

Jessica Leval  
BioEE 207: Term Paper  
Due: 12/8/06

## **The Visible Hand – The Role of Humans in Human Evolution in the 20<sup>th</sup> Century to the Present**

Since the beginning of human life, humans have been trying to find the means of making life easier and more pleasant by taming our surroundings and addressing human needs and wants. People have developed everything from the bare necessities such as food, clothing and shelter, to less necessary but life-enhancing items, such as cars, televisions and refrigerators. In the course of trying to alter human interaction with our environment, we have dramatically modified all aspects of human existence, even slightly affecting evolution itself.

Human intervention in the evolution of our species has become especially significant in recent times with the rise of improved technology and the implementation of practices that have markedly changed human life. In the medical arena, breakthroughs such as the introduction of antibiotics have greatly affected the human species by saving countless lives that would, otherwise, have been ended or might not have existed at all. It is also true that these life-enhancing developments have had their own unexpected consequences. Thus, for example, the widespread use of antibiotics has saved countless lives, but it has also given rise to antibiotic-resistant bacteria, increasing certain threats and making it necessary for mankind to further improve our knowledge of medicine.

The more we develop and improve both our understanding of the environment and the resultant technology, the better we are able to control and shape our surroundings and our own evolution. The more time passes, the greater effect artificial selection is having and will

continue to have on natural selection. As evolutionary history continues, the human hand is becoming more visible as a guiding – though at times confusing - force of evolution.

The effects of the human hand are especially visible throughout recent history – from the mid-20<sup>th</sup> century to the present, as exemplified through social policy, war and medicine. People have played an important role in altering the effects of evolution by artificially reshaping many aspects of the natural world, and attempting to significantly alter the effects of natural selection and natural evolution. Despite the many great breakthroughs which have challenged the power of nature, the impact of human actions remains rather slight, only marginally affecting the overall natural course of evolution. However, in the future, with the likely proliferation of even greater discoveries intended to tame nature, the impact of mankind on our evolution may grow exponentially. A brief review of various activities intended to alter the path of evolution, may shed some light on the likely impact of such developments in the future.

In this paper, we will look at several examples of actions by humans that are destined to have some impact on the progress of natural evolution. Some are intentional (e.g. China's efforts at controlling its own population) and some are accidental (e.g. war). As the technological power of mankind grows, each of these sorts of human intervention in the evolutionary process is likely to become far more significant. However, it remains to be seen whether this will be for the betterment of mankind or to its detriment.

### **Population control – China's One Child Policy:**

Attempts at population control, such as China's One Child policy, have helped us learn valuable information about population sizes and the effects that societal values can have on our attempts to change our environment. While seeking to control China's growing population, the

Chinese government developed policies relying upon a variety of known factors affecting population size. The age of first reproduction is crucial, as a woman can give birth to many children in her reproductive lifetime before reaching menopause at a specific, mostly predetermined time. Reproductive spacing is also known to influence the total number of offspring a woman will produce in her lifetime, as the longer the interval between births, the fewer children a woman will be able have while she is fertile. Another key factor is the number of children a woman has at a time. Since a woman can give birth to multiple children at one time, if each pregnancy results in a single child, she will have fewer children than if she were to give birth to multiple children at a time, for example, to twins or even triplets. The final principal factor controlling population size is the age at which a woman begins to give birth to offspring. Since the woman will inevitably enters menopause at a relatively predetermined time, marking the end of her reproductive years, the later a woman becomes pregnant, the fewer children she is likely to have. With these factors in mind, China's "one-child policy" has tried to reduce Chinese population growth, attempting to eliminate a much feared harsh, Malthusian struggle for limited resources in China.

Within Chinese cities, couples are encouraged to have only one child, primarily through threats of social or legal repercussions. Couples who refuse to comply with these policies are often forced by the Chinese government to pay heavy fines, or even to seek an abortion<sup>1</sup> or to undergo coercive sterilizations. Other penalties, primarily financial, include significantly higher tuition costs for the prohibited second child,<sup>2</sup> higher taxes, even as drastic as the state collecting

---

<sup>1</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000"  
(<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

<sup>2</sup> "One-Child Policy in China: Arthur E. Dewey, Assistant Secretary for Population, Refugees and Migration: Testimony before the House International Relations Committee, Washington, DC, December 14, 2004"  
(<http://www.state.gov/g/prm/rls/39823.htm>, accessed 20 Oct 06)

as much as 10% of a couple's total earnings in taxes for the first 14 years of the second child's life.<sup>3</sup> Already, school tuition in rural

areas constitutes about 27% of a one-child family's budget, serving as discouragement against having more children than is permissible, since families often cannot afford to educate and raise a second child.<sup>4</sup>

Actively participating in the manipulation of the natural evolutionary process, Chinese family planning officials are in charge of the distribution of birth control devices and the enforcement of birth control policies. These officials give women one particular type of birth control as determined by the government, without other options, so as to ensure its effectiveness. As a result of governmental programs such as this, as many as approximately 87% of married Chinese women use some form of birth control. The widespread use of generally effective birth control has also indirectly led to lower abortion rates with an abortion rate in China as low as 25% of all pregnancies versus 43% in the United States.<sup>5</sup>

In certain exceptional cases the Chinese policy is intentionally less stringent, even allowing for a second child. Exemptions to the one child limit are made in an attempt to counteract predicted problems associated with this policy as well as to change the makeup of the population to a more balanced and equitable distribution. If one or both parents are from an ethnic minority, often an exemption will be granted allowing them to have more than one child in an artificial attempt to reduce the gap between minority groups and the majority. If both

