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IT IS 200 YEARS SINCE CHARLES DARWIN WAS BORN AND 150 YEARS SINCE THE PUBLICATION OF "ON THE ORIGIN OF SPECIES". IN YOUR VIEW, WHAT EVOLUTIONARY DEVELOPMENTS ARE NEEDED TO ENSURE THE CONTINUING SURVIVAL AND WELL BEING OF HUMANITY?

In answering this question it is important to recognise that further evolution of humans would not ensure human survival, rather produce a new refined species that would supersede humanity. Paradoxically the survival of humans depends on our ability to avoid evolutionary development. However, I shall assume that the question really means the 'survival and well being' of future generations.

Although difficult to measure empirically, 'well being' implies a period of continued peace, prosperity and equality in society. Under this definition the current well being of our race is questionable; there are several international wars, half the world population live on less than \$2 per day¹, and the richest 25% of the world's population receives 75% of the world's income². The well being of future generations looks to be even more under threat with further vicissitudes to face such as exponential population growth and climate change due to global warming. Clearly people aren't going to achieve a better quality of life through Darwinian evolution, but can it safeguard our survival?

'Survival' can be defined as the enduring existence of a species to avoid extinction. Arguably there is very little risk of human extinction; humans have survived 155,000 years³ on Earth all ready and have adapted to become the dominant predator in almost

¹ <http://www.christianaid.org.uk/issues/lifeonthemargins/facts/index.aspx>

² <http://ucatlans.ucsc.edu/income.php>

³ <http://www.timeshighereducation.co.uk/story.asp?storyCode=177310§ioncode=26>

every environment. There are two plausible scenarios in which humans are threatened by extinction.

The first is an apocalyptic natural disaster, on the same scale as that which is thought to have wiped out the dinosaurs. This may seem unlikely, but let us consider the eruption of an active volcano such as the one in Yellowstone National Park USA. According to a computer-generated model by the UK's MET Office⁴ an eruption at Yellowstone would eject 1000 cubic kilometres of ash and gas into the atmosphere. Within a 1000km radius of the blast zone 90% of the population would be quickly killed by the inhalation of toxic ash. However the real threat to human survival would come from the consequences of long-term climate change. The computer model predicts that the 2000 million tonnes of sulphur released would block out the sun for 2 – 3 weeks causing crop failure. The planet would also cool by an average of 10°C, wreaking havoc with the climate. In addition to this, subsequent growing seasons could fail due to the prolonged presence of sulphur dioxide in the atmosphere causing acid rain. Based on geological data, massive eruptions at Yellowstone happen roughly every 600,000 years⁵. Rather disconcertingly, the last super eruption at Yellowstone was just over 600,000 years ago...

The second such scenario is the outbreak of a third world war fought on a nuclear scale. Greenpeace estimates the number of nuclear weapons held by governments worldwide at 30,000⁶. Although a nuclear war seems altogether less likely than it did 40 years ago, the US government still spends \$27 billion annually to prepare for such an event⁷. The consequences of nuclear war are hard to envisage as weapons technology has hugely improved since the bombing of Hiroshima and Nagasaki at the end of WW2. However we can predict that not only would millions of people die from the bombs themselves and the subsequent radiation, but that also faces a 'nuclear winter'. This is the term used to describe the climatic effects of nuclear war including ozone depletion and severe global cooling due to smoke blocking out the sun⁸.

⁴ <http://www.bbc.co.uk/sn/tyradio/programmes/supervolcano/article2.shtml>

⁵ http://vulcan.wr.usgs.gov/Volcanoes/Yellowstone/description_yellowstone.html

⁶ <http://www.greenpeace.org/international/news/5-minutes-190107>

⁷ <http://www.cdi.org/nuclear/facts-at-a-glance.cfm>

⁸ http://en.wikipedia.org/wiki/Nuclear_winter

In either scenario described above, it is inconceivable that the human race will undergo Darwinian evolution to form an anatomically different species. The survival of future generations would much more likely hinge on our ability to cooperate and share resources, along with the application of technology. Again we find Darwinian evolution irrelevant in a modern context.

So far I have considered evolution from a purely Darwinian perspective and we have established its irrelevance in ensuring the survival and well being of future generations. In his book 'The Selfish Gene' Richard Dawkins applies the principles of natural selection to the survival of successful ideas and cultural phenomena⁹. He introduces the concept of a 'meme', a unit of cultural information analogous to biological genes. This unit of culture can refer to almost any idea or concept, from religion, art and fashion through to scientific theories and material inventions. Like genes, memes are replicated, mutated and merged together to create new more successful memes. The success of a meme can be measured by its popularity and its enduring impact on society. In the context of preserving human 'survival and well being', Dawkins evolution of society through memes seems much more applicable than the Darwinian version.

