their inventions, sensible and viable alternatives to the flush toilet like Henry Moule’s ingenious Earth Closet, were relegated to the forgotten dustbin of history.

Educated at Cambridge, Henry Moule was a barracks chaplain and evangelical minister in Fordington, Dorset. Ac-

ording to the brief biography compiled by Michael Russell, a Fordington parish clerk whose duties include chronicling the area’s history, Henry Moule “decided his cesspool was intolerable and a nuisance to his neighbor, so he filled it in and instructed his family to use buckets.” The buckets were emptied into a shallow trench and the contents promptly buried. Apparently by accident, Moule discovered some 3 or 4 weeks later that “no trace of the matter could be detected.” He then promptly set about turning his discovery into a marvelous little invention called the Moule Earth Closet, which he patented in 1860 [9].

The Earth Closet commode was very similar in its design to the water closets of the day, but the tank held dry, sifted earth instead of water. When the lever was pulled, a measured amount of earth was deposited on top of the contents in the receptacle. The receptacle itself was actually large drawer in the base of the commode. When the drawer was full, it was removed and its contents added to an existing compost pile. The finished compost itself could be used as fertilizer or recycled and used in the tank. The system was odorless because it “employed the oxidizing effect” necessary for proper, odorless decomposition, a process facilitated by the circulation of air through dry earth, ashes, or other carbon-rich material [6]. Correctly perceiving that water “neither absorbs nor effectually deodorizes,” but is merely a vehicle for removing sewage from one’s immediate vicinity [10], the Reverend Moule became an indefatigable advocate for and promoter of dry-earth systems as the one real solution to the health crises of his day, publishing several lengthy pamphlets on the subject [6, 9].

Moule knew nothing about disease-causing pathogens, of course. Germ theory was still new and was not well known outside the small circle of scientists actually working on it, but the insight that led him to link the cause of disease to sewers and cesspools was one of sheer brilliance. What Moule also could not have known is that his belief in the cleanliness of composting would be verified by science over a century later. We now know that the center of a composting pile reaches temperatures between 150° and 160° Fahrenheit, high enough to kill even hepatitis and polio [5].

Moule also recognized the potential and not insignificant economic value of all that manure being flushed, literally, down the toilet. He managed to persuade a neighboring farmer to plant two batches of swedes (rutabagas to those of us in the US), one fertilized with earth cycled five times through his composting toilet, and the other fertilized with an equal amount of superphosphate. The swedes “nurtured in earth manure grew one third bigger” [9]. J.J. Rowley, a British commentator and contemporary of Moule, was similarly vexed by what he saw as the sheer absurdity of sending ships “thousands of miles across the Atlantic” at enormous cost “to scrape up guano from the Peruvian islands of Chicha in order to support vegetable cultivation” in England when they already possessed an inexhaustible supply of readily available and “better-quality” manure right in their own backyards. Rowley was so passionately devoted to the earth closet cause, he once declared in 1880 that “[t]he only... proper way to dis-

pose of the sewage of towns is to make none" [6].

So why was the earth closet never adopted? And, perhaps even more intriguing, why does a contemporary book claiming to be "a social history of the toilet" not contain a single word about either earth closets or composting toilets[3]? Why does another book, considered one of the most comprehensive histories ever written on the subject of toilets, devote only a single page to the earth closet, and then only to poke fun at it and marvel at how anybody could have thought such a system would ever catch on [4]? The technological momentum favoring water-based systems can explain much. The long-standing practice of using rivers to dispose of waste was already something of a cultural habit, and much of the sewage and drainage infrastructure was already in place long before Bazalgette ever appeared on the scene. But Dave Praeger makes a compelling case for the influence of Victorian morality in the wide-spread adoption of the flush toilet system.

So-called fecal aversion – the instinctive separation of feces from where one eats and sleeps – is apparently natural and is exhibited by many animals. The Victorian upper class, however, in their radical denial of the body "went far beyond fecal aversion," converting a natural instinct into a moral mandate, and thereby converting what had previously been only a physical threat into a social and moral threat as well. "[T]he influence of Victorian etiquette," Praeger writes, "is inseparable from the infrastructure" of flush toilets, which were specifically designed to facilitate the denial of the existence of feces. When the upper classes pushed for sanitation reform in wake of "The Great Stink," flush toilets were considered the only civilized option by those who happened to be holding the purse strings. Under the banner of sanitation reform, the dissemination of flush toilets among the "unwashed masses" likewise resulted in the dissemination of elite Victorian moral judgments and ideology [5].

Praeger may be on to something. Today, when we hear the words "composting toilet," our first reaction tends to be one of knee-jerk disgust. What is the mental image that comes to mind when you think of a "composting toilet"? Does it involve flies and filth? Is it accompanied by an imaginary odor? These associations stem from our experiences with cesspits, outhouses, privy vaults, and the modern chemical pit toilet, where "dark, damp conditions... promote rot and stench, not organic digestion" [5]. A properly maintained composting toilet is altogether different. It is perfectly sanitary and odorless – a fact I can personally attest to from having used more than

one composting toilet during my time as a volunteer on organic farms – but few of us would even be willing to entertain the notion of using a composting toilet unless we had no other alternative. Even when we hear about composting systems being implemented in Third World countries, we tend to think of them as stop-gap measures meant to suffice only until the area develops the means to implement a "properly civilized" flush toilet and sewer infrastructure [2].

The "dirty" truth we must face if we are to clean up our water supply and rehabilitate our land is that the very concept of "waste" is socially contrived. "[P]oop actually marks humanity's position in the circle of life – our feces and our urine are only 'waste' when we waste them" [5]. "Nature admits no waste. Nothing is left over; everything is joined in the spiral of life" [8]. Cholera epidemics, ocean dead zones, depleted soils injected with petroleum-based fertilizers – all these result from our attempts to remove ourselves from the circle. "[I]t is possible to quit putting our so-called bodily wastes where they don't belong (in the water) and to start putting them where they do belong (on the land). When waste is used, a liability becomes an asset, and the very concept of waste disappears" [1].

