The Sutton Grammar School Biology Magazine

Issue 7

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Blade Runner

Could Being Disabled Give You a Biological Advantage?

By Dominic Somerville-Brown

Most people would believe that two legs are a pretty vital prerequisite for a champion athlete. South African runner Oscar Pistorius would say otherwise. Born without fibulae, he was operated on at the age of one and both his legs were amputated below the knee. Nonetheless, prosthetics enabled him to walk and by high school, Pistorius was swimming and playing rugby to a good standard. It was only three years ago he took up running and today holds the disabled world records for an astonishing three events: the 100m, 200m and 400m. This seems like an amazing rags-to-riches tale but it is one fraught with controversy; cries of 'cheat!' permeate the cheers at nearly every event. In many athletic circles he is seen as an interloper, persona non grata to the extent that he is banned from competing in this year's Paralympics.

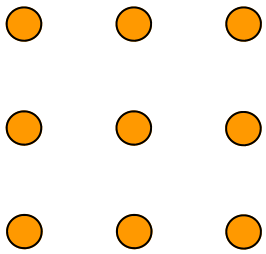
But what is it about this man's apparent success that is so divisive? He is not a steroids user. Indeed, he has never failed a drugs test in his life. No, the source of contention is his artificial limbs. The International Association of Athletics Federations has ruled that they give Pistorius an unfair edge over other competitors and even conventional athletes. Extensive biomechanical testing by numerous laboratories has shown his carbon fibre attachments to be more efficient than normal legs as less energy is wasted per stride i.e. more of Pistorius's energy goes into movement rather than being 'lost' as heat. In the world of running, where milliseconds can be the difference between a champion and fourth place, such a device is exceptionally contentious. Moreover, the 'Cheetahs' allegedly extend his legs beyond the length they would have been, disability notwithstanding.

As one might expect, the ban was angrily contested by Oscar Pistorius and co. who argued that the inherent weaknesses of the prosthetics – a tendency to move in the wind and an inability to grip wet ground – offset the benefits. They also cited the works of independent scientists who disputed the findings of the officially-endorsed bodies. Nonetheless, the IAAF upheld the ban with a clear message: in normal conditions, the Cheetahs illegally enhance performance. Perhaps a closer look at the man's records substantiates this view: his 100m time is faster than any woman on the planet and little more than a second behind Asafa Powell's 9.74. The case is the same at longer distances: he runs the 400m in 46.56 seconds; Michael Johnson did it in 43.18. Pistorius will continue to fight the ban, arguing that his achievements are mainly a result of natural speed, strength and determination. The evidence, however, is strongly and unfortunately stacked against him.

(related article on page4)

Mind Tricks

Can you join all of the dots in the picture below together with just four, continuous straight lines?



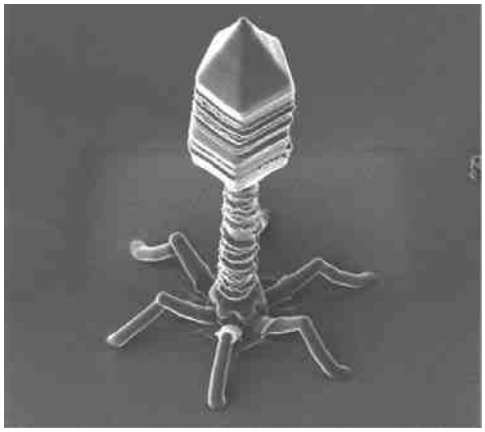
See overleaf for the solution

Inside This Issue of Life

Viruses

By Adam Gillis

A virus is an extremely small particle, which can have devastating effects on the body. This means that viruses are pathogens, the name is given to microorganims/particles that are harmful to us and other organisms.