---

<sup>3</sup> "Parliamentary Research Service: Research Note number 41, June 6, 1995: 'China's One Child Policy'" (<http://www.aph.gov.au/LIBRARY/Pubs/rn/1994-95/95rn41.pdf>, accessed 20 Oct 06)

<sup>4</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000" (<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

<sup>5</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H." (<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

parents are only children,<sup>6</sup> and therefore are presumably from underrepresented families, the couple may be allowed to have another child. Additional exceptions may be granted if the first child is disabled, or if both parents are engaged in hazardous labor, such as mining<sup>7</sup> and often in rural areas, where children are needed for farming and producing food to feed China's population.<sup>8</sup> In these situations, although the number of children is not as harshly restricted, the spacing between children is increased to approximately a five year minimum between children and is highly regulated.<sup>9</sup>

The Chinese government claims to have prevented between 250 and 300 million births through the implementation and enforcement of this policy. If this statistic is to any extent correct, then the Chinese policy has been a general success,<sup>10</sup> and has clearly had some impact on the evolution of the human race.

However, as with any attempt to tailor our environment, there have been unplanned and negative outgrowths associated with the Chinese policy. This policy has actually led to profound and unexpected consequences, most notably, a rather drastic uneven sex ratio, or a significant disproportion of male births to female births.

---

<sup>6</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000"

(<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

<sup>7</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H."

(<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

<sup>8</sup> "One-Child Policy in China: Arthur E. Dewey, Assistant Secretary for Population, Refugees and Migration: Testimony before the House International Relations Committee, Washington, DC, December 14, 2004"

(<http://www.state.gov/g/prm/rls/39823.htm>, accessed 20 Oct 06)

<sup>9</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H."(<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

<sup>10</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H."

(<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

China's one child policy, coupled with the traditional Chinese preference of male children over female children, has served to magnify China's already uneven sex ratio.<sup>11</sup> Traditionally, Chinese culture has valued male children, who are considered to be more physically fit than females and better able to care for parents in their old age as they remain near their parents, over females who will ultimately move to their husband's household. Additionally, males carry on the family name and are generally viewed as a greater asset, elevating the family's social prestige.<sup>12</sup> This deep seated view, when joined with the enforcement of the one-child policy has made sex selection and selective abortions increasingly popular. Numerous private companies in China are willing to perform sex selective procedures – a lucrative, though illegal industry.<sup>13</sup>

Many female babies are aborted or abandoned at birth or shortly after in an attempt to make the one permissible child a male.<sup>14</sup> Such practices, aside from being cruel and inhumane, have served to further affect an already uneven sex ratio, driving population growth rates down due to the greater population of males than females in China. Females are the limiting factor with regards to reproduction and the rate of population growth, making males essentially irrelevant in affecting the population size. There are currently at least 60 million more men than women in China,<sup>15</sup> preventing many males from marrying. As those men who do marry elect through human intervention to have male children, against the natural tendency in favor of at

---

<sup>11</sup> Ibid.

<sup>12</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000"  
(<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

<sup>13</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H."  
(<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

<sup>14</sup> "One-Child Policy in China: Arthur E. Dewey, Assistant Secretary for Population, Refugees and Migration: Testimony before the House International Relations Committee, Washington, DC, December 14, 2004"  
(<http://www.state.gov/g/prm/rls/39823.htm>, accessed 20 Oct 06)

<sup>15</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000"  
(<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

times expanding the female population, the sex ratio will become further skewed and further off target from the initial goal of the government. Additionally, this inequality in sex ratio is causing numerous other problems including the abduction of women from foreign countries<sup>16</sup> and an increase in prostitution, which has led to the spread of sexually transmitted diseases,<sup>17</sup> further affecting and harming the population. A normal sex-ratio, or proportion of male births to female births, is usually between 1.03 and 1.07.<sup>18</sup> In 2001, the ratio in China was at 1.17 in urban areas and as high as 1.3 in certain rural areas where males are valued for farm labor in addition to the traditional preference.<sup>19</sup> The ratio for permissible second births in rural areas is even more uneven, as there are approximately 152 male births for every 100 female births.<sup>20</sup> In 2000, the special efforts of the Chinese government to control the population were yet again reinforced and the one child law was made permanent.<sup>21</sup>

A particular obstacle to achieving the intended effects of the one child policy has been the Chinese government's inability to fully enforce this policy in rural areas. Approximately 70% of China's population lives in rural areas, where policies are often not strictly implemented.<sup>22</sup> By 1995, urban areas were strictly following these new policies, though rural

---

<sup>16</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H." (<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

<sup>17</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H." (<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

<sup>18</sup> Ibid.

<sup>19</sup> Ibid.

<sup>20</sup> "One-Child Policy in China: Arthur E. Dewey, Assistant Secretary for Population, Refugees and Migration: Testimony before the House International Relations Committee, Washington, DC, December 14, 2004" (<http://www.state.gov/g/prm/rls/39823.htm>, accessed 20 Oct 06)

<sup>21</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000" (<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

<sup>22</sup> "The New England Journal of Medicine: health policy report September 15, 2005: 'The Effect of China's One-child Family Policy after 25 years' By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H." (<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

areas often lagged in enforcement.<sup>23</sup> Realizing that restrictions are not implemented as well in rural areas, many couples have attempted to circumvent harsh urban restrictions by living in rural areas until the second child is born and then by pretending the baby has been adopted or by claiming upon their return that the couple is merely caring for someone else's, perhaps a relative's, child.<sup>24</sup> Furthermore, in many rural areas, a second child is often allowed provided the child is born at least five years after the birth of the couple's first child.<sup>25</sup> Since most second children and most illegal births are males, as it is only considered worth risking the high penalties contemplated by the law in order to have male children, the sex ratio is not self-correcting.