Even if people can accept composting toilets psychologically, however, the question remains whether it is possible to implement a composting toilet system on a large scale in our modern urban population centers. One can imagine a system similar to our current garbage collection system [6]. Many places already have curbside pickup for a variety of other recyclable materials, why not this one as well? But would composting systems really work in such densely concentrated population centers as New York City? I do not know. I think we may first need to answer the question of whether a city the size of New York is sustainable under any circumstances. But, to bring the question to my own doorstep in Arizona, I am quite confident that it is impossible to maintain a population of 3 million in a desert valley without large quantities of water pumped in from hundreds of miles away. I am equally confident that if we do not find a way to stop misusing our water supplies sooner rather than later, the questions of whether it is possible to implement a large-scale composting system and whether such a system can adequately support the sanitation needs of such a large population will be rendered moot. ■

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# The Microwave: A Friend or Foe in the Kitchen

Jessica Wong

**A**fter coming home from a long day at work or school, many people turn to the microwave as a way to save time in the kitchen. The speed and ease of heating food with a microwave remains unrivaled by any other method. However, some websites and research do indicate that using the microwave may be the wrong choice. But before we make a choice, we need to know what distinguishes the microwave from other cooking devices and what happens to the condition of microwaved food?

## How Microwaves Work

Inside microwaves, there is a magnetron that produces micro-

wavelength radiation at about 2.45 gigahertz. Micro-waves heat food via two concurrent mechanisms, dipolar polarization and ionic conduction. Molecular dipoles align with the external electric fields by rotation. With exposure to micro-waves, and, an oscillating electric field, the molecular dipoles in the food oscillate and create heat through molecular friction and collisions. In contrast,

ionic conduction involves the electrical field from micro-waves; ions in the food move towards like charges, which also increases the rate of molecular collisions and heat generation [1].

## Heat Spots in Microwaved Food

In comparison to a conventional oven, which heats food by heating the surrounding air, the heating of food in a microwave is caused by the previously described alternating electromagnetic field. Because the electromagnetic field from the micro-waves is not distributed evenly in the microwave, the food is heated unevenly. The uneven heating is also due to the differences in the characteristics of the microwaved food including quantity and composition. For example, food with higher water or salt content would have greater heating at the surface because they absorb more microwaves while decreasing the depth of penetration of microwaves. This leads to the formation of hot and cold spots in microwaved foods, which brings up concerns

regarding microbiological food safety issues. However, this can be resolved by mixing the food during the microwaving process and letting the food sit after microwaving to allow the heat to distribute evenly [4].

## What does Microwaving do to what is Microwaved?

In Oklahoma, there was a 1991 lawsuit for medical malpractice because a hospital administered microwaved blood for blood transfusion and consequently killed the patient. Typically, transfusion blood is heated using other methods and thus, the microwave may have altered the blood in some way different from traditional heating methods. This lawsuit has caused much concern

regarding the use of microwaves. If the microwave altered the blood of this patient, it could potentially be altering the food we microwave. However, the convenience of the microwave has led to its increased usage to warm food throughout the years. [5].

Dr. Hans Ulrich Hertel was one of the first scientists who studied the effects of consuming microwaved food on consumers, using

milk and vegetables as test materials. These consumers were given the same milk raw, conventionally cooked, pasteurized and microwaved at separate intervals. They were also given the same fresh vegetables raw, conventionally cooked, defrosted in a microwave and cooked in a microwave at separate intervals. Before and after these foods were consumed, blood samples of the consumers were taken to monitor any changes. Monitoring levels of hemoglobin and cholesterol in the blood showed a decrease in both after the consumers ate the microwaved food. There was also an observed increase in the number of leukocytes, or white blood cells, which is often a sign of damage to the body. This occurred only after the consumption of the microwaved food [6].

## Micro-wave Leakage from Microwaves

There has also been concern as to whether microwaves leak micro-waves and if the amount leaked is harmful to humans.



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The Food and Drug Administration (FDA) limits the amount of micro-wave leakage from microwaves throughout its lifetime to five milliwatts (mW) of microwave radiation per square centimeter at two inches from the surface. As you move away from the microwave, the amount of micro-waves from leakage decreases dramatically. There is also a required lock system to stop the production of micro-waves when the door of the microwave is opened. However, there has been little research on long-term exposure to these levels of micro-wave radiation on humans. Research on micro-wave exposure in mice has been performed but it is not certain how this would relate to micro-wave exposure to humans [7].

The limited research that has been performed has shocked the public. The symptoms of micro-wave exposure include fatigue, headaches, palpitations, insomnia, skin symptoms, impotence and altered blood pressure. All of these symptoms and have been termed 'microwave sickness'. In



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one such study, Sadicikova of the Academy of Medical Sciences studied two groups of people who worked with micro-waves of a frequency in the gigahertz range. One group of 1000 workers was exposed to a 'few mW/cm<sup>2</sup>' and another group of 180 workers experienced exposures of no more than several hundredths of a mW/cm<sup>2</sup>. A control group of 200 workers with no micro-wave exposure was included as well. The three main symptoms present were neurological (tiredness, irritability, sleepiness and partial loss of memory), autonomic vascular changes (sweating, dermographism, blood pressure changes), and cardiac changes. Tiredness affected forty-five percent of those exposed to a few mW/cm<sup>2</sup>, fifty-five percent of those exposed to several hundredths of a mW/cm<sup>2</sup> and only ten percent of the control group. There was not a large difference between the two levels of exposure but those with

over five years of exposure had more symptoms than those with less than five years of exposure [8].

In a separate study performed in La Nora, Murcia, Spain, exposure to wavelengths between 400MHz – 3 GHz and a power level of 1uW/m<sup>2</sup> was examined. After adjusting for sex, age and distance from the source of the radiation, researchers found a statistically significant positive dose – response association with fatigue, irritability, headaches, nausea, loss of appetite, sleeping disorder, depressive tendency, feeling of discomfort, difficulty in concentration, loss of memory, visual disorder, dizziness and cardiovascular problems [9].