Scientific developments constitute some of the most important memes in modern society, and I believe that science has boundless potential to secure the survival and well being of future generations. However scientific innovation can also be used to destructive ends, the most regrettable example being the Manhattan project in the 1940's. I believe that scientists must consider the consequences of their work and act responsibly, to avoid history repeating itself. We will now explore just a few of the positive implications of modern science.

The use of GM (genetically modified) crops to help solve the world's poverty crisis has become a controversial issue over recent years. In the face of exponential population growth, a changing climate and less agricultural land available (due to rising sea levels) we need crops which have a higher yield, and are more resistant to changes in the environment. The process of genetic engineering involves the insertion of a desirable gene from one organism to

⁹ 'The Selfish Gene' by Richard Dawkins (1979).

another using a vector (which can be a virus or a DNA gun)¹⁰. This allows biologists to select desirable traits in crops to make them more resistant to drought, flooding, pesticides and salinity of the soil. Critics of GM crops say that they could mutate to create a 'superweed' resistant to all known pesticides and that organic products are healthier¹¹. Whilst I concede that there are always risks where genetic engineering is concerned, I think that they are worth taking as an alternative to letting people starve. Despite their tarnished reputation GM crops can genuinely help poor farmers in the third world to increase their yield and to reduce their dependence on expensive and polluting pesticides.

Scientific advancements can also be used to tackle growing concerns over climate change. In an attempt to outgrow our dependence on the dwindling supply of fossil fuels we must develop cheap renewable energy sources. Existing technologies include wind, solar, hydroelectric and tidal power. If 'cold' fusion could be achieved then its energy production would dwarf that of all the aforementioned renewable energy sources. Fusion involves the collision of two nuclei to create a third particle which has less mass than the sum of its constituents. The mass lost is converted into energy by Einstein's famous equation: $E=mc^2$ (where e =energy, m =mass, c =speed of light, roughly equal to 300,000,000m/s). Evidently a lot of energy can be produced from a very small mass. Fusion powers the sun and is far more powerful than the nuclear fission used in current power stations and warheads. As fusion usually involves the collision of two heavy hydrogen isotopes (tritium and deuterium) to produce helium that is chemically inert, we can safely say that fusion is a clean process, unlike fission which produces dangerously radioactive by-products. Could fusion be properly controlled at manageable temperatures it could be a massive step towards saving the world's energy problems.

The total body of medical knowledge is set to double in the next 5 years, which will undoubtedly cause colossal improvements in the healthcare sector¹². Stem cell research is currently a very exciting area of medicine. Stem cells are cells that are yet to adopt a

¹⁰ 'A New Introduction to Human Biology (AQA Specification A') – Published by Hodder Murray 2000.

¹¹ <http://www.guardian.co.uk/science/2005/jul/25/gm.food>

¹² http://www.mmissions.org/mbc/home_mbc.html

specific function, so can theoretically be manipulated to change in to any cell type in the body. The use of stem cells could be applied to many branches of medicine to repair tissue damage all over the body from livers to kidneys and even eyes. Research in this is typically regarded as controversial as there have been cases of stem cell extraction from human embryos, but stem cells can also be harmlessly harvested from adult bone marrow. I believe that we are to truly achieve 'well being' defined as continued peace, prosperity and equality in society a widespread cultural evolution must take place. Unfortunately the implementation of new scientific advancements alone will not suffice.

In order to achieve peace, international organisations such as the UN and the G8 must work towards nuclear disarmament and ultimately the abolition of war. This may seem like an unrealistic objective but I have faith that a time will come when war will be largely seen as an unacceptable way to resolve conflict.

Prosperity and equality are very difficult to accomplish on a global scale and it could be argued that under a capitalist system universal prosperity can never be achieved. However the balance between quality of life in western countries and the third world is disgustingly skewed and must be readdressed. Western governments need to reassess their foreign aid policy starting with the cancellation of 3rd world debts. Again I concede that these goals may seem unobtainable but if we fail to act now then we must live with the consequences and the associated guilt.

In summary we have established that although the survival of the human race seems probable in the foreseeable future, our well being as a species is constantly under threat. We have discussed the inability of Darwinian evolution to improve equality in standards of living and have moved instead towards Dawkin's idea of cultural evolution. In working towards a universal state of human well being we must change our attitudes to war, poverty and inequality as well as to implement beneficial scientific advancements. I believe that we all have a duty to work towards the evolution of a society which is peaceful, prosperous and genuinely equal.