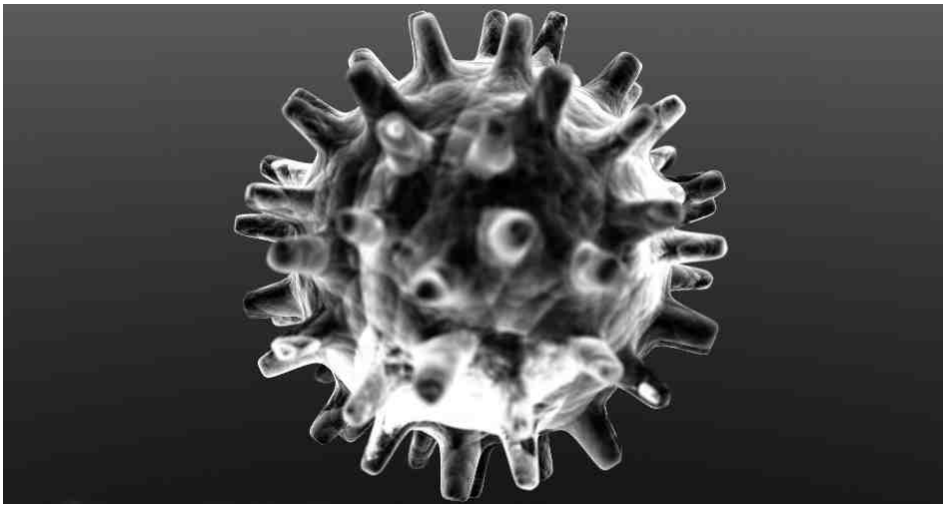
Viruses are usually around the size of 0.02 - 0.1 micrometers, which is basically 5 times smaller than any bacterium. Most viruses have fairly regular shapes; however, some have very abnormal figures. Shown adjacent is a virus called bacteriophage.

Despite the unique features of many viruses, they all have a few things in common. All viruses are made up of a protein coat which surrounds simple genetic material. This part is called the capsid, and is present with every virus.

Viruses need a host cell to reproduce, no matter what its classification. Bacteria simply reproduce by duplicating themselves, whereas a virus has to enter a living cell, where it can reproduce rapidly. The virus hides away from our immune system inside the cell, and uses some of the cells energy and nutrients like protein to help it duplicate even quicker. Soon, the cell will be infested, and at that point the viruses break down the host cell and destroy it, enabling them to spill out and repeat the procedure on other cells. That is how viruses reproduce and cause infectious diseases.

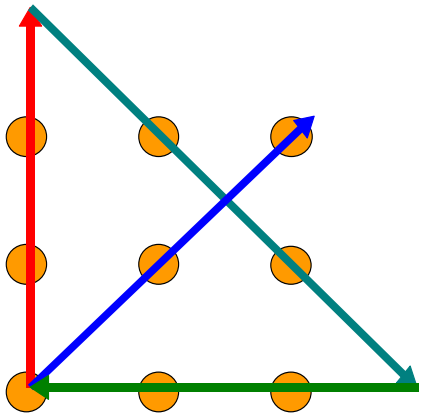
Viruses are usually much more dangerous than bacteria, and so the immune system has a difficult job taking them down. Firstly, as they are so small, they can easily bypass the cell membrane of a cell, permitting the 'invasion' process to begin. Secondly, your white blood cells cannot easily neutralize viruses, as they can remain undetected in the host cell, and they are constantly mutating, which means that antibodies, (produced by white blood cells that aid in the neutralization of microorganims by 'recognising' them), do not work. So, by the time a new one is created, the virus changes again. As a result the process of removing them is delayed significantly, enabling the disease to become worse and symptoms heightened. Lastly, medicines like antibiotics that can kill bacteria cannot do the same for viruses. This is due to the fact that it is very difficult to destroy the viruses without killing the host cells.

Regardless of viruses being classed as microorganisms, there is a massive debate as to whether viruses are actually living. They do not fully meet with the definition of life, so technically are not living organisms. Viruses can only replicate, (different from reproduction) – they cannot even move by themselves, they just wait for a host cell to arrive for them to enter and take over. However, viral genes can evolve by natural selection, so many people describe virus being on the edge of life.