Another research study performed in Russia gave similar results but also observed an increased rate of cancer cell formation in the blood as well as an increased rate of stomach and intestinal cancers and increased rates of digestive disorders [10].

#### What can we do?

There have been few studies on the effects

of eating microwaved foods for humans and whether micro-waves emitted at this level can be harmful in the long run. To do such research is difficult because it requires long-term isolation of the cause of microwave-sickness symptoms. Studies on the chronic effects of micro-wave emissions are rare because it is less ethical to test human subjects and so the only research is that which can be observed. Due to this limitation, there have been few public warnings and many people have been accustomed to the use of a convenient microwave in their daily lives. Until more studies are completed to solidify the existing research on microwaved foods and micro-wave leakage, using other methods to cook food may be resorted to for the time being. ■

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# How Brain Emulation Will Impact the Future of Our Society

Thomas S. McCabe

Over the past fifty years, scientists have learned how to model increasingly complex phenomena using computer simulations. These simulations, from models of the weather, to algorithms for forecasting the stock market, to battle simulations in times of war, have had a large impact on our lives and on the structure of our society. However, there is one kind of computer simulation - namely, full-scale, realistic simulation of the human brain - that may have not just large, but profoundly transformative impacts on our entire civilization.

Whole brain emulation (WBE) is a future technology that will create a new kind of intelligence - one that is based on computers rather than the cells and DNA that have been the foundations of life for the past few billion years. The basic idea behind WBE is that, if anything is simulated well enough, the behavior of the simulation as a whole will mimic the behavior of the thing being simulated. For instance, if one simulates a Space Shuttle accurately enough, the simulated Shuttle will be able to do anything the physical Shuttle can do, including blasting off, flying into orbit, re-entering the atmosphere, and landing [1]. Hence, if one constructs a detailed enough model of the human brain, down to the level of individual neurons, the model will be able to do everything a human can do, including learning, thinking, and creative reasoning [2], [3].

There are three key technologies currently under development that will lay the foundations for a WBE project: high resolution scans of large areas of the brain, programs to translate the imaging data into a model of the brain, and computing power and memory for running the final simulation.

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Adequate imaging technology must satisfy two different criteria: the scanner must have a high enough resolution to construct models of individual neurons, and it must also be able to scan a large area, so that a full human brain can be scanned in a reasonable amount of time. We have technologies, such as scanning electron microscopy, that can do the former, and other technologies, such as magnetic resonance imaging, that can do the latter, but we currently don't have anything that can accomplish both simultaneously. However, scientists in the field are making a lot of progress with new scanning techniques, such as massively parallel electron microscopy, that can scan rapidly at the resolution required. Systems that are powerful enough

to scan the entire human brain appear to be feasible within a decade or two [2].

The second component, data processing, is largely a problem of writing better image analysis software. Scientists today can look at sections of scanned brain tissue and identify neurons, synapses (connections between neurons), glial cells, and other structures, but this process is extremely slow, and therefore impractical for WBE [4]. However, if a computer could parse the images and build a 3-D model automatically, it would make building a model of the whole brain viable. Research in this area is ongoing, and the large library of image-processing techniques we currently have will probably work reasonably well, given enough effort and funding [5].

The third main component, computer processing power and storage, is very easy to forecast, because of the exponential trends collectively known as Moore's Law. Over the past century, numerous measures of computer power have improved

at an exponentially accelerating rate, with doubling times ranging from a year to a decade [6]. These trends are expected by industry specialists to continue for at least another twenty years, and probably longer [7].

Although such comparisons are necessarily inaccurate, the general scientific consensus is that the human brain has a processing capacity of around one to ten quadrillion floating point operations per second (FLOPS) [8]-[11], which is about the same as that of our most powerful supercomputer, IBM's BlueGene/P [12]. This includes not only our logical and deliberative reasoning abilities, but all the computation involved in everything our brain does, from moving muscles, to creativity, to seeing and modeling the world around us. Because of the exponential progress of computing technology, it will probably be only another decade or two before ordinary computers, ones available at your local store, can attain these speeds. Futurists, neurologists, and computer industry experts have calculated that a research group with a modest budget should be able to match the brain's computing power in ten to twenty years [2], [13].

Overall, projects in the field of computational neuroscience, the study of the brain as an information processor, are making rapid progress, although we aren't ready to attempt WBE yet. Researchers at IBM have recently simulated a mouse-scale brain on the neuronal level, using a BlueGene/L supercomputer to model each of the eight million neurons [14]. Another, more detailed simulation modeled the cortex of a small mammal, with 22 million neurons [15].

Once WBE has reached a high enough stage of development, it's important to note that WBEs will, essentially, have all the capabilities that humans do, as their thought processes will be indistinguishable from those of humans. It is still widely debated among philosophers and scientists whether WBEs will be conscious, whether they will experience pleasure and pain, and whether they will have souls or personal identities. However, it is generally agreed that, given enough simulation detail, they will be capable of doing anything that we can do, from composing symphonies, to programming computers, to proving Fermat's Last Theorem.

It is true that, for the foreseeable future, WBEs will not be able to directly manipulate human or human-like bodies, unless we deliberately build bodies for such a purpose. However, in the modern era, this is becoming, and will continue to become, increasingly irrelevant. Most of the important parts of our civilization and our economy already rely more on our

intelligence and thinking ability than anything our physical bodies can do. We do not usually regard disabled people as being unable to work, contribute to society, or rule nations and empires simply because their biological bodies are less functional. Similarly, WBEs will not be prevented from doing any of these things, just because they have no biological bodies at all.

In addition, it's important to ask the question: what new abilities will brain emulations have, as compared to modern-day humans? One of the most important is the ability to easily replicate themselves. Humans generally reproduce on the order of twenty years. A WBE, on the other hand, is simply a computer program- if a very complex one- and it can be copied as quickly as any other computer program. It will probably take decades before scientists and engineers have finished all the work of developing the scanning technology, creating fast enough computers, and then actually building the simulation. However, once this work is completed, the simulations will be able to copy themselves at the speed of electronics.

