contents

Contents

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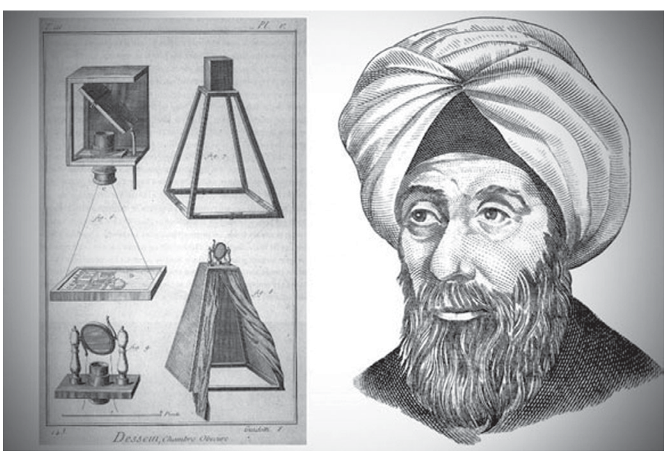
History of Photography and the Camera

Pinhole Cameras to The Daguerreotype

Mary Bellis

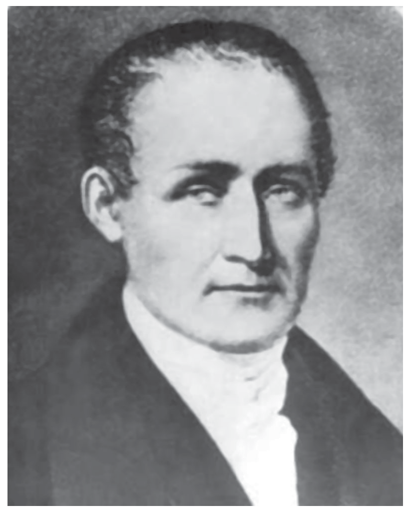
First American Daguerreotype. Robert Cornelius

Photography is a word derived from the Greek words photos ("light") and graphein ("to draw") The word was first used by the scientist Sir John F.W. Herschel in 1839. It is a method of recording images by the action of light, or related radiation, on a sensitive material.



Pinhole Camera

Alhazen (Ibn Al-Haytham), a great authority on optics in the Middle Ages who lived around 1000AD, invented the first pinhole camera, (also called the Camera Obscura and was able to explain why the images were upside down. The first casual reference to the optic laws that made pinhole cameras possible, was observed and noted by Aristotle around



330 BC, who questioned why the sun could make a circular image when it shone through a square hole.

The First Photograph

On a summer day in 1827, Joseph Nicephore Niepce made the first photographic image with a camera obscura.

Prior to Niepce people just used the camera obscura for viewing or drawing purposes not for making photographs. Joseph Nicephore Niepce's heliographs or sun prints as they were called were the

prototype for the modern photograph, by letting light draw the picture.

Niepce placed an engraving onto a metal plate coated in bitumen, and then exposed it to light. The shadowy areas of the engraving blocked light, but the whiter areas permitted light to react with the chemicals on the plate. When Niepce placed the metal plate in a solvent, gradually an image, until then invisible, appeared. However, Niepce's photograph required eight hours of light exposure to create and after appearing would soon fade away.

Louis Daguerre

Fellow Frenchman, Louis Daguerre was also experimenting to find a way to capture an image, but it would take him another dozen years before Daguerre was able to reduce exposure time to less than 30 minutes and keep the image from disappearing afterwards.

The Birth of Modern Photography

Louis Daguerre was the inventor of the first practical process of photography.

In 1829, he formed a partnership with Joseph Nicephore Niepce to improve the process Niepce had developed.

In 1839 after several years of experimentation and Niepce's death, Daguerre developed a more convenient and effective method of photography, naming it after himself - the daguerreotype.

Daguerre's process 'fixed' the images onto a sheet of silver-plated copper. He polished the silver and coated it in iodine, creating a surface that was sensitive to light. Then, he put the plate in a camera and exposed it for a few minutes. After the image was painted by light, Daguerre bathed the plate in a solution of silver chloride. This process created a lasting image, one that would not change if exposed to light.

In 1839, Daguerre and Niepce's son sold the rights for the daguerreotype to the French government and published a booklet describing the process. The daguerreotype gained popularity quickly; by 1850, there were over seventy daguerreotype studios in New York City alone.

Negative to Postive Process

The inventor of the first negative from which multiple postive prints were made was Henry Fox Talbot, an English botanist and mathematician and a contemporary of Daguerre.

Talbot sensitized paper to light with a silver salt solution. He then exposed the paper to light. The background became black, and the subject was rendered in gradations of grey. This was a negative image, and from the paper negative, Talbot made contact prints, reversing the light and shadows to create a detailed picture. In 1841, he perfected this paper-negative process and called it a calotype, Greek for beautiful picture.

Tintypes

Tintypes, patented in 1856 by Hamilton Smith, were another medium that heralded the birth of photography. A thin sheet of iron was used to provide a base for light-sensitive material, yielding a positive image.

Wet Plate Negatives

In 1851, Frederick Scoff Archer, an English sculptor, invented the wet plate negative. Using a viscous solution of collodion, he coated glass with light-sensitive silver salts. Because it was glass and not paper, this wet plate created a more stable and detailed negative.

Photography advanced considerably when sensitized materials could be coated on plate glass. However, wet plates had to be developed quickly before the emulsion dried. In the field this meant carrying along a portable darkroom.

Dry Plate Negatives & Hand-held Cameras

In 1879, the dry plate was invented, a glass negative plate with a dried gelatin emulsion. Dry plates could be stored for a period of time. Photographers no longer needed portable darkrooms and could now hire technicians to develop their photographs. Dry processes absorbed light quickly so rapidly that the hand-held camera was now possible.

Flexible Roll Film

In 1889, George Eastman invented film with a base that was flexible, unbreakable, and could be rolled. Emulsions coated on a cellulose nitrate film base, such as Eastman's, made the mass-produced box camera a reality.

Colour Photographs

In the early 1940s, commercially viable colour films (except Kodachrome, introduced in 1935) were brought to the market. These films used the modern technology of dye-coupled colours in which a chemical process connects the three dye layers together to create an apparent colour image.

Photography and Cameras

Advancements in Photographic Films & Photographic Prints

Mary Bellis

By definition a camera is a lightproof object, with a lens, that captures incoming light and directs the light and resulting image towards film (optical camera) or the imaging device (digital camera).

All camera technology is based on the law of optics first discovered by Aristotle. By the mid-1500s a sketching device for artists, the camera obscura (dark chamber) was common. The camera obscura was a lightproof box with a pinhole (later lens were used) on one side and a translucent screen on the other.

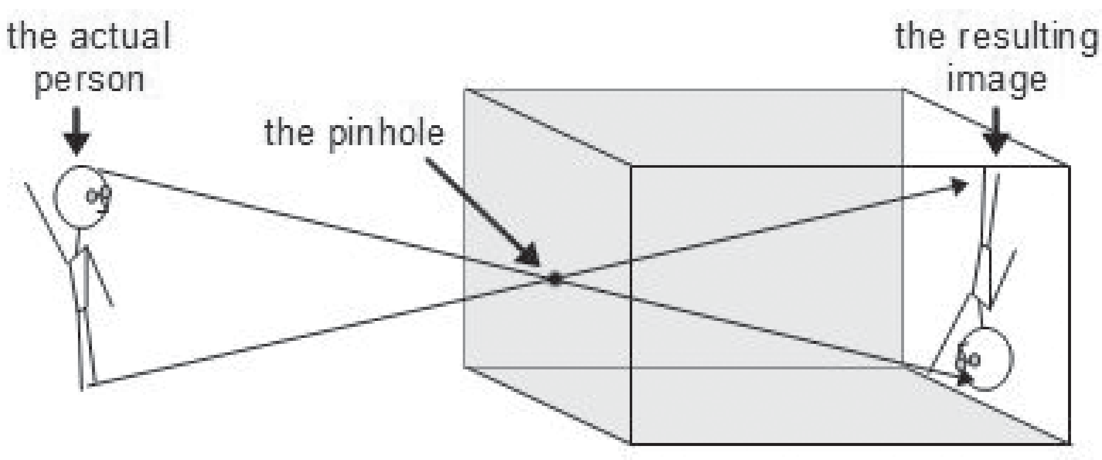
This screen was used for tracing by the artists of the inverted image transmitted through the pinhole.