However, realizing that an inevitable crisis awaits China unless the Chinese government can find some way to counteract the harmful side-effects of the one child policy and sex selection, as well as due to pressure from the United States, the Chinese government has begun to reverse its policy. Between 2002 and 2004, China began letting up on forced abortions and marriage qualifications. 25 out of the 31 provinces in China have changed their official policy of requiring government consent for married couples to become pregnant, making monitoring the population and the number of children per couple extremely difficult and more relaxed.<sup>26</sup> Laws in rural areas regarding two children have been qualified, now permitting a second child provided the first child is a daughter, in an attempt to counterbalance the traditional value of

---

<sup>23</sup> "Parliamentary Research Service: Research Note number 41, June 6, 1995: 'China's One Child Policy'" (<http://www.aph.gov.au/LIBRARY/Pubs/rn/1994-95/95rn41.pdf>, accessed 20 Oct 06)

<sup>24</sup> "China Steps up 'one child' policy: Monday, 25 September, 2000" (<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 10/20/06)

<sup>25</sup> Ibid.

<sup>26</sup> "One-Child Policy in China: Arthur E. Dewey, Assistant Secretary for Population, Refugees and Migration: Testimony before the House International Relations Committee, Washington, DC, December 14, 2004" (<http://www.state.gov/g/prm/rls/39823.htm>, accessed 20 Oct 06)



males over females and to encourage the survival of some female offspring.<sup>27</sup> Realizing the problems with its original policy, the Chinese government is attempting to correct its flaws, to learn from its mistakes and to adjust so as to be able to better and more effectively artificially control population growth.

It is clear that through the use of government policy, the Chinese have played a role in altering an important component of the human species. The full and ultimate impact remains difficult to measure. The Chinese experience suggests that the more humans evolve, the better we are able to control certain aspects of our development as humans through the utilization of government and modern technology. However, the complexity of the human character makes it difficult to anticipate the precise impact of such efforts to control human behavior. Achieving the immediate goal of drastically reducing the population growth rate, the Chinese government is now striving to correct its unintentional and unforeseen effects of creating a drastically uneven sex ratio, with far more males than females. The government is slowly calibrating its efforts at population control, but the results of its policies will have a continuing and unpredictable impact on China and on the rest of humanity for all time.

### **War – World Wars I and II and their aftermath:**

Improved technology has enabled societal competition and animosity to be manifested in extremely violent and devastating wars such as World Wars I and II. The millions of deaths in each of the World Wars, including during the Holocaust, were facilitated by the increased killing efficiency through gas, bombs, and perhaps most dramatically as a result of the atomic bomb. One of the effects of the immense number of deaths caused by the two mammoth struggles of the

---

<sup>27</sup> “The New England Journal of Medicine: health policy report September 15, 2005: ‘The Effect of China’s One-child Family Policy after 25 years’ By Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H.” (<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

20<sup>th</sup> century was some reduction of the intense competition within the natural, Darwinian struggle for existence and reproduction. The effect of wars may generally be minimal from an evolutionary standpoint, as evidenced by the fact that the world population was rapidly replenished with an increase in the population growth rate during the post-World War II era, resulting ultimately in a tripling of its size during the course of the twentieth century.<sup>28</sup> However, World Wars I and II and the rapidly improving and increasingly dangerous technology of war that resulted from each, provide us with a rather frightening prospect for the evolution of mankind.

Many deaths during World War I, particularly in countries such as France, produced a significantly altered generation deprived of many young men in their prime reproductive years, which in turn produced a generation with an over-representation of women and immigrants brought in to replace the killed and maimed. Close to 1½ million of the most active, healthiest men in France were killed, while men who had not been sent to war due to some medical or other disqualifying issue and many less active individuals remained untouched. Following World War I, the population pyramid in France was forever altered.

Beginning on July 28, 1914 when Austria-Hungary declared war on Serbia after the assassination of Archduke Franz Ferdinand, heir to the throne of the Austro-Hungarian Empire, World War I would cause a staggering number of casualties. Often referred to as “the War to end all wars,” World War I would drag on for over four years of brutal trench warfare. Poor records make accurately estimating the full human cost of the War extremely difficult. When the War ultimately ended on November 11, 1918, its cost was measured in millions of dead and missing throughout Europe. Austria-Hungary lost 922,000 men with 855,283 counted as

---

<sup>28</sup> “U.S. Census Bureau: World Population Profile – 1998 Highlights” (<http://www.census.gov/ipc/www/wp98001.html>, accessed 4 Dec 06)

missing. Britain would be left with 658,700 dead and 359,150 missing. France, suffering by far the largest number of casualties of the Allies, was left with casualties as high as 1,359,000 dead and 361,650 missing. Italy suffered the loss of 689,000 dead and Russia lost 1,700,000 casualties. Germany suffered a staggering 1,600,000 dead with 103,000 missing.<sup>29</sup>

While still trying to recover from the population losses of World War I, European nations faced an even more catastrophic event - the outbreak of World War II. This second major conflict in under a generation caused a significant artificial alteration in the natural evolution of European population.