This implies, among other important consequences, that there will be extremely fast growth in the number of WBEs [16], [17]. The overpopulation of humans is already a major concern for society. With reproduction times on the order of minutes to days- the time it takes to copy a computer program- WBEs could well run up against the carrying capacity of the Earth's computers before we even have time to realize that a problem exists, let alone formulate a solution.

What is the carrying capacity of the world's computers? Currently, it's not very large; as of 2009, Folding@HOME, the world's largest distributed computing project, has a total capacity of around 8 quadrillion floating point operations per second (FLOPS) [18], or about the same as a single human brain. However, if historical trends continue, our computational capacities will just keep growing exponentially, until they run up against the bounds set by the laws of physics [13].

These bounds, it's important to note, are extremely high. For every bit of data crunched, at room temperature, Landauer's principle requires that  $2.9 \times 10^{-21}$  joules of energy be expended [19]. The Earth receives a steady energy flow of about 122 PW, or 122,000,000,000,000,000 joules per second, from the Sun [20]. Hence, the total amount of computing power that the Earth can support is around  $10^{36}$  FLOPS, which corresponds to a carrying capacity of around  $10^{20}$  WBEs, a number fifteen billion times larger than the current population of seven billion humans.

“ **In addition, it's important to ask the question: what new abilities will brain emulations have, as compared to modern-day humans? One of the most important is the ability to easily replicate themselves. Humans generally reproduce on the order of twenty years. A WBE, on the other hand, is simply a computer program- if a very complex one- and it can be copied as quickly as any other computer program.** ”



In addition, WBEs will theoretically be able to think at much faster speeds than humans. A physical neuron runs at around 200 cycles per second, or 200 Hz, and there is no way to speed this up substantially. A WBE, however, could speed itself up simply by moving to a more powerful computer. A brain emulation is, after all, a computer program, and if you run a program on a more powerful computer, it will run faster [21]. By 2025, the world's top supercomputers will have processing power in the range of  $10^{18}$  FLOPS, or around a thousand times the power of the human brain.

While this explosion in artificial intelligence and computing power may offer many benefits for society, the uncontrolled replication of WBEs may in fact threaten our economy and way of life. Humans, like all other organisms, have survival instincts hardwired into their brain; it is possible that a simulation thereof may have the same characteristics. As noted earlier, WBEs will be capable of doing many of the tasks humans currently perform, and driven by this instinct for survival, may enter into competition with us for those jobs as well as our resources. Though they do not directly consume the same natural resources that we do, they may compete with us over technological and economic resources. Combined with the vast computational power and nearly infinite numbers of WBEs, it may prove impossible for humans to control them. In a worst case, albeit speculative scenario, our governments may lose control of our computer networks, which we rely to run our utilities and communication systems, store and disseminate information, and control traffic and transportation, among numerous other things. Even if we all wanted to, it's doubtful that we could shut down the world's computer networks. To

quote Ray Kurzweil, a technology entrepreneur:

"If all computers stopped functioning, society would grind to a halt. First of all, electric power distribution would fail.... There would be almost no functioning trucks, buses, railroads, subways, or airplanes. There would be no electronic communication... You wouldn't get your paycheck. You couldn't cash it if you did. You wouldn't be able to get your money out of your bank." [22]

Of course, these negative outcomes are by no means guaranteed. Indeed, there are many scientists who think that it is best to speed up WBE research in order to harness the large benefits that it would bring to our civilization. It must finally be noted that it is both impractical and undesirable to ban the development of WBE technology indefinitely.

However, because of the potential for devastating consequences, it is extremely important for all of us to ensure that the process of developing WBEs is gradual and carefully planned. Unfortunately, this sort of careful planning is not how we are currently responding to the issue. There are currently no plans in place to deal with the economic impact of WBEs, or to ensure that WBEs will not display hostile tendencies. We can't afford to wait, as we don't have a clear idea of how long we have, or just how bad the consequences of delaying will be. We must have a plan of action in place now. ■

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# Fighting Disease: Are Global Funds Misallocated?

Chana Messinger

Of the many global issues the world faces, one of the most prominent is allocation of the world's resources to fight disease. Three of the eight Millennium Development Goals agreed to by 192 nations and over twenty-three international organizations relate to combating disease and promoting health. These goals, set forth in 2001, are the markers by which the United Nations evaluates progress on important global issues. Unfortunately, policy decisions are not always entirely based on the scientific and statistical evidence available. In fact, there are severe misallocations in the way that limited funds have been used to fight disease. Current policies on AIDS, malaria, diarrhea and other diseases are almost entirely at odds with the way that the money could save the most lives, focusing money and attention on the first, an expensive and as yet unsolved problem, and underfunding and marginalizing the others, which are curable and less costly.

In deciding how much funding to funnel towards a particular disease, one important factor should be fatality. Malaria kills over 1 million people every year [1], AIDS kills 2 million[2], and diarrhea causes the death of up to 6 million[3]. The numbers are even starker when specifically children are considered, as they should be, given that the fourth millennium development goal relates to child mortality. In Nigeria and Ethiopia, 237,000 people died from AIDS [4]. Over twice that number of children under five died of pneumonia and diarrhea [5]. Researchers at the Johns Hopkins Bloomberg School of Public Health and the WHO estimate that 10.6 million children die before their fifth birthday worldwide. Diarrhea accounts for 17% of these deaths and malaria for 8%. In fact, diarrhea has been described as the leading cause of death for children. In contrast, AIDS caused the deaths of only 2.5% of these children[8]. It makes sense then, that based solely on the relative preponderance and fatality of the diseases at hand, that diseases such as malaria and diarrhea should receive at least as much fiscal attention as AIDS. This is not the case.