Around 1600, Della Porta reinvented the pinhole camera. Apparently he was the first European to publish any information on the pinhole camera and is sometimes incorrectly credited with its invention.

Johannes Kepler was the first person to coin the phrase Camera Obscura in 1604, and in 1609, Kepler further suggested the use of a lens to improve the image projected by a Camera Obscura.

Daguerreotype Cameras

The earliest cameras used in the daguerreotype process were made by opticians and instrument makers, or sometimes even by the photographers themselves. The most popular cameras utilized a sliding-box design. The lens was placed in the front box. A second, slightly smaller box, slid into the back of the larger box. The focus was controlled by sliding the rear box forward or backwards. A laterally reversed image would be obtained unless the camera was fitted with a mirror or prism to correct this



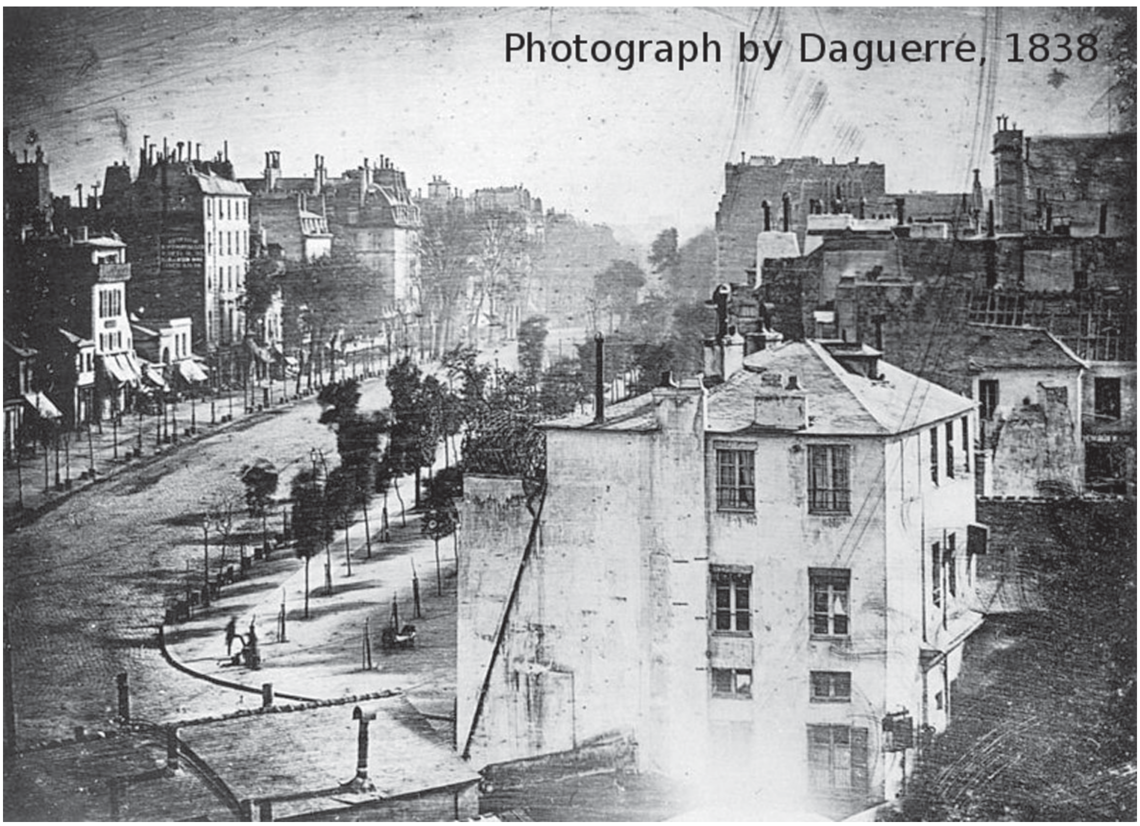
effect. When the sensitized plate was placed in the camera, the lens cap would be removed to start the exposure.

Box Camera

George Eastman. a dry plate manufacturer from Rochester, New York, invented the Kodak camera. For $22.00, an amateur could purchase a camera with enough film for 100 shots. After use, it was sent back to the company, which then processed the film.

The ad slogan read, "You press the button, we do the rest." A year later, the delicate paper film was changed to a plastic base, so that photographers could do their own processing.

Eastman's first simple camera in 1888 was a wooden, light-tight box with a simple lens and shutter that was factory-filled with film. The photographer pushed a button to produce a negative. Once the film was used up, the photographer mailed the camera with the film still in it to



Minolta Digital Camera

the Kodak factory where the film was removed from the camera, processed, and printed. The camera was then reloaded with film and returned.

Filters - Frederick Charles Luther Wratten (1840-1926)

English inventor and manufacturer, Frederick Wratten founded one of the first photographic supply businesses, Wratten and Wainwright in 1878. Wratten and Wainwright manufactured and sold collodion glass plates and gelatin dry plates.

In 1878, Wratten invented the "noodling process" of silver-bromide gelatin emulsions before washing. In 1906, Wratten with the assistance of Dr. C.E. Kenneth Mees (E.C.K Mees) invented and produced the first panchromatic plates in England. Wratten is best known for the photographic filters that he invented and are still named after him - Wratten Filters. Eastman Kodak purchased his company in 1912.

35mm Cameras

As early as 1905, Oskar Barnack had the idea of reducing the format of film negatives and then enlarging the photographs after they had been exposed. As development manager at Leica, he was able to put his theory into practice. He took an instrument for taking exposure samples for cinema film and turned it into the world's first 35 mm camera: the 'Ur-Leica'.

Polaroid or Instant Photos

Polaroid photography was invented by Edwin Herbert Land. Land was the American inventor and physicist whose one-step process for developing and printing photos created instant photography. The first Polaroid camera was sold to the public in November, 1948.

Disposable Camera

Fuji introduced the disposable camera in 1986. We call them disposables but the people who make these cameras want you to know that they're committed to recycling the parts, a message they've attempted to convey by calling their products "single-use cameras."

Digital Camera

In 1984, Canon demonstrated first digital electronic still camera.

Photography: A Timeline

• 1816 Nicéphore Niépce makes the first partially successful photograph

• 1839 Daguerre invents the daguerreotype

• 1861 Oliver Wendell Holmes invents stereoscope viewer.

• 1865 Photographs and photographic negatives are added to protected works under copyright.

• 1871 Richard Leach Maddox invented the gelatin dry plate silver bromide process - negatives no longer had to be developed immediately.

• 1880 Eastman Dry Plate Company founded.

• 1884 George Eastman invents flexible, paper-based photographic film.

• 1888 Eastman patents Kodak roll-film camera.

• 1900 First mass-marketed camera—

the Brownie.

• 1913/14 First 35mm still camera developed.

• 1927 General Electric invents the modern flash bulb.

• 1932 First light meter with photoelectric cell introduced.

• 1935 Eastman Kodak markets Kodachrome film.

• 1941 Eastman Kodak introduces Kodacolor negative film.

• 1942 Edwin Land markets the first instant picture Polaroid camera.

• 1960 EG&G develops extreme depth underwater camera for U.S. Navy.

• 1963 Polaroid introduces instant colour film.

• 1968 Photograph of the Earth from the moon.

• 1978 Polaroid introduces one-step instant photography with the SX-70 camera.

• 1978 Konica introduces first point-and-shoot, auto-focus camera.

• 1978 Sony demonstrates first consumer camcorder.

• 1984 Canon demonstrates first digital electronic still camera (picture is formed on memory card, not photographic plate or film)

• 1985 Pixar introduces digital imaging processor.

• 1999 DoCoMo releases first smart phones on large scale; Japan sells first camera phone in 2000

• 2014 LG releases smart phones with lasers to help camera focus

Nobel Prizes

The Physics Prize

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics 2016 with one half to David J. Thouless of University of Washington, USA. The other half has been jointly won by F. Duncan M. Haldane of Princeton University, USA, and J. Michael Kosterlitz of Brown University, USA. The prize was awarded "for theoretical discoveries of topological phase transitions and topological phases of matter."

According to the press release, this year's Laureates opened the door on an unknown world where matter can assume strange states. They have used advanced mathematical methods (topology) to study unusual phases, or states, of matter, such as superconductors, superfluids or thin magnetic films. We know that light bulbs get heated when current passes through them. Hence part of the energy needed to light a bulb is lost as heat. Because of this, a current continuously needs to be passed through the light bulb for it to stay lit. As the material is cooled, these losses decrease and eventually at absolute zero of temperature (-273 C) there are no losses; in other words, the resistance of the material is zero.