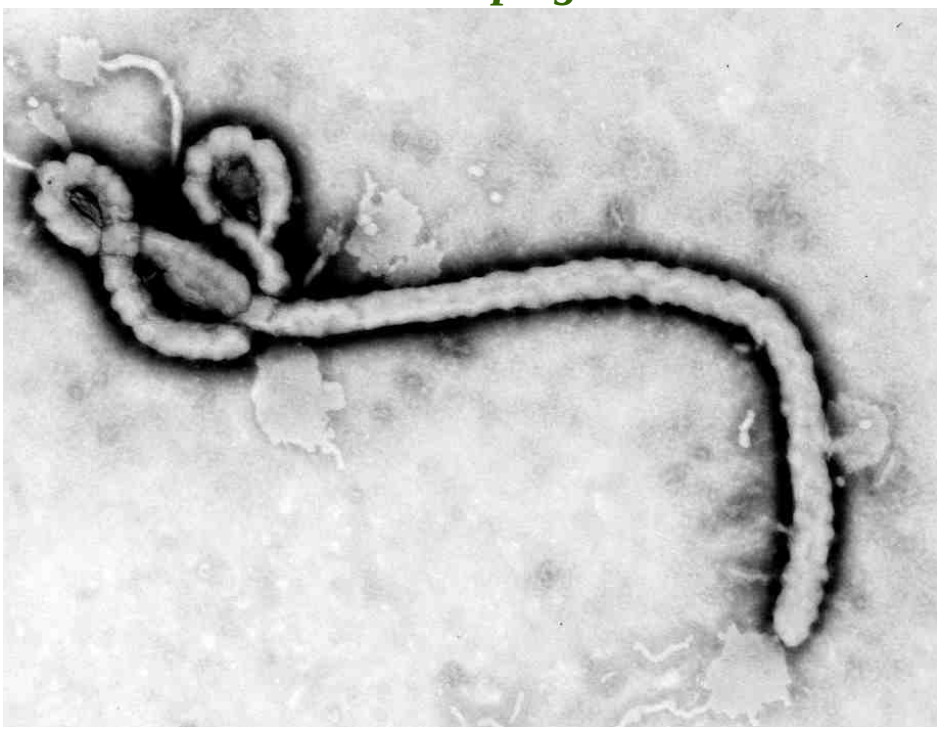
Solution

A majority of people attempt to join the dots, without breaching the square boundary that they create – in this way, joining all 9 of the dots with just 4 continuous lines is impossible. The lines must be extended further, in order to join them all together. This is where the phrase 'thinking outside the box' comes from.



Amis' Ailments

'Another look at some of the more obscure and gruesome illnesses that plague mankind' - Ebola



By Sam Amis

Despite what many may think, the purpose of these articles is not to inspire a mass panic or create a new generation of paranoid hypochondriacs afraid to leave their homes. It is simply because I, like you other sick-minded individuals, find this stuff interesting. Plus I had nothing better to do as apparently a bird was nesting on our sky dish so we weren't getting any signal. I decided therefore to scour the web for the most disgusting and horrific disease known to man….. And I think I've found it.

The electron micrograph photo above depicts the seemingly innocent and harmless Ebola virus Filoviridae, widely considered the deadliest virus of all time, responsible for what is known as Ebola hemorrhagic fever.

From its discovery in 1976, in outbreaks across central Africa, it has been classified as a bio-safety level 4 agent (in a 1-4 scale) and a category A bioterrorism agent. Investigated extensively by both the US and USSR during the cold war as potential biological weapons , Ebola has fortunately been confined to small, isolated villages as it kills its victims to quickly to result in an epidemic. Of the several strains of Ebola, Filoviridae is the most virulent with a 90% mortality rate.