The actions of the United States, the most powerful and wealthy participant in this global summit, are quite telling. In 2008, United States aid, mostly in the form of direct bilateral donations to combat AIDS and HIV, constituted half of the world's funds allocated to this particular problem[6]. Of the United States Agency for International Development's (USAID) total Health budget of \$4.15 billion, 24%, combined, is allocated

to fighting infectious disease, child mortality and promoting maternal health. AIDS/HIV, alone, constitutes a 64% slice of the budget, which amounts to over 2.5 million dollars [7]. The President's Emergency Plan for AIDS Relief, created in 2003, gave \$15 billion to fight AIDS, and this amount was increased to \$48 billion when it was renewed earlier this year. To fight malaria, which kills one person every 15 seconds, \$1.2 billion was given in 2005 by USAID, to be spent over a period of five years[8]. An argument might be made for research, given that AIDS has no known cure, whereas the others do. However, only 12% of the US budget for AIDS is allocated specifically to research, undercutting this line of reasoning[9]. Money allocated to combat diarrhea-related illness and pneumonia was not even listed on the USAID site. Those diseases, which are leading causes of death in the developing world, are part

of a larger initiative to promote maternal and child health and suppress infectious diseases.

Not only, however, is money not donated in proportion to how deadly a disease is, but also, the costs of prevention and treatment are not being addressed. Treatment of some diseases is, overall, more cost-effective than treatment of other diseases, and so would save more lives per dollar donated. Even if AIDS were responsible for as many

deaths as it might appear to be from the amount of money the US apportions against it, the fact remains that AIDS is a much more expensive disease to treat than are the others. Yet, all the aforementioned diseases – AIDS, diarrhea, pneumonia, malaria – are preventable: AIDS with safe sex practices and drugs for mothers, diarrhea with clean water, pneumonia with vaccines and malaria with drugs and the use of bed nets. Diarrhea requires a one-time investment into clean water and hygienic sewage for any given community, which might be expensive, but could easily recoup its own cost as these simple but effective measures reduced the prevalence of the disease. Vaccines, such as the one for pneumonia, must be distributed on a case-by-case basis, but once it is eliminated from an area, it often never returns, as is clear from the example of the United States. Bed nets are extremely inexpensive, and hugely reduce the rate of malaria if used correctly. But stopping the spread of HIV and AIDS requires continued education, voluntary implementation of safe sexual practices and an intensive drug regimen.

The treatments themselves put the disconnect between

“ [B]ased solely on the relative preponderance and fatality of the diseases at hand, that diseases such as malaria and diarrhea should receive at least as much fiscal attention as AIDS. This is not the case. ”

disease fatality and funding for treatment into sharper perspective. Oral Rehydration Salts, the most widely accepted treatment for acute diarrhea, cost 8 cents per person. Pneumonia antibiotics generally cost \$1 a day, and only have to be taken for a few weeks[10]. Malarial drugs are more expensive, about \$4 a day, but a new program has been implemented that combines pressure on drug companies and subsidies to make them cost approximately 5 cents[11]. By comparison, an HIV cocktail in the United States costs thousands of dollars a month. UNAIDS estimates that to treat and care for all Africans infected with HIV / AIDS



Reproduced from [28]

in a given year would cost \$1.5 billion [12]. Implementing prevention programs and antiretroviral therapy would cost billions more. From a strictly utilitarian perspective, money allocated to fight malaria, pneumonia, diarrhea and other preventable, curable diseases would help and save more people than money given to fight AIDS. As Nigerian President Olesegun Obasanjo noted, "It should be recognized that given the nexus of malaria and HIV / AIDS, it makes no practical sense to spend so much on one while leaving the other underfunded." [13].

There are four main reasons why AIDS is overly emphasized. The first is that it is treated as separate from other diseases. The 2004 annual World Health report from the World Health Organization (WHO) addressed AIDS and the need for a comprehensive strategy to stop and reverse the spread of this pandemic. It asked for expanded treatment, more community involvement and further integration of different sources of knowledge[14]. In order to achieve such a goal, the WHO called on the international community to respond quickly, with money and aid, so as to effectively fight the disease. The very next year, the annual health report focused on child mortality, noting that almost 11 million children under the age of five die each year [15]. An

emphasis on child mortality would necessarily include a focus on AIDS, as this disease kills 270,000 children each year. However, the artificial division created by emphasizing them separately quickly gives rise to allotment of funding that equates one disease, AIDS, with the rest of the illnesses that affect children. AIDS is still extremely important, and needs funding, but these other diseases are being unfairly dismissed. The problem is that, as separate causes, any money donated to combat AIDS is not given to alleviate any other disease and vice versa.

Secondly, societal perspectives on the issues, which often inform political decision-making, seem to be playing a large part. AIDS is at the forefront of the national and global consciousness. Google Trends, for example, a fairly accurate measure of internet-user sentiment, puts searches for "AIDS" and "HIV" at 4 to 10 times more frequent than "malaria", "pneumonia" or "diarrhea [16]." Similarly, the New York Times has published almost 6,000 articles dealing with AIDS in the last 27

years, with articles on the subject of diarrhea numbering just 48 [17]. The reasons are varied. Tropical diseases have been a part of the human condition for hundreds of years, whereas the first known cases of AIDS were discovered in 1981. Another aspect of popular pressure is the fact that AIDS is still a problem in the US, whereas the other diseases mentioned are not, and furthermore, while the tropical diseases mostly affect children, AIDS is widespread across the age spectrum, and in fact mostly affects people of prime working and child-bearing age [18].