Superconductors are materials where such losses do not happen (electrical resistance is zero) even at higher temperatures. But all superconductors had to be cooled quite a bit before they exhibited superconductivity.

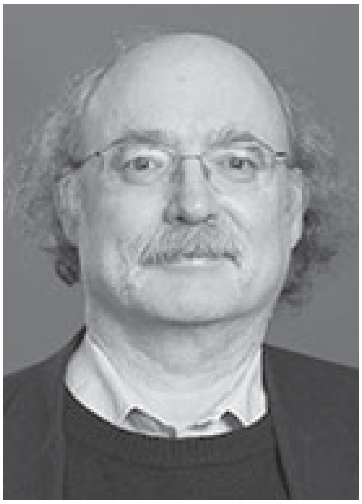
In the early 1970s, Michael Kosterlitz and David Thouless overturned the then current theory that superconductivity or suprafluidity could not occur in thin layers. They demonstrated that superconductivity could occur at low temperatures and also explained the mechanism called phase transition, that makes superconductivity disappear at higher temperatures.

In the 1980s, Thouless studied a 2-dimensional system (a thin layer of gas) cooled to nearly absolute zero in temperature and placed in a magnetic field. It was found that the conductance (inverse of resistance) was always an integer times some constant and never any value in between.

This proportionality to integers is what is called topological behaviour. Thouless was able to give a theoretical explanation for this behaviour.

Soon Haldane realised that such behaviour could be seen even when there was no magnetic field applied. This phase of matter described by Haldane is now called a Chern insulator. Twenty five years later, in 2013, such a quantized Hall effect was indeed observed in thin films of a material containing Cr-doped $(Bi,Sb)_2Te_3$ at zero magnetic field: a new phase of matter had been found.

Thanks to their pioneering work, the hunt is now on for new and exotic phases of matter. Many people are hopeful of future applications in both materials science and electronics.



The Chemistry Prize

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry 2016 to Jean-Pierre Sauvage, University of Strasbourg, France, Sir J. Fraser Stoddart, Northwestern

University, USA, and Bernard L. Feringa, University of Groningen, the Netherlands, "for the design and synthesis of molecular machines."

They developed the world's smallest machines, which are just molecules. They have developed molecules with controllable movements, which can perform a task when energy is added. The first step towards a molecular machine was taken by Jean-Pierre Sauvage in 1983, when he succeeded in linking two ring-shaped molecules together to form a chain, called a catenane.

Normally, molecules are joined by strong covalent bonds in which the atoms share electrons, but in the chain they were instead linked by a freer mechanical bond. For a machine to be able to perform a task it must consist of parts that can move relative to each other. The two interlocked rings fulfilled exactly this requirement.

The second step was taken by Fraser Stoddart in 1991, when he developed a rotaxane. He threaded a molecular ring onto a thin molecular axle and demonstrated that the ring was able to move along the axle. Among his developments based on rotaxanes are a molecular lift, a molecular muscle and a molecule-based computer chip.

Bernard Feringa was the first person to develop a molecular motor; in 1999 he got a

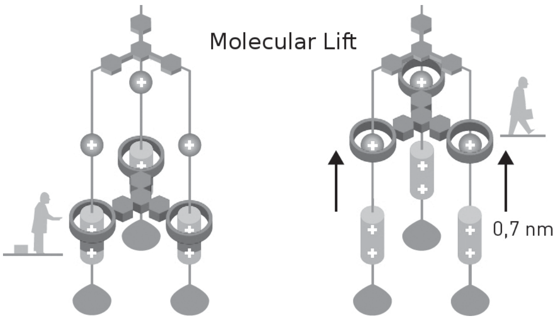
molecular rotor blade to spin continually in the same direction. Using molecular motors, he has rotated a glass cylinder that is 10,000 times bigger than the motor and also designed a nanocar.

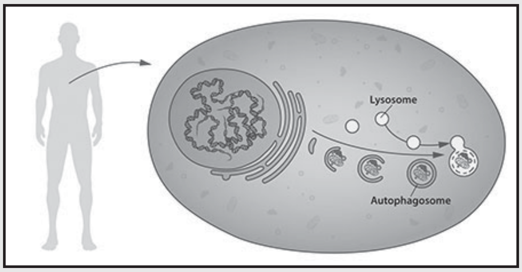
Molecular machines will most likely be used in the development of things such as new materials, sensors and energy storage systems in the future.

The Medicine Prize

The Nobel Assembly at Karolinska Institutet has decided to award the 2016 Nobel Prize in Physiology or Medicine to Yoshinori Ohsumi of the Tokyo Insttitute of Technology, Japan, for his discoveries of mechanisms for autophagy.

Autophagy is a fundamental process for





Autophagosomes

Our cells have different specialized compartments. Lysosomes constitute one such compartment and contain enzymes for digestion of cellular contents. A new type of vesicle called autophagosome was observed within the cell. As the autophagosome forms, it engulfs cellular contents, such as damaged proteins and organelles. Finally, it fuses with the lysosome, where the contents are degraded into smaller constituents. This process provides the cell with nutrients and building blocks for renewal.

degrading and recycling cellular components.

The word autophagy originates from the Greek words auto-, meaning self, and phagein, meaning to eat. Thus autophagy denotes self-eating. This concept emerged during the 1960's, when researchers first observed that the cell could destroy its own contents by enclosing it in membranes, forming sack-like vesicles that were transported to a recycling compartment, called the lysosome, for degradation.

Yoshinori Ohsumi used yeast cells to study protein degradation in the vacuole, an organelle that corresponds to the lysosome in human cells. He therefore cultured mutated yeast lacking vacuolar degradation enzymes and simultaneously stimulated autophagy by starving the cells. The results were striking! Within hours, the vacuoles were filled with small vesicles that had not been degraded. The vesicles were autophagosomes and Ohsumi's experiment proved that authophagy exists in yeast cells. But even more importantly, he now had a method to identify and characterize key genes involved this process.

Ohsumi studied how stress signals initiate autophagy and the mechanism by which proteins and protein complexes promote distinct stages of autophagosome formation.

After the identification of the machinery for autophagy in yeast, a key question remained. Was there a corresponding mechanism to control this process in other organisms? Soon it became clear that virtually identical mechanisms operate in our own cells. The research tools required to investigate the importance of autophagy in humans were now available.

Thanks to Ohsumi and others following in his footsteps, we now know that autophagy controls important physiological functions where cellular components need to be degraded and recycled.

Autophagy can rapidly provide fuel for energy and building blocks for renewal of cellular components, and is therefore essential for the cellular response to starvation and other types of stress. After infection, autophagy can eliminate invading intracellular bacteria and viruses.

Autophagy contributes to embryo development and cell differentiation. Cells also use autophagy to eliminate damaged proteins and organelles, a quality control mechanism that is critical for counteracting the negative consequences of ageing.

Disrupted autophagy has been linked to Parkinson's disease, type 2 diabetes and other disorders that appear in the elderly. Mutations in autophagy genes can cause genetic disease. Disturbances in the autophagic machinery have also been linked to cancer. Intense research is now ongoing to develop drugs that can target autophagy in various diseases.

Economics Nobel Prize 2016: Hart and Holmstrom

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Economic Sciences for 2016 to *Professor Oliver Hart of Harvard University, USA* and *Professor Bengt Holmstrom of Massachusetts Institute of Technology, USA*, "for their contributions to contract theory".

What does **contract theory** mean? Do you know what a contract is? For instance, suppose that I own a house that I want to rent out to someone, and you are looking for a house to rent. I put up a *To Let* board on the house and wait. You come by, look at the house and feel happy with it. I say I want a rent of Rs 10,000 per month. You are willing to pay only Rs 7,500. We talk for a while, and finally we both agree on Rs 9,000.

How good is this agreement? Suppose that you move in, and next month I demand that you should pay Rs 10,000. Or suppose that next month comes by and you pay me only Rs 5,000. In either case, do one of us have a right to complain to the police? Or, suppose that there is no problem with payment, you pay me the agreed amount of Rs 9,000 and I do not demand more. But when the electricity bill comes, and I insist that you pay (since you are the one using it). Should you agree to it? Suppose that a tile breaks loose. You insist that I repair the tile since I am the owner. Should I agree?