The symptoms of the hemorrhagic fever that result from infection by Ebola are sudden and aggressive. The severe fever of the initial stages of the diseases are accompanied by throbbing headaches, muscle and joint pain and weakness as well as exhaustion dizziness and nausea. These early symptoms are easily mistaken for typhoid, malaria, dysentery or influenza; all considerably more common and less deadly illnesses. As the virus rapidly establishes its dominance over the immune system, it reacts with the platelets in the blood to produce billions of jagged cell sized chemicals that cut chunks out of the walls of capillaries and minor arterioles causing mass haemorrhages. As a result the disease quickly progresses to cause diarrhoea with bloody faeces, vomiting blood, blood shot eyes as capillaries in the sclera rupture, maculopapular rashes and purpura as the vessels closest the surface of the skin also rupture, and even external bleeding. Finally, the millions of tiny cuts cause hypotension (low blood pressure), hypovolemia (low blood volume), and tachycardia (rapid heart rate) which result in multi-organ failure and a painful death.

An example of a maculopapular rash

As outbreaks of the disease are sporadic, the virus must have a natural reservoir, believed in this case to be fruit bats, which are capable of sustaining the virus without contracting it and thus effective at spreading it. The virus is currently decimating lowland gorilla populations in central Africa and the first human cases are believed to have been contracted from handling these deceased gorillas. In humans the virus is transferred by direct contact with contaminated body fluids, which, due to the nature of hemorrhagic fever, there tend to be a lot of. The tendency of the disease to cause bleeding from the majority of external orifices has led to it featuring in extensively in the media, namely in Tom Clancy's novel 'Rainbow Six' and the film '28 Days Later,' where the 'rage virus' is a mutated Ebola virus.

There is no known vaccine to protect against infection and no known cure to the disease. All that can be done is help replenish lost blood and fluids as well as maintaining oxygen and coagulation factor levels to help repair the internal vessel damage. However, this kind of treatment often only serves to slow the inevitable progression of the disease and expends large volumes of vital fluids that could be better used to help someone else. The most recent and notable outbreaks of the disease were in the republic of Congo where 103 people died in August 2007 and in Uganda where the initial death toll of 25 people has been rising since November, reaching over a hundred just a few weeks ago.

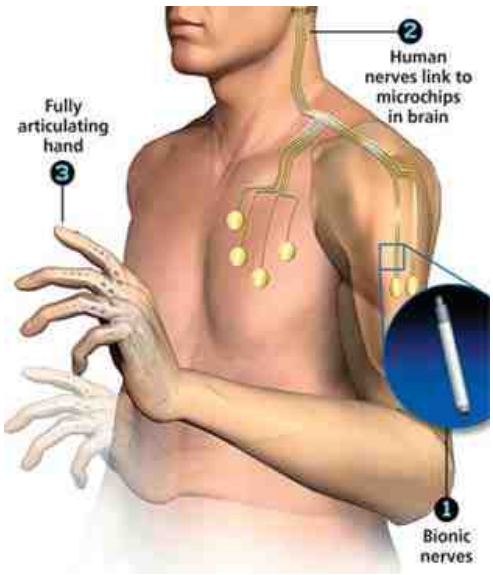
Bionics - The Future of Disability

By Nick Pepper

Bionics has been used for hundreds of years without us really thinking about it, for example when people lost their legs in war, they would have to have it amputated and would sometimes replace the missing limb with a wooden leg. Amputation still goes on today but, instead of replacing the leg with that of an average man's, can we instead chose to have the legs of an athlete?

Kevin Warwick is a modern day cyber man from Reading University, he has wired his nervous system to a computer and had a tiny ultrasonic microchip implanted in his arm. This has caused him to gain several unbelievable traits. Firstly he has trained himself to be able to navigate himself ultrasonically by recognising the pulses that an object gave as he moved closer towards it. He could move unimpaired even whilst wearing a blindfold. Another effect is Kevin's new found ability to detect mobile phone signals, whilst studying his brain patterns on screen he realised his brain activity increased when a researcher received a text message. This is not the only success in the field of implantation, implants have been successful in making blind people improve their vision and deaf people hear well.