World War II began on September 1, 1939 when Germany invaded Poland,<sup>30</sup> leading to a devastating war among many of the nations of the world. The effects of World War II would be staggering. Not only were soldiers fighting and killing each other during the course of the War, but the Germans were systematically killing Jews, blacks, Gypsies, homosexuals and generally all of those who the Nazis did not deem to be part of the perfect, though nonexistent “Aryan” race. With approximately 59,600,000 total war-related deaths world-wide, only approximately 18,600,000 of which were military casualties,<sup>31</sup> World War II was assuredly the human conflict that had the greatest impact on the evolution of the human race.

War-related casualties alone were staggering. France would suffer approximately 810,000 casualties. About 25,568,000 Soviet citizens would die. Germany would suffer the loss of approximately 7,060,000, while Poland would lose a total of 6,850,000 people.<sup>32</sup>

---

<sup>29</sup> “Feature Articles: Military Casualties of World War One: Updated Wednesday, 22 March, 2006” (<http://www.firstworldwar.com/features/casualties.htm>, accessed 24 Nov 06)

<sup>30</sup> “World War II in Europe” (<http://www.ushmm.org/wlc/en/index.php?lang=en&ModuleId=10005137>, accessed 16 Nov 06)

<sup>31</sup> “World War II Casualties” (<http://www.fathersforlife.org/hist/wwiicas.htm>, accessed 24 Nov 06)

<sup>32</sup> “World War II Casualties” (<http://www.fathersforlife.org/hist/wwiicas.htm>, accessed 24 Nov 06)

These and other countries' casualties combined with the horrific casualties of the various atrocities committed against civilians would dramatically manifest the extent to which humans could engage in wholesale slaughter in a relatively short period of time. Approximately 90% of all Jews in both Germany and Poland would be killed in the Holocaust, involving about 210,000 and 3,000,000 people respectively. 86% of all Czechoslovakian Jews or 155,000 people would be killed and 75% of the Jews in Holland, estimated at 105,000 people, would be killed. The combined death toll in the countries of Europe as a result of the Holocaust would be approximately 6 million Jews alone. In addition, numerous, though not as high a proportion of Gypsies, homosexuals, blacks, persons with physical and mental disabilities, as well as political opponents of the Nazis would be killed.<sup>33</sup>

On August 6, 1945, a U.S. B-29 bomber, dropped an atomic bomb weighing 9,700 pounds over Hiroshima. Producing a 15 kiloton explosion and a large mushroom cloud above the city, the atomic bomb killed approximately 70,000 people in Hiroshima virtually instantaneously both from the intense heat and the radiation. Later deaths due to long-term exposure to radiation from the bomb may have been as high as 200,000 within the next five years.<sup>34</sup>

The second atomic bomb was dropped on Nagasaki on August 9, 1945. Creating an explosion of 21 kilotons, this atomic bomb caused approximately 40,000 immediate casualties and initially injured about 60,000 people. By January 1946, a total of approximately 70,000 people had died due to exposure to radiation, a statistic which may have even doubled by 1951.<sup>35</sup>

---

<sup>33</sup> "The Holocaust" (<http://www.historylearningsite.co.uk/holocaust.htm>, accessed 24 Nov 06)

<sup>34</sup> "The Atomic Bombing of Hiroshima" (<http://www.mbe.doe.gov/me70/manhattan/hiroshima.htm>, accessed 24 Nov 06)

<sup>35</sup> "The Atomic Bombing of Nagasaki" (<http://www.mbe.doe.gov/me70/manhattan/nagasaki.htm>, accessed 24 Nov 06)

Such devastating capabilities – with the atomic bombs dropped on Hiroshima and Nagasaki being mere precursors to the far more significant capabilities we currently have – demonstrated the abilities of mankind to affect the evolution of the world population in an extremely short period of time. Breakthroughs such as the creation of the hydrogen bomb and yet more lethal thermonuclear weapons have enabled humans to significantly increase our destructive capabilities. The first hydrogen bomb was tested on October 31, 1952 on the island of Elugelap in the Marshall Islands. This bomb, when detonated, generated a 10.4 megaton explosion, destroying the entire island and causing damage elsewhere as well. The hydrogen bomb has unlimited potential for widespread destruction. By merely adding more fuel the destructive capabilities of the hydrogen bomb there are potentially no limits to its potential destructiveness.<sup>36</sup>

With the development of nuclear weapons, and other weapons generally referred to as WMDs (“Weapons of Mass Destruction”), humans have gained the capability of bringing unprecedented destruction and possibly even our own extinction, or an end to our evolution as a species, if we so desire. Though this was assuredly not the intent of those who labored to develop these weapons, they still serve as major breakthroughs in the emerging human influence on natural evolution.

## **Medicine:**

### **Antibiotics**

Despite an ever-increasing ability to control much of our surroundings, until quite recently, human beings could not control the havoc caused by diseases. Many deadly diseases such as syphilis, small pox, tuberculosis, strep and other infections had plagued people

---

<sup>36</sup> “Los Alamos National Laboratory: ‘Mike Shot’”  
(<http://www.lanl.gov/history/postwar/mikeshot.shtml>, accessed 24 Nov 06)

throughout the ages. Finally being able to overcome some of these diseases has been a major breakthrough of recent generations. With the development of antibiotics, powerful disease-fighting agents, people have finally been able to overcome significant obstacles to controlling our health – a key part of directing our evolution and improving our quality of life.