All this is what makes a contract necessary. We do not settle for an oral agreement, but write down the "terms and conditions" for you renting my house, whereby we agree on how much rent you pay for how many months, and what all you can expect to get for the rent, what each of us should pay for etc. We also write down

the conditions for what should be done if one of us wants to walk away from the contract — for instance, you get transferred to another city and need to return the house to me.

The advantage of a contract is that in case of any dispute between us, whoever feels that the other is violating the contract can go to court and demand justice. The court can examine the terms of the contract, inquire into what actually happened, and in case it is established that one of us violated the contract, punish that person. If there were no court we could go and complain to, the contract would be quite useless. So it is the presence of **government**, in the form of courts in this case, that makes contracts meaningful.

Thus a contract helps the two sides of the deal to work together over a long period of time. Secondly, the contract creates rules that allow people with different interests to cooperate to achieve some goal.

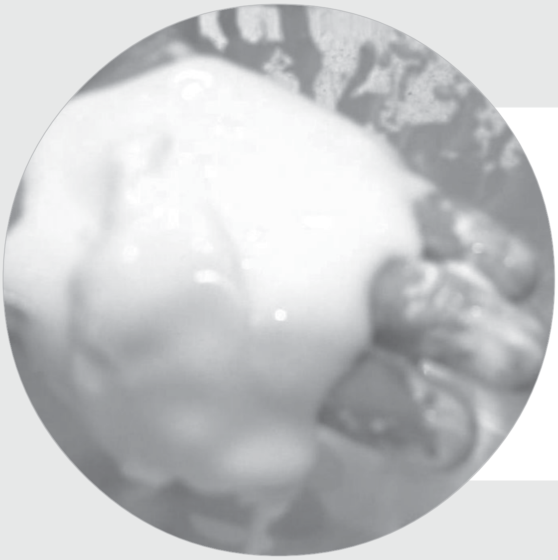
Contract *theory* studies questions like: how do contracts get their status? Are some contracts morally unacceptable? (For instance if you and I enter into an contract to steal from another person, would it be a valid contract?) Can one compare contracts? And so on.

One obvious problem with contracts is that they are necessarily *incomplete,* since we cannot anticipate all that might happen. If such an unforeseen circumstance arises, which party to the contract should be entitled to make decisions in which circumstances? This is precisely what Professor Oliver Hart studied in the 1980s.

Can two parties enter into a contract in such a way that each gets what (s)he

considers to be the best outcome? Can we make sure that neither gets any unfair advantage? These relate to what economists call *optimal contract design*, and this is the area that Professor Bengt Holmstrom made his contributions to., especially in situations when one of the parties has more information than the other. (For instance I know much more about my house that I am renting out than you, the person who wants to rent it.)

Are such theories applicable to actual human societies, national economies ? Opinion is divided among economists. Some regard buying and selling in markets as the template for human relations and claim that market choices reflect society. Others point out that the doctrines of such economics are not well founded: premises are unrealistic, models inconsistent, predictions often wrong. They suggest an entirely different basis for economics, one based on a method of mutual support that has proved to be the most efficient in areas like education, health care, pensions etc. In this regard, the 2016 Nobel Prize for Economics continues the tradition of theorising about market economics.



Your Own Quick Sand

Quick sand is a fascinating substance, make some of your own and experiment on a safe scale. Amaze your friends by demonstrating how it works.

Sponsored Links

What you'll need:·

1 cup of maize cornflour

- Half a cup of water
- A large plastic container
- A spoon

Instructions:

1. This one is simple, just mix the cornflour and water thoroughly in the container to make your own instant quick sand.

2. When showing other people how it works, stir slowly and drip the quick sand to show it is a liquid.

3. Stirring it quickly will make it hard and allow you to punch or poke it quickly (this works better if you do it fast rather than hard).

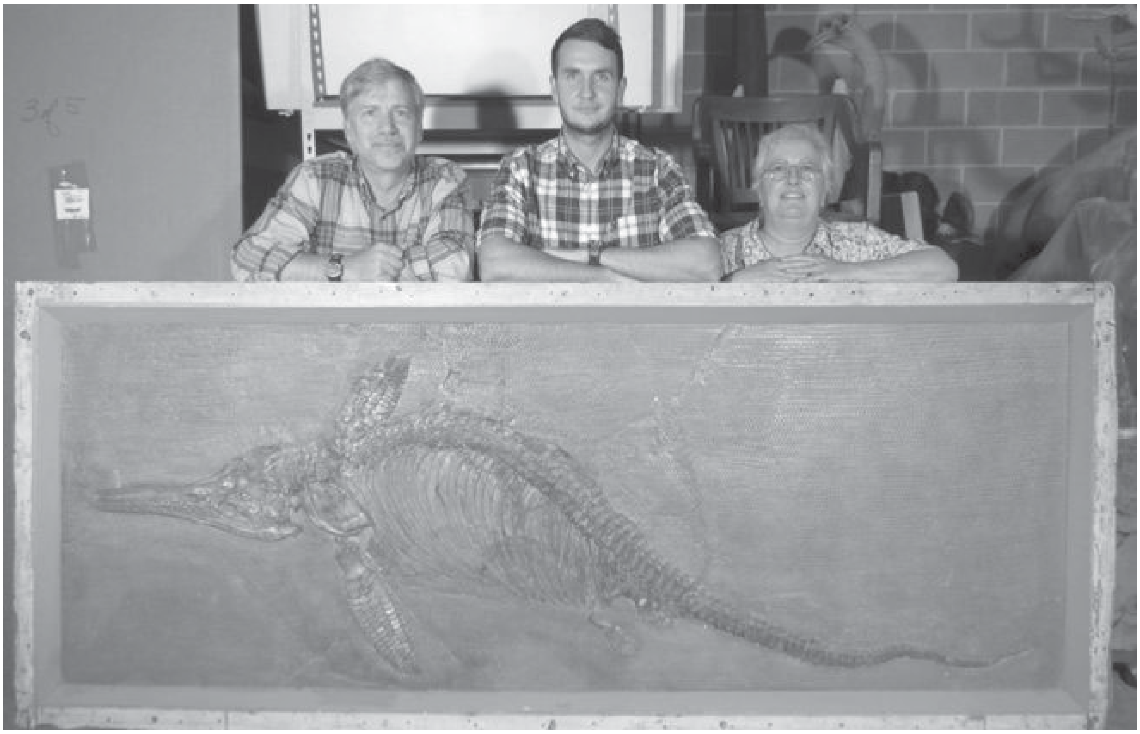
4. Remember that quick sand is messy, try to play with it outside and don't forget to stir just before you use it.

5. Always stir instant quicksand just before you use it!

What's happening?

If you add just the right amount of water to cornflour it becomes very thick when you stir it quickly. This happens because the cornflour grains are mixed up and can't slide over each other due to the lack of water between them. Stirring slowly allows more water between the cornflour grains, letting them slide over each other much easier. Poking it quickly has the same effect, making the substance very hard. If you poke it slowly it doesn't mix up the mixture in the same way, leaving it runny. It works in much the same way as real quick sand.

Its funny behaviour of looking liquid and acting solid has given it the name of "Non-Newtonian fluid."



British ‘sea dragon’ fossils are ‘new to science’

By Helen Briggs, BBC News

Scientific detective work on fossils collected in Victorian times has identified two new species of Ichthyosaurs - the giant reptiles that swam at the time of the dinosaurs.

It brings to six the known species of *Ichthyosaurus* - ‘‘sea dragons’’ that ruled the oceans in Jurassic times.

Both fossils were unearthed in Somerset in the 1800s.

One specimen has been on display at Bristol University for decades, under the gaze of countless students.

The other was donated to a museum in Philadelphia, US, by Thomas Hawkins, a well-known Victorian fossil collector.

He amassed a huge collection of marine reptiles from Somerset in the first half of the 19th Century.

Such was the Victorian craze for skeletons of ichythyosaurs - the first was found by Mary Anning on the Dorset coast - that they ended up in museums and collections right across the world.

Palaeontologists Dean Lomax of Manchester University and Judy Massare of Brockport College, New York, examined hundreds of ichthyosaur fossils in Europe and North America, including some that had been kept hidden for decades.

‘‘These are two new species - brand new species to science,’’ Dean Lomax

told BBC News.

''They show that during the early Jurassic - around 200 million years ago - the ichythyosaur, and specifically this particular type, was a lot more diverse than previously thought.''

Ichthyosaurs were fierce predators, growing up to 15m in length.

The dolphin-shaped creatures patrolled the seas at a time when the UK was a series of small islands.