Advances have been made in prosthetics to allow us to replace lost limbs and now a new generation of artificial limbs called I limbs are completely controlled by the nervous system. If it were not for the metal they were made out of they could almost be 'real' limbs. As well as this, the same implants used on the likes of Kevin Warwick can be used to enhance the characteristics of a human being. Researchers are now working on



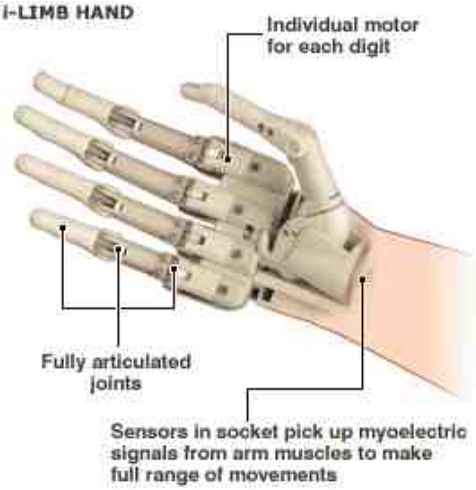
ways to connect humans directly to the internet. But, the question remains, can a person chose to have a limb if it increases their physical qualities?

The answer is likely to be yes. With the control of prosthetic limbs advancing at such a fast rate the only thing left to distinguish between a prosthetic hand and a real limb of flesh and blood is that the prosthetic limb when felt is clearly made of metal. But this may be about to change, scientists have found a way to make synthetic tissue using placenta cells to make a tissue matrix. This, coupled with complete nervous control of the limb gives the 'wearer' a feel as though the limb was completely natural. These prosthetics, when combined with an implant to give it mechanical precision will make a persons limb infinitely superior to the 'original'. The possibilities are endless; athletes could have further increase their pace with a new set of legs or soldiers with eyes to give them eagle eyes.

Of course, if a human can be made more like a machine then a machine can become more like a human. Recently a batch of human nerve cells were grown and trained to fly an aircraft simulator. Could the machines of the future be piloted by lumps of flesh?

Such questions pose a number of ethical questions. Is it right to give a perfectly fit human a set of bionic arms to increase their strength? When does a human stop being a human? Why would people stick to having old limbs when they could have life like, more efficient artificial ones? There are also security issues, some worry that an uplink to the internet inside the human brain could lead to a series of computer viruses released by hackers that could have drastic consequences.

In summary, the future could be a bright one for survivors of car crashes and war veterans and perhaps even brighter for humanity itself.



Science in crime

By Oliver Curwen

The Case: The Umbrella Murder

On the 7th of September 1978, Georgi Markov was jabbed in the foot with a poison tipped umbrella by a KGB agent. Three days later, he died. Scotland Yard ordered an autopsy to be taken place. A metal pellet was found embedded in Markov's calf. It had two holes in it and traces of ricin were found on the inside. There was a specially designed sugary coating around the pellet which was made to melt at 37°C. Ricin is a poison extracted from the castor bean and is lethal. It is 6,000 times more powerful than cyanide. There is still no known cure to ricin poisoning.

However, the US military have developed a vaccine. If a person survives from ricin poisoning it is likely that (s)he will suffer from long-term organ damage and may die from shock. Ricin is not traceable.

My Score for this poison: 9/10. It is effective, leaving enough time for the killer to get away. There is no cure but it is hard to get and expensive to use.

The Castor Bean that Ricin is extracted from

‘Tomorrow’s People’

By Tom Irons

‘Tomorrow’s People’ is a biologically based book written by Baroness Susan Greenfield who is a highly acclaimed neuroscientist. In this, she attempts to argue and explain how new technology, ranging from information communication technology to biomedicine, and ways of thinking will alter lives of the future, mainly based around the future of 21st century technology. She examines ten topics in particular, vaguely discussing them and approaching different views and possible predictions on the general subject.