Thirdly, lobbyists fighting for more funding for AIDS appear to have been hugely successful. As Philip Lee, University of California at San Francisco professor of social medicine says on the subject, "The system is a political process." [19]. There is not one AIDS lobby, but

“ **Money allocated to combat diarrhea-related illness and pneumonia was not even listed on the USAID site. Those diseases, which are leading causes of death in the developing world, are part of a larger initiative to promote maternal and child health and suppress infectious diseases.** ”

rather multiple organizations that have formed powerful coalitions, such as National Organizations Responding to AIDS, which has over 170 member organizations[20]. They even have specific lobby days in Congress, which are May 24 through June 3 [21]. Just last year, in Massachusetts, over 500 people lobbied their state Congress for the yearly AIDS Lobby Day on behalf of Project AIDS Budget Legislative Effort (ABLE) [22]. The AIDS Action Council claims to have successfully helped in the reauthorization of the CARE Act and attained agreement in House of Representatives for removing a ban on funding of syringe exchange programs in Washington, DC. Their mission involves “advocacy on a national level” and they profess to have assisted in implementing important public health policies in the United States [23]. A centralized source of information on South African NGOs called NGO pulse runs a class called the Advanced HIV and AIDS Lobbying and Advocacy Course [24]. This is but one example, but it is indicative of a broader trend. There is no malaria lobby, pneumonia lobby or diarrhea lobby; such lobbies simply do not exist.

All such causes are in desperate need of funds, and charitable policies of any kind should be encouraged as much as possible. At the same time, there is also the matter of responsible giving. Good intentions are not enough. Political decisions, even if made in the name of doing good for people around the world, generally ought to be done on the basis of good evidence. When money is given with as much thought to the status of the cause as the help that is needed, there is a substitution of opinion for fact. Ezekiel Emanuel, a bioethicist, calls the ignored issues “mundane but deadly diseases,” emphasizing not only the danger of these illnesses but also the effect that social approval has on the attention and support they receive [25]. Philanthropists are free to distribute their monies as they

wish, but the federal government of the United States must be held to a higher standard. Obasanjo’s message, given in the year 2000 at a world summit on malaria is still relevant. As he said, “Africans have consistently put it to the world that malaria is the number one health problem. When recognition of the HIV/ AIDS virus came to the fore, Africans continued with their message that malaria was still killing more people. But we went unheeded.” [26].

It seems to be a fact that popular opinion is a major factor in the way money is allocated to combat disease, one that is perhaps stronger than how the money can be used to save the most lives. The future of change in this area is the molding of public opinion to make underfunded diseases as well known as those such as AIDS. People who feel that these other, ignored, diseases need more attention and funding are likely to create organizations dedicated solely to one of these problems. This focus demonstrates the importance of each particular illness. Then, coalitions can form and eventually give rise to lobbies, which can affect political decisions. More importantly, the rise of organizations in relation to one disease, for example, malaria, should work to raise awareness and disseminate important information. In this way, it will become part of the national consciousness and relevant evidence, such as that found in this article, will become common knowledge among both the public and politicians. These strategies have been used successfully by those concerned, rightfully, about AIDS, and they can be appropriated for use to fight other diseases. When all of the causes are equally well-known, then the relative importance and opportunity costs will be brought into question and funds may be allocated more fairly. ■

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# Physics for the Masses

Oliver Pike

Although science has always been performed by a very small subsection of the public, science communication with the ‘educated layman’ has a well-established history [1]. Its importance is outlined by Thomas and Durant in nine key benefits [2]. These include; benefits to science, as the taxpayer often funds scientific research; benefits to democratic governments and national economies; and benefits to the individual, as some sense of scientific process is necessary in the modern technological world. Indeed, physics education benefits “all sections of society... the specialist... the skilled worker... the citizen ... [and] the individual” [3].

Science communication takes many different forms. The formal education of science is a mandatory part of the National Curriculum in the UK until the age of 16. Television has proven itself a powerful vehicle for presenting the public with science in an intriguing, sensationalist fashion, whilst scientific journals present cutting edge research more formally and ‘popular science’ books and magazines seek to make scientific theories technically accessible and interesting to all. Many of these have been written on topics such as Einstein, specifically his work in relativity, and more recent theories like string theory. Famous scientists, notably Feynman and Hawking, have themselves written books for the layman. There have been best-selling books targeted at a wider audience, which aim to install a basic scientific literacy in the reader. These include *A Brief History of Time*, *A Short History of Nearly Everything*, and recently, *The Trouble with Physics*. Hawking’s *A Brief History of Time*, which explains a range of cosmological subjects, including the Big Bang, black holes and superstring theory to the non-scientist, holds the record for the longest time spent on the Sunday Times best-seller list; 237 weeks. The book’s sales suggest the public’s appreciation for basic scientific literacy, but Robert Pollock argues in the *Wall Street Journal* that “publishing watchers cite Stephen Hawking’s *A Brief History of Time* [as an example of] the unread bestseller” [4], implying that it was either uninterest-

ing or inaccessible to the reader.

Scientific writing is objective and factual; it is methodically structured, cross-referenced and clearly defined. ‘Popular science’ writing on the other hand is engaging and seductive, its “main purpose is to celebrate rather than validate” [5]. Particular emphasis is placed on the incredibility or apparent implausibility of results; in one Atom episode alone, the words “phenomenal”, “astonishing”, “revolutionary”, “jaw-dropping”, “amazing”, “magnificent” and “awesome” were all used. The effect this has is to exaggerate the science and make the results more impacting. Popular science will also often try and invoke an emotional response in the reader; perhaps the most famous example of this is in *The Ascent of Man*, Bronowski standing in the pools of water at Auschwitz, imploring that we “must cure ourselves of the itch for absolute knowledge and power”. The audience is no longer objective about the subject and its implications.

“ **Television often adopts a sensationalist approach to science communication.** ”

Television also often adopts a sensationalist approach to science communication. As the number of television sets in the UK has risen to over 60 million today, with the average daily viewing time of 3:36 hours, inaccessibility has become less of a problem for this powerful vehicle for dissemination of scientific ideas [6].