They were among the first skeletons to be discovered by early British fossil-hunters, at a time when theories of evolution and concepts of geology were in their infancy.

The reptile fossils were categorised as new species on the basis of distinctive features of their skull and other bones.

One of the new species was identified from a complete skeleton of an ichthyosaur that has been on display at the University of Bristol for more than 30 years.

The other - originally found in a quarry in Glastonbury - was donated to Philadelphia's Academy of Natural Sciences in 1847.

The specimen had been in storage, and few people even knew of its existence.

''It's been hidden away behind the scenes for such a long time,'' said Dean Lomax.

''It was quite amazing when Judy Massare and myself examined the specimen and then found that it was a practically complete skeleton and in my personal opinion the best example ever of the ichthyosaur genus to be collected and studied.''

The Philadelphia specimen has been named *Ichthyosaurus somersetensis*, in honour of the county where so many specimens have been dug up or found in quarries.

The Bristol University fossil has been called *Ichthyosaurus larkini*, in honour of British palaeontologist Nigel Larkin, whose whose family has lived in the Bristol area for centuries.

A scholarly paper describing the research is **published in the journal Papers in Palaeontology**.

Reaching alien planets

The myth and reality about: Is reaching alien planets outside our Solar System actually possible, and if so, how would it work?

Bianca Nogrady

Science fiction writers and moviemakers have shown us countless visions of humanity spread out across the Universe, so you might be forgiven for thinking that we've already got this in the bag. Unfortunately, we still have more than a few technical limitations to overcome – like the laws of physics as we understand them – before we can start colonising new worlds beyond our Solar System and galaxy.

That said, several privately funded or volunteer initiatives such as the **Tau Zero Foundation**, **Project Icarus** and **Breakthrough Starshot** have emerged in recent years, each hoping to bring us a little bit closer to reaching across the cosmos. The discovery in August of **an Earth-sized planet orbiting our nearest star** has also raised fresh hopes about visiting an alien world.

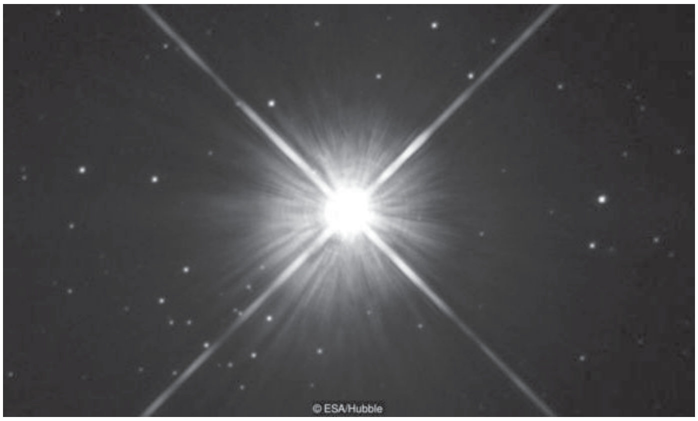
Interstellar spacecraft will be one of the topics discussed at**BBC Future's World-Changing Ideas Summit in Sydney in November**. Is travelling to other galaxies possible? And if so, what kinds of spacecraft might we need to achieve it? Read on to get up to (warp) speed:

WHERE WOULD WE GO?

Where wouldn't we go? There are more stars in the Universe than there are **grains of sand on Earth** – around 70,000,000,000,000,000,000,000 – and billions of these are estimated to have one to three planets in the so-called 'Goldilocks' zone: **not too hot, not too cold**.

As we're just starting out, the best contender so far is our nearest stellar neighbour – the triple star system of Alpha Centauri, 4.37 light-years away. This year, astronomers at the European Southern Observatory discovered an Earth-sized planet orbiting **Alpha Centauri's red dwarf star Proxima Centauri**. The planet, named Proxima b, is at least 1.3 times the mass of the Earth but has a very tight orbit around Proxima Centauri, taking just 11 Earth days to

Proxima Centauri, our closest stellar neighbour



complete the trip. What has astronomers and exoplanet hunters especially hot under the collar is that this planet is in the right temperature range for liquid water, which is a useful proxy for habitability.

The downside is we don't know if it has an atmosphere, and given its closeness to its own star Proxima Centauri – closer than the orbit of Mercury around our Sun – it would likely be exposed to dangerous solar flares and radiation. It is also tidally-locked, which means the planet always presents the same face to its star; something that would completely alter our notions of night and day. For instance if you choose to live on the side facing the Sun, you are always in daylight, while on the other side it is always night. So you may have to live in a place that is either too hot or too cold always, not a nice decision to have to make.

HOW WOULD WE GET THERE?

That's the $64 trillion question. Even at the fastest speeds of our current technology, a quick jaunt to check out Proxima b would see us **arriving in around 18,000 years**, by which time there's every chance our Earth-bound descendants would have arrived there well ahead of us and grabbed all the glory.How is that possible? Well, just think about it for a moment and imagine this scenario. You have made your first inter-stellar space-ship that travels at (say) 10 km/s and you are ready to spend 2 lakh years to reach Proxima b. About 1,000 years later, science and technology on Earth has progressed so much that space-crafts with speeds of 100 km/s are being built! This space-craft needs only 20,000 years to reach Proxima b, and so will overtake you even if you have set out 1,000 years earlier! When you finally arrive, your space-craft will be taken away and put in a museum!!

But many smart minds – and deep pockets – are being turned to the challenge of finding a faster way to cross vast distances of space.

Breakthrough Starshot – a $100 million initiative privately funded by Russian billionaires Yuri and Julia Milner – is focusing on propelling a tiny unmanned probe by hitting its extremely lightweight sail with a **powerful Earth-based laser**. The idea is that if the spacecraft is small enough – and we're talking barely a gram – and the sail light enough, the impact of the laser will be enough to gradually accelerate the craft to

Light Year

Light travels at the incredible speed of 30,00,00,000 (30 crore) metres per second or 3 lakh km/s. This means that if you could shoot a light ray so it would go around the Equator, it can go around the Earth 8 times in just 1 second! That's really fast. But the Universe is really large, so it takes about 8 minutes for the light from the Sun to reach us on Earth: that's how far away we are. So a useful unit in astronomy and astrophysics is a light year: this is the distance that light can travel in one year (so a light year is a unit of distance and not of time!). Since there are about 3 crore seconds in a year, one light year is about 30 crore times 3 crore or about 10^{16}. Even if you travel at rocket speed (about 8 km/s) you will need about 40,000 years to travel a distance of 1 light year, and about 2 lakh years to reach the closest star, Alpha Centauri.

around one-fifth of the speed of light, taking it to Alpha Centauri in around 20 years.

The Milners are counting on miniaturisation technologies to enable this tiny craft to carry a camera, thrusters, a power supply, communication and navigation equipment so it can report on what it sees as it flashes past Proxima b. Hopefully the news will be good, because that will lay the foundation for the next and more difficult stage of interstellar travel: people-moving.

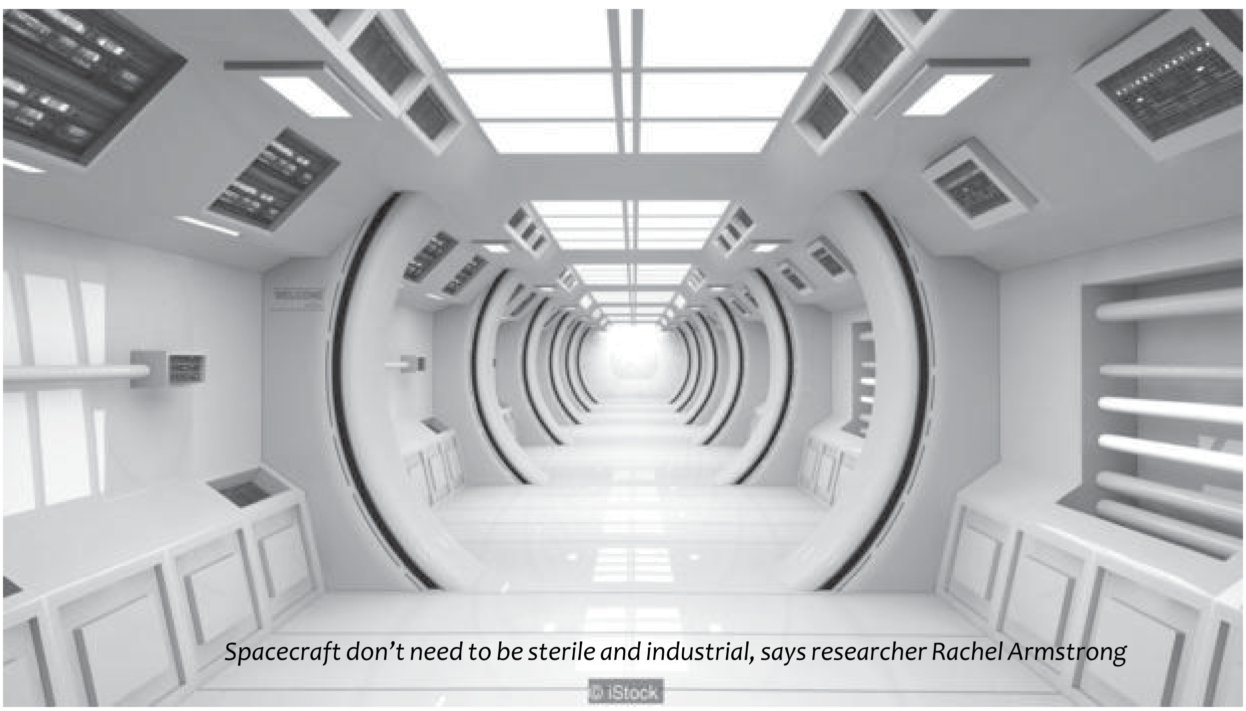
WHAT ABOUT WARP DRIVE?