In 1928, Alexander Fleming accidentally discovered the mold *Penicillium notatumy*, generally referred to as “penicillin.” Fleming found that this new mold could cure a staph infection caused by an extremely harmful and even deadly bacteria. However, the true potential of penicillin was only realized under the research of a group of scientists at Oxford University under the direction of Howard Florey. This team of scientists conducted experiments on penicillin mold with live mice beginning in 1935 and ultimately, after achieving great success in curing mice suffering from harmful bacteria, tested penicillin on humans.<sup>37</sup> These tests proved to be surprisingly successful and it appeared as though mankind had found the key to curing disease. Bacteria such as those causing pneumonia, meningitis, bloodstream infections and other infections attacking surgical wounds could easily be cured by penicillin,<sup>38</sup> a huge breakthrough especially during times of war with troops especially prone to bacterial infections due to close living quarters and generally unsanitary conditions. By the end of World War II, over 21 U.S. chemical companies were working on the production of penicillin<sup>39</sup> and the U.S. was manufacturing as many as 650 billion units of penicillin per month.<sup>40</sup>

The great success of antibiotics was due to their function in one of two primary ways. Firstly, antibiotics can attach themselves to crucial

---

<sup>37</sup> “Fleming Discovers Penicillin: 1928-1945”  
(<http://www.pbs.org/wgbh/aso/databank/entries/dm28pe.html>, accessed 26 Nov 06)

<sup>38</sup> “The Bug Stops Here, By Dr. Peter Collignon”  
(<http://abc.net.au/science/slab/bug/default.htm>, accessed 27 Nov 06)

<sup>39</sup> Ibid.

<sup>40</sup> “Fleming Discovers Penicillin: 1928-1945”  
(<http://www.pbs.org/wgbh/aso/databank/entries/dm28pe.html>, accessed 26 Nov 06)

portions of the harmful bacteria's cell walls and destroy them, rendering the microbes defenseless against the body's immune system and leaving the bacteria to self-destruct. Secondly, antibiotics such as erythromycin, tetracycline, streptomycin or gentamicin can attack the bacteria's ribosomes, or small protein-making structures, making the bacteria useless.<sup>41</sup>

While the impact of antibiotics has been significant in warding off previously deadly diseases and infections, there have been some unanticipated consequences. Over the years, many antibiotics have been over-prescribed and overused, causing new, antibiotic-resistant bacteria to evolve. Certain diseases such as gonorrhea, malaria, tuberculosis and even common childhood ear infections have, in recent times, become far more difficult to treat or cure due to antibiotic resistance and the resulting ineffectualness of existing treatments.<sup>42</sup>

Though we may have to continually struggle to keep one step ahead of natural selection in our ability to control our health, by discovering new vaccinations, antibiotics, surgical methods, etc., as we increase our understanding of medicine and the human body, we are able to move towards the human dream of effectively combating disease. Already today, we are able to combat numerous diseases by which our grandparents, or even our parents were threatened as children.

### **Reproductive Control – Fertility and Infertility Controls and Stem Cell Research:**

Improved medical technology has also greatly reduced the effects of a purely Darwinian-type struggle for reproduction. Initially, with the ability to terminate or even to prevent natural pregnancies in healthy, fertile women, humans gained an element of control over our lives as women are now able to choose to put off having children until a more convenient, not

---

<sup>41</sup> "FDA Consumer Magazine, September 1995: The Rise of Antibiotic-Resistant Infections, By Ricki Lewis, Ph.D. ([http://www.fda.gov/fdac/features/795\\_antibiotics.html](http://www.fda.gov/fdac/features/795_antibiotics.html), accessed 9 Oct 06)

<sup>42</sup> "Facts About Antibiotic Resistance" ([http://www.fda.gov/oc/opacom/hottopics/antiresist\\_facts.html](http://www.fda.gov/oc/opacom/hottopics/antiresist_facts.html), accessed 29 Oct 06)

necessarily natural time. With the ability to artificially impregnate a woman, who would otherwise be unable to naturally produce offspring, through reliance on ART (“Assisted Reproductive Technology”) processes, we have gained almost complete control over our own reproduction, drastically altering the natural competition for reproduction. Through new medical technology, we are now able to effectively sidestep certain key issues in the struggle for reproduction, and we are potentially able to sustain life for longer and to improve the quality of life, making improvements that were impossible just a few decades ago.

Women, in particular, gained an element of control over reproduction with the creation of birth control and with doctors’ abilities to conduct relatively safe and easy abortions. Modern day birth control methods are quite effective. Latex condoms have approximately an 86% success rate for avoiding unwanted pregnancies per year.<sup>43</sup> After using a birth control pill – either a progestin pill or a combination estrogen and progestin pill – for a period of one year, success rates for birth control can be as high as 99%. Progestin injections such as Depo-Provera and Noristerat have an almost immediate 99% effectiveness in preventing unwanted pregnancies.<sup>44</sup> Most notably, the newly developed “Morning After,” or Emergency Contraceptive pill, prevents pregnancy by stopping the egg from being released from the ovaries or by preventing the egg from implanting in the uterus with. This pill has anywhere between a 75% and 95% effectiveness if taken within 72 hours of unprotected sex. Other methods including the use of diaphragms, spermicides, as well as the combination of multiple forms of birth control are often used.<sup>45</sup>

---

<sup>43</sup> “MedlinePlus Medical Encyclopedia: Over-the-counter Birth Control” (<http://www.nlm.nih.gov/medlineplus/ency/article/004003.htm>, accessed 16 Nov 06)

<sup>44</sup> “Lifespan’s A-Z Health Information Library: Birth Control Options for Women” (<http://www.lifespan.org/adam/indepthreports/10/000091.html>, accessed 23 Nov 06)

<sup>45</sup> “MedlinePlus Medical Encyclopedia: Over-the-counter Birth Control” (<http://www.nlm.nih.gov/medlineplus/ency/article/004003.htm>, accessed 16 Nov 06)