The first chapter: ‘The Future: What Is The Problem?” seems to examine nothing in particular and seems to be a summary of recent scientific advancements and a comparison between what humans were like and what they are like now, with a few famous quotes and other people’s opinions mixed in there too. She seems to classify groups of anonymous people as *‘the cynics’*, *‘the technophiles’* and *‘the technophobes’*, seemingly to compare attitudes of different people to technology then and now. She does however correctly state that there will be a growing rift in society between the technologically able and those that are not, leading to not such as rosy future. This is a short chapter and is best described as an introduction to the entire content of the book.

Set somewhere in the future, the second chapter ‘Lifestyle: What Will We See As Reality?’ has the general purpose to examine what the lifestyles of normal people will be like in the future (however place or timescale is not mentioned…or extremely varied throughout). At the start of the chapter, it can be hard to see what point she is trying to make, as it is many pages into the chapter before it really starts, and this is a common trend for the book as a whole, to branch off on a marginally related subject for pages at a time, after which you have completely forgotten the last relevant point made and have lost your train of thought. If you read it carefully, you will however be able to find the key ideas jumbled into this book. It is interesting that she believes that in the future people will go so far as to have a ‘natural room’ in their gadget laden home for the sole purpose of perhaps having a good old fashioned conversation(!) As Baroness Greenfield is by no means an acclaimed computer scientist, her predictions could be taken with a pinch of salt – some of them sound more like a scene you might find in ‘*Harry Potter*’ (weather animated ceilings etc). As stated in the preface, this book is close to fiction (at least for Baroness Greenfield herself.) However, as the future is incredibly hard to predict, it could all become reality…another interesting point raised by Greenfield was how absolutely everything (except in the ‘natural room’) would be ‘smart’ i.e. seemingly conscious and able to react as a human would, leading to an inevitable high level of automation.

About us, perhaps, ‘Robots: How Will We Think Of Our Bodies?’ This is the chapter in which Greenfield is best able to go into extreme detail about neurology and genetics. This chapter describes and explains how modern engineering will affect the lives of those in the future, how silicon hybrids will become the norm and how artificial intelligence (AI) will cause a whole new species of robots to emerge. It begins with a detailed discussion about what intelligence actually is, and how hard it would be for robots to acquire artificial intelligence, is it understanding, knowledge of facts or just speed of response. Will neurone chips become the norm for computers, or will the briefly mentioned quantum computers be the future? Baroness Greenfield leaves you to decide these. Also mentioned, though in considerably more detail, is genetic engineering.

‘Work: What Will We Do With Our Time?’ attempts to address the other half of the story of how people will live their lives in the future, however the start ‘work…’ seems a little inappropriate as very little of this chapter is to do with work, it mainly consists of Greenfield going off on a neurological tangent, explaining the process of depression and other biological phenomena. She seems to twist many of the key discussions into arguments about brain function and biological meaning.

‘Reproduction: How will We View Life?’ answers the hot topics of: Designer babies, organ replacement and gene therapy today, however the ethical issues are briefly touched on, written off as solvable. It asks how early development in the womb can have an impact much later on in life, such as how exposure to male hormones whilst in the uterus can determine sexual orientation and how much of development will gene therapy, gene alterations and cloning will see in the years to come. This chapter is clear cut as far as fact, detail and explanation are concerned as this is Greenfield’s forte.

‘Education: What Will We Need To Learn?’ questions the normal educational systems and challenges traditional views on ageing brains. It is argued why students need to go to school at all, if silicon implants as mentioned earlier can connect the brain to unlimited sources of information on the World Wide Web, then surely secondary education will not teach them anything that they could not find out with a simple brainwave. Alternatively, if this seems too big a step from normal schooling, online lessons will be provided to students from an interactive virtual teacher.