In fact, science documentaries have a long-standing history on television. In 1952, *Science Review* became the first of this kind and was watched by over 10% of the population. *The Sky at Night* was first presented in 1957 by Patrick Moore and still takes the same format today. It is now Britain’s longest running programme and appears to have conquered one of the main issues facing the science communicator: the interest of the audience. Not only does popular science need to be at a technical level that is accessible to the public, it also needs to excite their curiosity. Moore attributes the success of *The Sky at Night* to the fact that “astronomy is a fascinating subject. You look up... you can’t help getting interested and it’s there” [7]. Given also the amount of competition in the television industry, it comes as no surprise that of primary importance for modern scientific documentaries is the entertainment value. Colourful computer-generated particles, battlefields, drum-rolls and emotive story lines are all for the audience’s enjoyment.

Other documentaries have been less successful than *The Sky at Night* in keeping with their original format. After several attempts to modernise its format, *Tomorrow’s World*



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was cancelled in 2003 due to falling ratings; the number of viewers had dropped from 10 million at its peak of popularity in 1980's to 3 million by 2002. The programme's original presenter, Raymond Baxter, responded to the show's cancellation, "There's a thing in broadcasting... where you have to change things. If it ain't broke, don't fix it" [8]. The format of *Horizon* also changed in the early 90's to adopt a narrative format, much like many other modern documentaries. A problem is posed at the start, and solved within the hour. The scientist becomes idolised as the "genius in our story" [9]; the narrator takes the audience on a journey in which ultimately the mystery is always solved. Gregory and Miller argue in *Science in Public* that "the overriding social message of science on television is that scientists always solve the problem" [10]. This is completely incompatible with the actual scientific process, which involves high-powered theory and slow, precise experiments. Hypotheses are tried, tested, disproved and another one conjured. Results are even stumbled upon in the search of something completely different. Indeed, many scientists believe there is no reason we should be able to answer every question about the universe. This has little impact on accurately conveying scientific theories, but severely limits the layman's understanding of the scientific process.

New Scientist came under criticism from readers over an article, featuring Roger Sawyer's controversial "emdrive", an engine with no moving parts, which generates "thrust purely from electromagnetic radiation". Many readers wrote in to argue that this engine as described contravenes one of physics

most fundamental theories, the conservation of momentum. Sawyer replied, "the emdrive concept is clearly difficult to comprehend without a rigorous study or the theory paper." This clearly exemplifies the conflict between making scientific writing both accessible and accurate. These problems are not limited to the written media. The *Horizon* 'Parallel Universes' documentary begins with the narrator stating, "everything you are about to hear is true. At least, in this universe it is." Although this assertion immediately engages the audience, it is rather inconsistent with the scientific process of doubt.

To combat the problems facing science communication, organisations exist to encourage scientists themselves to get involved in public engagement. The Engineering & Physical Sciences Research Council (EPSRC) offer "Partnership for Public Engagement (PPE) Awards" to help fund scientists who communicate research to the public. The Royal Society provides courses in communication skills and media training, and also offer prizes for popular science books.

In a 2006 survey [11], which examined the views of scientists with regard to public engagement, 74% had taken part in at least one science communication activity within the past year, a 18% rise since 2000. Of the "no activity" subgroup, 53% stated they would like to spend more time with the public and only 6% "just did not want to" get involved in any public engagement. These are very positive statistics and show scientists' appreciation for the importance of communication. However, 64% said the need for time researching was stopping them getting more involved. This is an unfortunate conflict with no simple solution. Yet, "researchers are the best people to promote research" [12] and should therefore spend as much time as possible in public engagement.

One of the benefits to science communication is that many research projects receive their funding from the public. It is therefore very much in the direct interest of the scientist to let his/her work and its importance be known to as many people as possible. However, the scientist must also appreciate the wider benefits of science communication. Indeed, they must be trusted members of society as the consequences of science can be incredible; the atomic bomb, climate change and nuclear energy. It is important that these areas are particularly well understood so that informed democratic decisions can be made collaboratively, between scientists and the public. ■

*Oliver Pike was a fourth year studying Physics, and has now graduated from Cambridge.*

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# The Guarded Gate: DNA Testing for Refugees

Nipun Verma

## The Human Provenance Project

The United Kingdom Borders Agency started the pilot program, Human Provenance Project, in September 2009 to pinpoint the nationalities of people seeking refugee status in the United Kingdom. Specifically, U.K. officials were concerned that Kenyans were trying to pass themselves off as Somalis, who have a greater chance of being granted refugee status due to the civil war in Somalia. The program would use DNA testing to compare nucleotide sequences of living individuals to sequences of historic populations to determine ethnic origin. The program would also use isotopic analysis, which matches certain isotope ratios in hair and nails to the ratios found in the individual's place of birth or upbringing [1]. However, the DNA analysis for African populations has limited resolution and is subject to considerable errors. There is also no evidence that isotopic ratios present at birth or early childhood are preserved in continuously growing tissues. More obviously, these tests ignore the fact that people move and nationalities can change, whereas DNA remains the same [2]. The scientific community and refugee support groups expressed outrage the moment the program was announced. This reaction led to the temporary suspension of the program in October 2009 [3].