Additionally, abortions, or “suction curettage,” are being performed with increasing proficiency, allowing couples to choose not to have a child even well after the beginning of the woman’s pregnancy. Abortions are conducted by removing the fetus and placenta from the woman’s uterus through either surgery or medications. Surgical abortions may be easily performed between 6 to 12 weeks of pregnancy, though following 12 weeks the woman is usually put to sleep during the more difficult surgery.<sup>46</sup> They are usually performed by dilating the cervical canal and inserting a hollow tube into the uterus. The fetus and placenta tissues are sucked out with a machine. Oxytocin can be given to reduce uterine bleeding and force the uterine muscles to contract, helping make the abortion run more smoothly and be less painful.<sup>47</sup>

The FDA has recently approved the use of Mifepristone (RU486), a type of antiprogesterin, followed shortly after by the use of misoprostal. Though typically performed before the 7<sup>th</sup> week of pregnancy, i.e. the 7<sup>th</sup> week after the woman’s last period,<sup>48</sup> RU-486, or the “Abortion pill,” can be used as late as 7 to 9 weeks of pregnancy. Mifepristone prevents progesterone from binding to the lining of the uterus, essentially killing the fetus<sup>49</sup> by not allowing nutrients to pass through the placenta to the fetus.<sup>50</sup> Misoprostol medications are administered 36 to 48 hours later and induce contractions in the woman’s uterus, ultimately removing the fetus.<sup>51</sup>

“Assisted Reproductive Technology (ART)” have enabled people to have far more control over sex and reproduction. The first successful “ART” procedure was achieved in

---

<sup>46</sup> “U.S. National Library of Medicine and the National Institutes of Health: Medical Encyclopedia - Medline Plus” (<http://www.nlm.nih.gov/medlineplus/ency/article/002912.htm>, accessed 16 Nov 06)

<sup>47</sup> “U.S. National Library of Medicine and the National Institutes of Health: Medical Encyclopedia - Medline Plus” (<http://www.nlm.nih.gov/medlineplus/ency/article/002912.htm>, accessed 16 Nov 06)

<sup>48</sup> Ibid.

<sup>49</sup> “American Pregnancy Association: Medical Abortion Procedures” (<http://www.americanpregnancy.org/unplannedpregnancy/medicalabortions.html>, accessed 16 Nov 06)

<sup>50</sup> “Cincinnati Institute for Reproductive Health: In Vitro Fertilization (IVF) by Sherif Awadalla, MD” (<http://www.fertilitynetwork.com/articles/articles-ivf.htm>, accessed 16 Nov 06)

<sup>51</sup> “American Pregnancy Association: Medical Abortion Procedures” (<http://www.americanpregnancy.org/unplannedpregnancy/medicalabortions.html>, accessed 16 Nov 06)

England in 1978 by Gynecologist, Dr. Steptoe and Dr. Edwards through the “in vitro fertilization” (IVF) process. Most ART procedures entail surgically removing eggs from the woman, adding sperm in a laboratory setting, then returning the newly fertilized egg through the cervix into the woman’s uterus.<sup>52</sup> However, in vitro fertilization (IVF), the most common infertility treatment, is less invasive, as it is performed without surgery, enabling us to help infertile couples have children relatively easily, regardless of the natural impossibility<sup>53</sup> or ability to withstand surgery.

To begin the IVF process, the woman is given “GnRH agonist” which temporarily stops her ovaries from ovulating and usually receives Lupron supplements two weeks after her ovaries have shut down. Next, Pergonal or other ovulation drugs are administered through injections for about 10 days, preparing the woman’s eggs to be removed.<sup>54</sup> These drugs will stimulate “superovulation” in the woman, or the production of multiple, relatively mature eggs. Drugs used in IVF include the relatively harmless and easy to take Clomiphene, Gonadotropins and Bromocriptine.<sup>55</sup> Finally, the patient is given hCG to insure that the eggs are mature enough and ready to be removed.<sup>56</sup>

“Ultrasound guided vaginal retrieval” – a surgery-free procedure performed by using ultrasound technology to guide a small needle into the ovaries - is used to remove the eggs. The needle takes approximately 5-15 eggs out of the ovaries through the use of suction to separate them from the follicles. Approximately 100,000 sperm are added to fertilize the eggs in a laboratory setting and the newly created embryos are kept in the

---

<sup>52</sup> “Department of Health and Human Services: Centers for Disease Control and Prevention: Assisted Reproductive Technology” (<http://www.cdc.gov/ART/index.htm>, accessed 16 Nov 06)

<sup>53</sup> “Cincinnati Institute for Reproductive Health: In Vitro Fertilization (IVF) by Sherif Awadalla, MD” (<http://www.fertilitynetwork.com/articles/articles-ivf.htm>, accessed 16 Nov 06)

<sup>54</sup> Ibid.

<sup>55</sup> “Fertility Drugs for Women” (<http://www.babycenter.com/refcap/preconception/fertilityproblems/4091.html>, accessed 16 Nov 06)

<sup>56</sup> “Cincinnati Institute for Reproductive Health: In Vitro Fertilization (IVF) by Sherif Awadalla, MD” (<http://www.fertilitynetwork.com/articles/articles-ivf.htm>, accessed 16 Nov 06)

laboratory for at least 3-6 days until they have grown to 6 to 8 cells and are ready for implantation in the woman. Finally, 3 or 4 fertilized eggs are implanted in the woman through a catheter connected to the woman's cervix, a fairly easy and noninvasive procedure. Follow up pregnancy tests are taken two weeks later to be sure that the embryo did in fact implant itself.<sup>57</sup>

Particularly as a result of IVF, it is now no longer as important to choose a reproductively healthy mate from an evolutionary standpoint, as even people who are not naturally capable of reproducing are potentially able to have children through the use of recent technological improvements. Those deemed to be evolutionarily weaker or less fit are now effectively able to combat their natural fate, the result of natural selection, using artificial means as most ART procedures are becoming simpler and more reliable. Despite currently somewhat limited accessibility, since ART procedures can be both costly and difficult to perform effectively, as we continue to improve these technologies, the human hand becomes more visible in our own evolution.