Also covered, it is predicted that as the mind ages, its traditional ‘crystallisation’ will reduce as new technology will allow a 60 year old to learn as quickly as a schoolchild. Some of these predictions seem a little unrealistic, as mentioned in the book a quote from *‘The New York Times*’ sometime in the 1960’s says the working year will be 147 days in work and 218 days off work by 2000, and a similar quote from general motors in the 1960s states that ‘6 month vacations would not be out of the question’.

Overall, this book is an interesting read if you want to expand your knowledge about neurology and the operations of the brain, and if you’re interested in what sort of lives your children and grandchildren could be living in the future, or just how much technology has advanced and in depth discussions about human nature and current biological related issues, this is definitely a book that might interest you and increase your anticipation of life to come if you don’t mind the swift, treatment of some political issues. However, if you want to know more detail about future technology and are not happy with the numerous assumptions made, long sidetracks from the main argument or swift escapes from political dilemmas, then you may find this book a little too swift in some areas or perhaps you may find that it gets a little irrelevant on many occasions.

Stone Child

By Nicholas Weise

In a small village near Casablanca, Morocco, a young mother goes into labour with her first child. After 48 hours in a hospital the labour ceases but there is no baby. The mother returns to her village. 46 years later she experiences more pains, as if she is going into labour again. This time a cæsarean section is carried out. This time the doctors find a large lump of stone in the woman's abdomen. It is her unborn daughter.

This was a case of an *ectopic pregnancy*. This occurs when the fertilised egg does not reach the uterus and instead implants itself into one of the oviducts. As these are both small tubes (approximately 10cm long and 1 or 2cm wide) the baby soon out grows this tiny volume and the oviduct bursts. The fœtus is now no longer contained within the reproductive system and occupies space within the abdominal cavity. As the placenta can still adhere to any organ with a blood supply, the baby continues to grow as it would normally, but outside the uterus. The fact that the baby is outside the womb makes it problematic to actually give birth. Nowadays most ectopic children are removed via cæsarean section.

However, in cases where this does not happen the baby stays inside the mother after the failed delivery. As the mother's body has physically and physiologically experienced labour, the endocrine system ceases to release immunosuppressive hormones.

Unfortunately for the unborn but still very much alive baby this means that the mother's immune system begins to attack the fœtus. The immune system usually either expels a foreign object from the body or digests and absorbs it. However in the rare case that the object is too large for either, the body takes It uses calcium amongst other substances to form a thick stone layer around the object so that it cannot attack or infect the mother. A remarkable defence mechanism but a down side is that the baby is slowly killed as it is turned to stone. This rare phenomenon is known as *Lithopedion* and has there have been about 300 cases in 400 years of medical history.

The Future of Travel

By Jack O'Neill

There is a large amount of research concerning travel at the moment, in hope of finding a cleaner, quicker way of travelling. Large amounts of scientists dream of creating a teleportation device capable of transporting a person from one place to another instantly. At the moment we are trying our best to transport humans but at the moment all we have managed is to teleport is an atom using a quantum teleportation device. Teleportation involves dematerializing an object at one point and transferring the precise details of its configuration to another location, where the object is then reconstructed. In quantum teleportation tiny units of computer information, called quantum bits, are transferred from one place to another. The technology is called teleportation because the information moved behaves more like an object than normal information. But no scientists expect to be able to teleport people or other macroscopic objects in the foreseeable future.

Another more likely option of clean travel is the hydrogen fuel cell, which uses hydrogen for its power. If we could create this fuel cell its only by-product would be water. This means that it would not produce any green-house gases or do any damage to the environment at all. Seen most optimistically, H_2 could be seen as a remarkable energy carrier - a bold dream too long overlooked, with the potential to some day transform energy systems. Holding out the promise of clean, abundant, and firm power, using renewably-made 'green' hydrogen to power fuel cells, or engines, might potentially help in the future to reduce reliance on oil, and prevent greenhouse gas emissions.

There are many great ideas but these ideas have not yet proven possible to be of practical use due to our lack of knowledge in science and technology. But in the future who knows?