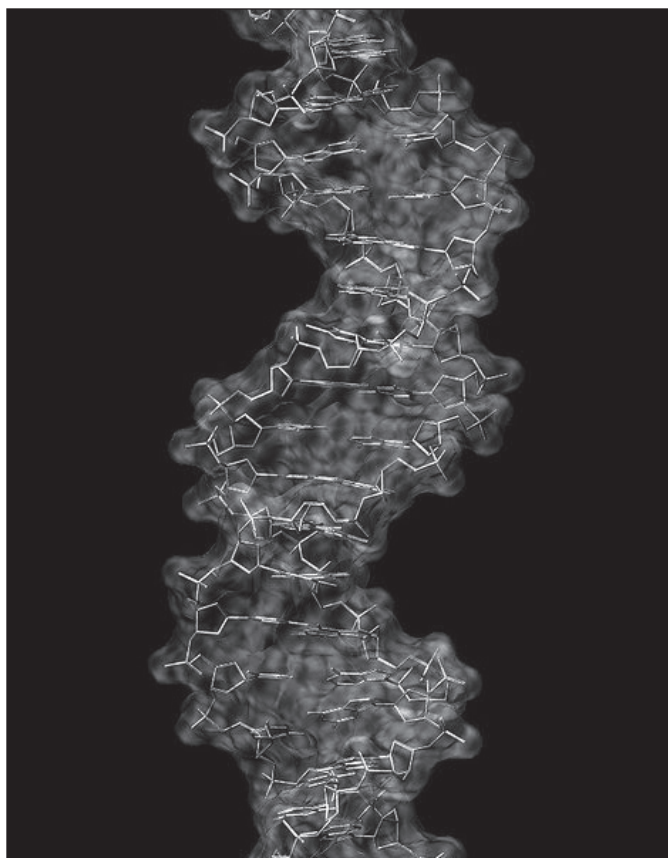
## DNA Testing for Family Reunification

The emergence of the Human Provenance Project highlights the capacity for scientific technology, including DNA testing, to expand from its traditional fields and to influence refugee cases. When refugees flee their country of origin, they often leave family members behind.

Many countries have established procedures that use DNA testing to determine biological relationships in family reunification cases, but other countries, notably the United States, have not yet come to a decision on this issue [4, 9]. Programs like the Human Provenance Project, which try to establish nationality, should be terminated because they are fundamentally flawed. But what about employing DNA testing to establish biological relationships? Comparing DNA sequences between individuals can be used to establish biological relationships, because blood relatives share similar sequences of DNA, which can be obtained from cell samples drawn from blood, saliva or hair [5]. The technological accuracy and validity of this genetic testing is unquestioned; DNA testing to establish paternity is regularly used and the results are admissible in court. Nevertheless, is DNA testing for family reunification ethically justifiable?

Family reunification is vital for refugees. The absence of family members can exacerbate the trauma of migration and can impede assimilation into a new country [6]. Several international documents stress this importance of family reunification. The Universal Declaration of Human Rights of 1948 and the United Nations Covenant on Civil and Political Rights of 1966 both recognize that "the family is the natural and fundamental group unit of society and is entitled to protection by society and the State" [7]. In addition, the executive committee of the

United Nations High Commissioner for Refugees has issued numerous recommendations urging refugee family reunification. However, the executive committee's recommendations are not binding upon governments and are fairly broad and



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non-descript. As a result, national governments have developed their own procedures to determine the legitimacy of family reunification in individual cases [7]. Although the humanitarian reasons for allowing family reunification are understood, financial support for refugees comes from domestic welfare programs, so governments have an incentive to limit the number of refugees admitted [8]. Ultimately, the issue of family reunification underscores the tension between

a national governments’ responsibility to respect the human rights of refugees and their interests in curbing migration across their borders.

#### **Fraud in Refugee Family Reunification**

The problem of fraudulent applications is an important point of focus for governments that deal with refugees, as shown by the emergence of the Human Provenance Project. In the context of family reunification, this would arise when refugees claiming to be family members have no actual hereditary link. In 2008, the U.S. Department of State suspended the humanitarian program, Priority 3, which reunited African refugees with relatives living in the U.S. In February 2008, the U.S. government started a pilot DNA testing program to verify the genetic ties between relatives. The initial DNA testing included 500 individuals, primarily from Somalia and Ethiopia, but it was later expanded to over 3000 individuals from Ethiopia, Uganda, Ghana, Guinea, Gambia and Cote d’Ivoire. DNA testing showed that a large number of the ap-



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plicants were not related to their putative family members, and thus they were ineligible for family reunification. Due to the high number of fraudulent applications, the reunification program was suspended in October 2008 and has not yet been reinstated [9].

In the past few months, reports have surfaced that the Obama administration is considering restarting the Priority 3 program, with new procedures that include DNA testing for some refugee applicants [10]. If the program does include DNA testing, the U.S. will be far from alone. Many nations, including Denmark and Canada, have already instituted procedures for DNA testing as part of family reunification procedures. Other countries, like Germany and Switzerland, have established DNA testing for immigrants, and these procedures often overflow into the refugee context [4]. As such, DNA testing is well established in some countries and is increasing in popularity in others.

### Problems with DNA Testing

Although DNA testing to establish biological relationships is scientifically accurate, it poses some important limitations and ethical ramifications. Most importantly, families are not always biologically related. For example, the traditional family conception ignores the case of adopted children. Also, there is no universal definition of family; it is a socially constructed term that differs from one culture to another. In many cultures, family incorporates both biological and close social relationships [12]. In fact, after U.S. DNA testing revealed fraud, many refugee advocates argued that the definition of family among Africans

extends beyond blood relatives, especially in cases in which relatives are scattered due to persecution or warfare [11].

The application of DNA testing can produce practical problems as well. There are concerns that DNA testing is more likely to be requested from individuals from poorer countries. These individuals are less able to obtain documentary evidence from their governments, and the receiving governments are more likely to reject these documents as fraudulent. Furthermore, DNA testing can be expensive, and applicants may not be able to pay. Others may be constrained by religious beliefs that ban the surrendering of blood samples. Lastly, DNA testing poses serious concerns on the right to privacy for refugees because of the risks that personal data obtained can be disclosed to unauthorized parties [12].

### A Compromise?

Nations ultimately have a responsibility to guard their own borders. DNA testing can be useful in family reunification cases as long as the method’s limitations are recognized and its use is carefully regulated. First and foremost, DNA testing should be used as a last resort, and results showing no biological relationship should be overturned by sufficiently strong contrary evidence equivalent to a family tie. There must be strict and uniform national guidelines detailing when DNA testing should be used, in order to ensure its application is as non-discriminatory as possible. The cost of DNA testing for refugees should be borne by the receiving government and there must be clearly defined measures for data protection.

Family reunification at heart is a matter of humanitarianism and needs to recognize the rights of refugees. However, reuniting families of displaced refugees also has positive social and economic consequences for the receiving country. The presence of family members eases assimilation into the national culture and integration into the workforce. Although an open door policy is not the solution, neither is the creation of more restrictive measures that unfairly prevent refugees from joining their families. ■

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