According to the Human Fertilisation and Embryology Authority, success rates for infertility procedures such as IVF currently range from 10% to 46% and are steadily increasing.<sup>58</sup> During 1998 and 1999, the success rate for all IVF cycles was 19.5% as compared to 21.8% in 2000 and 2001. Additionally, success rates are usually higher in younger women, with a success rate as high as 22.1% in 1998 and 1999 for women under 38 years old. This would increase by 3% as of 2000 and 2001.<sup>59</sup> However, success rates vary greatly based on the fertility clinic, and costs are still high. Costs for IVF procedures currently range from \$6,000 to \$7,000 per cycle. There are also currently a number of difficulties in achieving successful implantation of the

---

<sup>57</sup> Ibid.

<sup>58</sup> "Data on IVF Clinics Show Wide Variation In Success Rate, By Roger Dobson"

(<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1169457>, accessed 16 Nov 06)

<sup>59</sup> Ibid.

embryo on the first IVF cycle, often resulting in many children,<sup>60</sup> making evolutionarily “unfit” parents (as defined by not being able to reproduce naturally) using the IVF procedure likely to have more children than evolutionarily “fit” parents who choose to have fewer offspring. However, this technology is continuing to improve and become more standardized and affordable, giving humans the potential to successfully gain tremendous abilities for regulating a key component of the Darwinian struggle – reproduction. As a result of

these various medical advances, couples are now increasingly able to choose if they will have children, when, as well as how many they will have – revolutionizing sex, making it no longer a purely natural evolutionary process, but rather subjecting it to society’s wishes. Relatively safe, easy abortions, and birth control have served to lessen the degree to which a non-directional, Darwinian-type struggle occurs. Furthermore, people are now able to choose the gender of each child they will have. The struggle between the stronger and the weaker for reproduction is virtually a non-issue, or has possibly even been reversed, as many people who would be successful from a natural evolutionary standpoint, i.e. strong, healthy people, choose to have fewer children, or even not to reproduce at all - something which can be facilitated in light of modern reproductive techniques - thereby no longer passing on their genes into the world of Darwinian competition.

By building off of knowledge obtained through ART and growing embryos in laboratory settings, scientists discovered stem cells – cells that are like no other type of human or animal cell. Stem cells have the unique potential to be grown into any type of cell. In a laboratory setting, they may be grown into differentiated cells with specific functions and characteristics. When grouped together, stem cells can form specific tissue types and, ultimately, may create

---

<sup>60</sup> “Cincinnati Institute for Reproductive Health: In Vitro Fertilization (IVF) by Sherif Awadalla, MD” (<http://www.fertilitynetwork.com/articles/articles-ivf.htm>, accessed 16 Nov 06)

complete human organs. Stem cells appear to be more effective in regenerative work than ordinary human cells.<sup>61</sup> They are “totipotent,” genetically undifferentiated cells that can divide and grow into any of the 210 different human tissue types. They can be grown into human tissue, organs, or other stem cells, creating stem cell “lines.” Ordinary human cells are differentiated and can multiply to form other cells, but, unlike stem cells, these cells will only possess the specific characteristics of the original ones.

If healthy artificially created embryos are grown in a laboratory setting, they may develop into particular cells, tissues, or even organs and then be transplanted into patients to replace their diseased counterparts. This technology could help people who suffer from spinal cord injuries, juvenile diabetes, Alzheimer’s, Parkinson’s, and heart disease. New cures could be found for diseases once considered to be fatal.

By merging stem cell technology with “cloning,” the potential for tissue engineering may be limitless,<sup>62</sup> enabling people to gain more control over our health and possibly enabling us to live longer. “Therapeutic cloning” aims to produce replacement cells to heal the sick. If a person needs an organ transplant, a new organ could be grown in a laboratory and placed into the patient’s body without risk of rejection or the need to use potentially harmful anti-rejection drugs. The new organ would be created from a single cell extracted from the patient. The nuclear DNA from the patient’s cell would be removed and injected into a denucleated egg cell, which would create a nearly exact replica of the patient’s cell. Stem cells could be extracted from this replica and grown into the organ that needs to be transplanted, sidestepping numerous health issues and artificially preserving those who would not naturally be preserved.

---

<sup>61</sup> Eisenberg, Daniel. “Stem Cell Research in Jewish Law.” <http://www.jlaw.com/Articles/stmcellres.html>, November 9, 2001.

<sup>62</sup> Weiss, Rick. “First Human Embryos Are Cloned in U.S.” Washington Post, November 26, 2001.

## **Conclusion:**

Despite some unpredicted and undesirable results of mankind's attempts to control our evolution, overall, humans have increasingly been able to shape our environment and fulfill many of our desires. The potential for an ever-increasing enhancement of the quality of human life, as viewed from our current perspective, is virtually unlimited as we continuously discover new and successful ways to control our lives and to diminish the impact of natural forces.