Star Trek made it all look so easy, but everything we currently know about the laws of physics tells us that**faster-than-light travel – or even travel at the speed of light – is not possible**. Not that science is throwing in the towel. Inspired by another propulsion system that has captured the imagine of science fiction creators, Nasa's Evolutionary Xenon Thruster project is developing an ion engine which is hoped to accelerate a spacecraft to speeds up to 145,000kmph (40 km/s) using only a **fraction of the fuel of a conventional rocket**.

But even at those speeds, we won't be getting far out of the Solar System within a single generation of spacefarers. Until we work out how to warp time and space, interstellar travel is going to be a very slow boat to the future. It might even be better to think of that travel period as the end itself, rather than a means to an end.

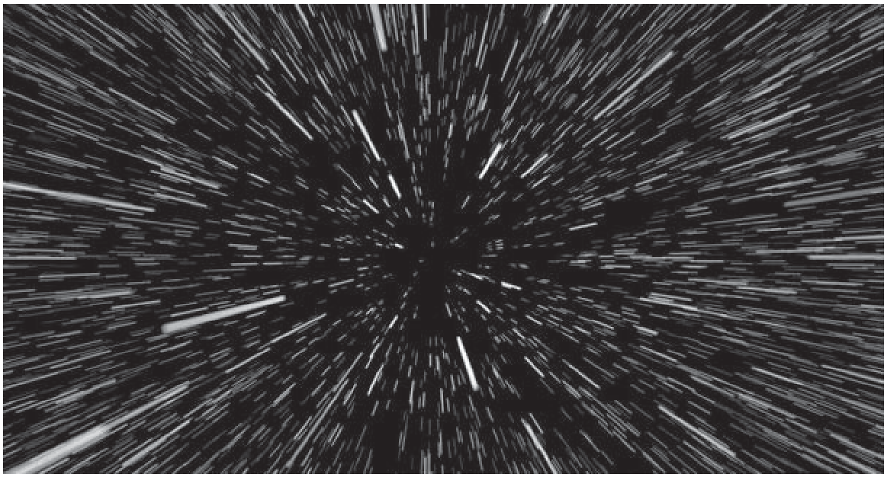
HOW WOULD WE SURVIVE ON AN INTERSTELLAR VOYAGE?

Warp drives and ion propulsion are all very sexy, but they're not much use if our interstellar voyagers starve, dehydrate or suffocate long before they even leave our



Spacecraft don't need to be sterile and industrial, says researcher Rachel Armstrong own Solar System. Researcher **Rachel Armstrong, who will be presenting at BBC Future's World-Changing Ideas Summit in Sydney** in November, argues we need to start thinking about the ecosystem that interstellar humanity will occupy out there in between the stars. "We're moving from an industrial view of reality to an ecological view of reality," she says.

As professor of experimental architecture at the University of Newcastle in the UK, Armstrong talks about 'worlding':



"it's about the inhabitation of spaces, not just the design of an iconic object," she says. The inside of a spacecraft or space-station today is sterile, and industrial, she argues. Armstrong believes we instead need to think ecologically about our vessels – about the vegetation that is grown, and even the kinds of soils we take with us. In the future, she envisages **giant biomes, full of organic life, not the cold, metal boxes of today**.

CAN'T WE JUST SLEEP ALL THE WAY THERE?

Cryosleep, hibernation or some form of stasis are favoured solutions to the prickly problem of how to keep people alive on a voyage that might take longer than a human lifespan (a subject explored in **the upcoming movie Passengers**). A facility full of **cryopreserved bodies and heads** at the Alcor Life Extension Foundation are testament to human optimism that we will one work out how to **safely freeze and thaw humans**, but again, no such technology currently exists.

One suggestion, which is explored in movies such as Interstellar and books such as Neal Stephenson's Seveneves, is to send frozen embryos that could – presumably – survive those hardships by virtue of not needing to eat, drink or breathe. But this raises the very 'chicken and egg' problem of who would raise these fledgling humans when they arrive at their destination.

SO, WILL IT ACTUALLY HAPPEN?

Probably not in the lifetime of anyone old enough to read this article, but in the longer term, there's cause for optimism. "From the outset of human existence we've looked up at the stars and projected our hopes and fears, anxieties and dreams there," says Armstrong. And with the launch of projects to tackle the engineering, such as Breakthrough Starshot, "this is no longer just a dream, this is an experiment now".

Make an egg float in salt water

An egg sinks to the bottom if you drop it into a glass of ordinary drinking water but what happens if you add salt? The results are very interesting and can teach you some fun facts about density.

What you'll need:·
One egg·
Water·
Salt·
A tall drinking glass

Instructions:

1. Pour water into the glass until it is about half full.
2. Stir in lots of salt (about 6 tablespoons).
3. Carefully pour in plain water until the glass is nearly full (be careful to not disturb or mix the salty water with the plain water).
4. Gently lower the egg into the water and watch what happens.

What's happening?

Salt water is denser than ordinary tap water, the denser the liquid the easier it is for an object to float in it. When you lower the egg into the liquid it drops through the normal tap water until it reaches the salty water, at this point the water is dense enough for the egg to float. If you were careful when you added the tap water to the salt water, they will not have mixed, enabling the egg to amazingly float in the middle of the glass.

The mystery of why left-handers are so much rarer

Relatively few people are lefties, and it's a puzzle why. Still, the science of handedness is revealing fascinating insights about you – from how it could change the way you think, to the fact that you might be 'left-eared'.

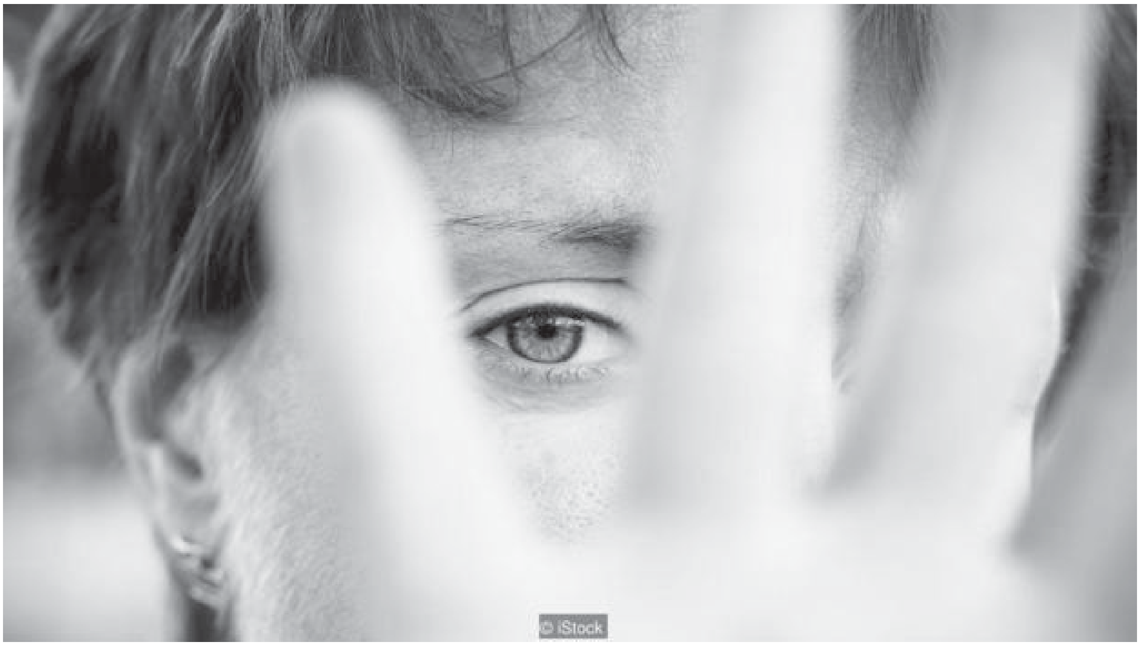
From the time we pick up a chunky crayon and start scribbling as children, it begins to become clear whether we're right- or left-handed. But what makes one hand dominate? And why are left-handers in the minority?