Despite such potential, we must be ever-vigilant and constantly try to better understand the effects of our actions, knowing that everything that we do now will affect generations to come, either positively, or negatively. The consequences of this growing ability to impact natural evolution, if not carefully considered, could so drastically alter evolution as to temporarily destroy its inherent self-regulating and beneficial balancing mechanism. Before manipulating the forces of nature too extensively, mankind must find the means by which to better understand natural evolution and must learn to better appreciate the consequences of tampering with this process. The future is, more than ever, in our hands. The more we humans evolve, the more powerful the human hand is becoming as a force for altering the role of natural evolution.

## **Bibliography**

### **Population control – China's One Child Policy:**

“China Steps up ‘one child’ policy: Monday, 25 September, 2000”  
(<http://news.bbc.co.uk/2/hi/asia-pacific/941511.stm>, accessed 20 Oct 06)

“One-Child Policy in China: Arthur E. Dewey, Assistant Secretary for Population, Refugees and Migration: Testimony before the House International Relations Committee, Washington, DC, December 14, 2004” (<http://www.state.gov/g/prm/rls/39823.htm>, accessed 20 Oct 06)

“The New England Journal of Medicine: health policy report September 15, 2005: ‘The Effect of China's One-child Family Policy after 25 years’ By

Therese Hesketh, Ph.D., Li Lu, M.D., and Zhu Wei Xing, M.P.H.”  
(<http://content.nejm.org/cgi/content/full/353/11/1171>, accessed 5 Nov 06)

“Parliamentary Research Service: Research Note number 41, June 6, 1995: ‘China’s One Child Policy””  
(<http://www.aph.gov.au/LIBRARY/Pubs/rn/1994-95/95rn41.pdf>, accessed 20 Oct 06)

## **War – World Wars I and II and their aftermath:**

“America’s Hydrogen Bomb”  
(<http://www.pbs.org/opb/citizenk/superbomb/americanbomb.html>, accessed 26 Nov 06)

“Feature Articles: Military Casualties of World War One: Updated Wednesday, 22 March, 2006”  
(<http://www.firstworldwar.com/features/casualties.htm>, accessed 24 Nov 06)

“Los Alamos National Laboratory: ‘Mike Shot””  
(<http://www.lanl.gov/history/postwar/mikeshot.shtml>, accessed 24 Nov 06)

“U.S. Census Bureau: World Population Profile – 1998 Highlights”  
(<http://www.census.gov/ipc/www/wp98001.html>, accessed 4 Dec 06)

“The Atomic Bombing of Nagasaki”  
(<http://www.mbe.doe.gov/me70/manhattan/nagasaki.htm>, accessed 24 Nov 06)

“The Atomic Bombing of Hiroshima”  
(<http://www.mbe.doe.gov/me70/manhattan/hiroshima.htm>, accessed 24 Nov 06)

“The Holocaust”  
(<http://www.historylearningsite.co.uk/holocaust.htm> - accessed 24 Nov 2006)

“World War II Casualties”  
(<http://www.fathersforlife.org/hist/wwiicas.htm> accessed 24 Nov 06)

“World War II in Europe”  
(<http://www.ushmm.org/wlc/en/index.php?lang=en&ModuleId=10005137>, accessed 16 Nov 06)

## **Medicine:**

### **Antibiotics**

“Facts About Antibiotic Resistance”  
([http://www.fda.gov/oc/opacom/hottopics/antiresist\\_facts.html](http://www.fda.gov/oc/opacom/hottopics/antiresist_facts.html), accessed 29 Oct 06)

“FDA Consumer Magazine, September 1995: The Rise of Antibiotic-Resistant Infections, By Ricki Lewis, Ph.D.”

([http://www.fda.gov/fdac/features/795\\_antibio.html](http://www.fda.gov/fdac/features/795_antibio.html), accessed 9 Oct 06)

“Fleming Discovers Penicillin: 1928-1945”

(<http://www.pbs.org/wgbh/aso/databank/entries/dm28pe.html>, accessed 26 Nov 06)

“The Bug Stops Here, By Dr. Peter Collignon”

(<http://abc.net.au/science/slab/bug/default.htm>, accessed 27 Nov 06)

### **Reproductive Control - Fertility and Infertility Controls and Stem Cell Research:**

“American Pregnancy Association: Medical Abortion Procedures”

(<http://www.americanpregnancy.org/unplannedpregnancy/medicalabortions.html>, accessed 16 Nov 06)

“Data on IVF Clinics Show Wide Variation In Success Rate, By Roger Dobson”

(<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1169457>, accessed 16 Nov 06)

“Department of Health and Human Services: Centers for Disease Control and Prevention: Assisted Reproductive Technology”

(<http://www.cdc.gov/ART/index.htm>, accessed 16 Nov 06)

“Fertility Drugs for Women”

(<http://www.babycenter.com/refcap/preconception/fertilityproblems/4091.html>, accessed 16 Nov 06)

“In Vitro Fertilization (IVF) by Sherif Awadalla, MD Cincinnati Institute for Reproductive Health”

(<http://www.fertilitynetwork.com/articles/articles-ivf.htm>, accessed 16 Nov 06)

“Lifespan’s A-Z Health Information Library: Birth Control Options for Women”

(<http://www.lifespan.org/adam/indepthreports/10/000091.html>, accessed 23 Nov 06)

“MedlinePlus Medical Encyclopedia: Over-the-counter Birth Control”

(<http://www.nlm.nih.gov/medlineplus/ency/article/004003.htm>, accessed 16 Nov 06)

“U.S. National Library of Medicine and the National Institutes of Health: Medical Encyclopedia - Medline Plus”

(<http://www.nlm.nih.gov/medlineplus/ency/article/002912.htm>, accessed 16 Nov 06)