Curious Cases

It soon became clear that there was more to the question than we thought: for example, I had never realised that our body is lopsided in other ways too. Take your eyes, for instance. You can tell whether you are right or left-eyed by trying the following test:

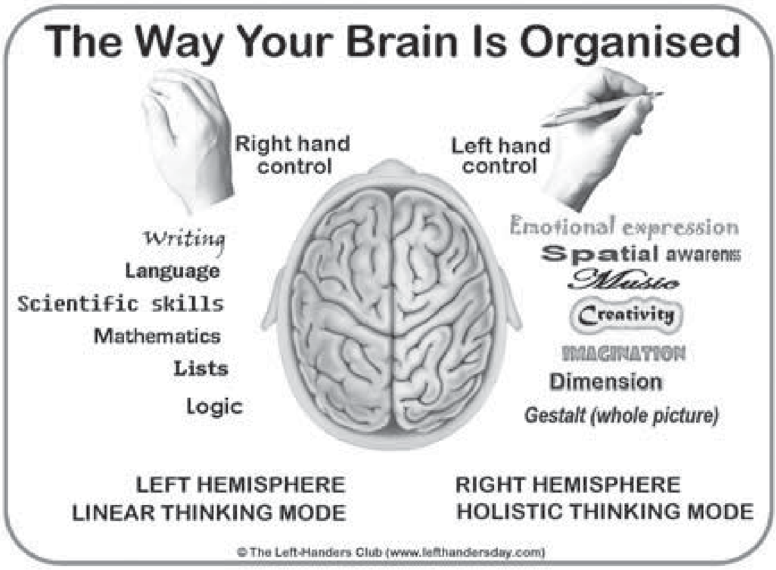
Hold a thumb out at arm's length in front of you. First, look at it with both eyes, then try covering each eye in turn. Your strongest eye is the one which gives the nearest picture to stereo vision.

Similarly, you can test your ears: which ear would you naturally use on the



telephone? Or to listen, clandestinely, against a wall?

It's funny to spot these strange asymmetries in action – I often find myself holding the phone with my left hand and pressing it, rather awkwardly, against my right ear, whilst scribbling down notes with my right hand. If ease was the biggest consideration, this odd arrangement certainly doesn't deliver. It's all about playing to our natural strengths.



Overall 40% of us are left-eared, 30% are left-eyed and 20% are left-footed.

But when it comes to handedness, only 10% of people are lefties.

Why could this be? Why are left-handers in the minority?

In times gone by, left-handedness was drummed out of errant schoolchildren, and oddly negative connotations still linger in our language. The word 'left' comes from the Anglo-Saxon word 'lyft', meaning 'weak'. And the opposite in Latin is 'dexter' which is associated with skill and righteousness.

So what determines whether we are right- or left-handed? From an evolutionary standpoint, specialising with one hand makes sense. Chimpanzees tend to choose a favourite hand for different tasks.

Take termite fishing. After selecting the perfect stick, the chimp pokes it into the termite mound, their sense of touch providing a host of information about how deep, wide and full of tasty termites their house may be. Then they'll gently pull the stick out to reveal their prey, the termites' jaws clamping down hard on the foreign invader. Unbeknown to them, they are about to get chomped by a hungry chimp. By specialising with one hand, chimps become more dexterous, and more termites bite the dust.

But when primatologists study chimpanzees in the wild, their patterns of handedness look very different to ours. For each task around 50% are right-handed, and 50% left. So where in our evolutionary tree does this 1 in 10 ratio emerge?

An important clue comes from Neanderthals' teeth. Neanderthals, it turns out, were clever, but clumsy. Our ancestors used their teeth to anchor slabs of meat, whilst they held a knife in their dominant hand to carve it up. Now and again, they would scratch their teeth. The distinctive pattern of grooves in their front incisors reveals which hand must have been holding

the food, and which was grasping the knife. Incredibly, when you compare the number of left- and right-handed Neanderthals, this same ratio of 1 in 10 left-handers that we see today pops out.

We know that left- and right-handedness has a genetic origin. However, geneticists are still trying to pinpoint which bits of DNA are involved, and there may well be up to 40 different genes at play. As things stand, the answer to what determines left or right handedness and why lefties are in the minority remains a resounding “don’t know”.

But does being left-handed have any impact on people’s lives, beyond finding right-handed scissors, zips and fountain pens a little bit annoying?

Left-handers are much more variable in the way that their brains are organised

There’s been a long running debate about how being left-handed affects your brain. The right side of the brain controls the left hand, and vice versa. And so being left-handed can have knock-on effects on the way the brain is arranged.

“Left-handers are much more variable in the way that their brains are organised,” explains psychologist Chris McManus, from University College London, author of the book Right Hand, Left Hand.

“My personal hunch is that left-handers are both more talented, and suffer deficits. If you are left-handed you might find yourself with a slightly unusual way your brain is organised and suddenly that gives you skills that other people don’t have.”

However, not everyone agrees. Dorothy Bishop is Professor of Developmental Neuropsychology at the University of Oxford and she has a personal interest. “I myself am left-handed and I always wondered why I was different from other people.

“There’s been all sorts of claims over the years linking left-handedness with disabilities like dyslexia and autism. On the other hand, there have been positive attributes – it’s claimed that architects and musicians are more likely to be left-handed.”

A lot of associations between disabilities and handedness are the result of selective reporting bias

But after looking into the data, Bishop is not convinced. A lot of these associations, she says, are the result of what’s called selective reporting bias. Scientists add a question about handedness into their study on, for example, creativity, and become excited if they find a positive association, but don’t report the instances when no connections are found.

It’s true, she says, that when you look at rare conditions, like Down Syndrome,

epilepsy and cerebral palsy, the ratio of left- to right-handers is more like 50:50 rather than 1:10.

But, Bishop says, left-handedness may be symptomatic, rather than causal.

"It's not the left-handedness itself that's creating problems," she explains, "it's more that it can be a symptom of some underlying condition. But in most people it doesn't have any significance at all for intellectual cognitive development."

The debate rages on, and there is still so much we need to discover about the left-handed brain. Part of the problem is that when neuroscientists look at various aspects of behaviour, MRI studies are only done on right-handed people, in order to try and minimise the variation between different participants. Only specific studies on left-handedness will invite lefties to take part.

Since I'm currently seven months pregnant, it's fascinating to think that my baby has already determined whether she is right- or left-handed. We know this because Peter Hepper, from Queen's University in Belfast, has done some wonderful ultrasound studies looking at babies' movements inside the womb.

He found that nine out of 10 foetuses preferred sucking their right thumb, mirroring the familiar pattern we see in the general population. And when he followed those children up many years later, the babies who were sucking their right thumb in the womb became right-handed, and the ones who preferred their left, stuck with that.

So, even though my baby is already favouring one hand over the other, I won't be in on the secret until she decides to pick up those chunky crayons and start scribbling.

Bye Bye, Rosetta!

Rosetta was a space probe built by the European Space Agency and was launched more than 10 years ago on 2 March 2004. Along with Philae, its lander module, Rosetta performed a detailed study of the comet called Churyumov–Gerasimenko or quite simply, 67P. During its journey to the comet, the spacecraft flew by Mars and the asteroids 21 Lutetia and 2867 Šteins.

Historic journey

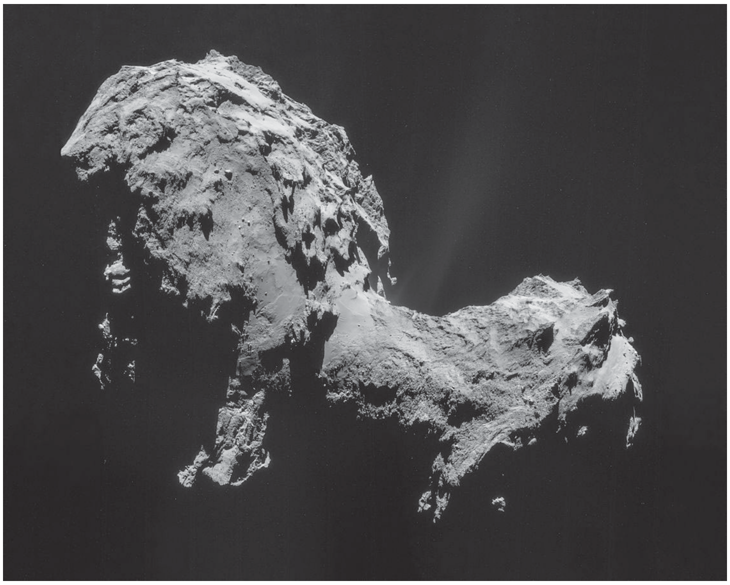
On 6 August 2014, the spacecraft reached the comet and performed a series of manoeuvres to be captured in its orbit. On 12 November, its lander module Philae performed the first successful landing on a comet, though its battery power ran out two days later. Communications with Philae were briefly restored in June and July 2015, but due to diminishing solar power, Rosetta's communications module with the lander was turned off on 27 July 2016. On 30 September 2016, the Rosetta spacecraft ended its mission by landing on the comet in its Ma'at region. The final image transmitted by the spacecraft of the comet was taken by its OSIRIS instrument at an altitude of 20 m about 10 seconds before impact, showing an area 0.96 m across.

The photo is a single frame enhanced NavCam image taken on 30 September 2016 at 00:59 GMT, when Rosetta was 17.4 km from the centre of the nucleus of Comet 67P/Churyumov-Gerasimenko, about 15.4 km from the surface. The image measures about 1.5 km across. Imagine: this is the first

What is a comet?

Any comet has a nucleus surrounded by a coma. The coma is the nebulous envelope around the nucleus of a comet. It is formed when the comet passes close to the Sun on its highly elliptical orbit; as the comet warms, parts of it sublimes (becomes vapour directly from solid state). This gives a comet a "fuzzy" appearance when viewed in telescopes and distinguishes it from stars. The word coma comes from the Greek "kome", which means "hair" and is the origin of the word comet itself.

The coma is generally made of ice and comet dust. Water dominates up to 90% of the volatiles that outflow from the nucleus when the comet is within 3-4 AU of the Sun. (1 AU is the Sun-Earth distance, called an astronomical unit). The H2O parent molecule is destroyed primarily through photodissociation and to a much smaller extent photoionization. Larger dust particles are left along the comet’s orbital path while smaller particles are pushed away from the Sun into the comet’s tail by light pressure. A detailed understanding of a comet will therefore need a detailed study of the coma’s ice and dust content.



time we have seen the surface of a comet at such close quarters. That is the real achievement of the Rosetta mission.

Rosetta's computer included commands to send it into safe mode upon detecting that it had hit the comet's surface, turning off its radio transmitter and rendering it inert in accordance with International Telecommunication Union rules.

What is known about Comet 67P?

67P/Churyumov–Gerasimenko (abbreviated as 67P or 67P/C-G) is a Jupiter-family comet, originally from the Kuiper belt (a disc extending from the orbit of Neptune (at 30 AU) to approximately 50 AU from the Sun). It has an orbital period of 6.45 years, a rotation period of approximately 12.4 hours and a maximum velocity of 135,000 km/h (38 km/s).

Churyumov–Gerasimenko is approximately 4.3 by 4.1 km in size. It was first observed on photographic plates in 1969 by Soviet astronomers Klim Ivanovych Churyumov and Svetlana Ivanovna Gerasimenko, after whom it is named. It came to perihelion (closest approach to the Sun) on 13 August 2015, and the Rosetta mission was planned so that the arrival of the space-craft coincided with this time.

Many firsts

- Rosetta was the first space-craft to fly close to Jupiter's orbit using solar cells as its main power source.
- Rosetta was the first spacecraft to orbit a comet nucleus.
- It was the first spacecraft to fly alongside a comet as it headed towards the inner Solar System.
- It became the first spacecraft to examine at close proximity the activity of a frozen comet as it is warmed by the Sun.
- Shortly after its arrival at 67P, the Rosetta orbiter dispatched the Philae lander for the first controlled touchdown on a comet nucleus.
- The robotic lander's instruments obtained the first images from a

comet's surface and made the first in-situ analysis of its composition.

What did it find?

Researchers expect the study of data gathered will continue for decades to come.

In fact, hydrogen and oxygen are present in the coma, and no significant areas of water-ice have been found on the comet's surface. Water-ice was expected to be found as the comet is too far from the Sun to turn water into vapour.

The water vapour from comet 67P, as determined by the Rosetta spacecraft, is substantially different from that found on Earth. That is, all water on earth is made of H_2O, with some fraction of hydrogen being replaced by heavy hydrogen or deuterium. This fraction is constant. The ratio of deuterium to hydrogen in the water from the comet was determined to be three times that found for terrestrial water. This makes it very unlikely that water found on Earth came from comets such as comet 67P, according to the scientists.

Measurements carried out before Philae’s batteries failed indicate that the dust layer could be as much as 20 cm (7.9 in) thick. Beneath that is hard ice, or a mixture of ice and dust.

Philae’s COSAC instrument was able to detect organic molecules in the comet’s atmosphere. It revealed sixteen organic compounds, four of which were seen for the first time on a comet, including acetamide, acetone, methyl isocyanate and propionaldehyde.

The only amino acid detected thus far on the comet is glycine, along with the precursor molecules methylamine and ethylamine.

One of the most outstanding discoveries of the mission was the detection of large amounts of free molecular oxygen O_2 gas surrounding the comet.

- Adapted from
the European Space Agency
and Wikipedia web-sites

Use a **Straw** to Stab a **Potato!**

Is it possible to stab a potato with a drinking straw? Find out with this fun science experiment for kids that shows how air pressure can be used in surprising ways.

What you'll need:·
Stiff plastic drinking straws·
A raw potato

Instructions:

1. Hold a plastic drinking straw by it sides (without covering the hole at the top) and try quickly stabbing the potato, what happens?

2. Repeat the experiment with a new straw but this time place your thumb over the top, covering the hole.

What's happening?

Placing your thumb over the hole at the top of the straw improves your ability to pierce the potato skin and push the straw deep into the potato. The first time you tried the experiment you may have only pierced the potato a small amount, so why are you more successful on the second attempt?

Covering the top of the straw with your thumb traps the air inside, forcing it to compress as you stab the straw through the potato skin. This makes the straw strong enough to pierce the potato, unlike the first attempt where the air is pushed out of the straw.

Gulmohar tree

(Delonix regia)

Delonix regia is a species of flowering plant in the bean family Fabaceae, subfamily Caesalpinioideae. It has fern-like leaves and a flamboyant display of flowers. In many tropical parts of the world it is grown as an ornamental tree and in English it is given the name royal poinciana or flamboyant. It is also one of several trees known as Flame tree.

The flowers of Delonix regia are large, with four spreading scarlet or orange-red petals up to 8 cm long, and a fifth upright petal called the standard, which is slightly larger and spotted with yellow and white. They appear in corymbs along and at the ends of branches. There is also a variant with yellow flowers. The flowers are enjoyed by monkeys including macaques.

The pods are green and flaccid when young and turn dark-brown and woody when they are ready to fall, right around this season. They can be up to 60 cm long and 5 cm wide. The seeds are small, weighing around 0.4 g on average. The compound leaves have a feathery appearance and are a characteristic light, bright green and are doubly pinnate. Each leaf is 30–50 cm long with 20 to 40 pairs of primary leaflets or pinnae, each divided into 10–20 pairs of secondary leaflets or pinnules.

In addition to its ornamental value, it is also a useful shade tree in tropical conditions, because it usually grows to a modest height (mostly 5 meters, but it can reach an maximum height of 12 meters) but spreads widely, and its dense foliage provides full shade. In areas with a marked dry season, it sheds its leaves during the drought, but in other areas it is virtually evergreen.