MUSÉE D'HISTOIRE DES SCIENCES GENÈVE

UN SITE DU muséum Genève

Scientific images

Images de science

English texts of the exhibition

Une institution Ville de Genève

www.museum-geneve.ch

VILLE DE GENÈVE

musée d'histoire des sciences

Scientific Images is an original and bilingual (french/english) exhibition of the Musée d'histoire des sciences of Geneva, presented from the 17th of May 2017 until the 26th of August 2018.

More information about the exhibition on the website

www.ville-ge.ch/museum

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Scientific images

What is a scientific image? How is it different from other kinds of image? What role does its distinctive iconography play in research? How is a scientific image produced and distributed? These are the questions that we explore in this temporary exhibition.

Scientific images begins with images of what we can see with our own senses. You are then invited to visit realms beyond our physical limits and to new encounters with science.


4 Vnderricht von den Instrumenten
Das Ander Capitel.
Vnderricht/wie man diß Instrument machen vnd zubereiten soll/so zu dem grund legen gebraucht wirdt.

Laß dir ein eben Brett in allweg vngefehr anderthalben Schuch machen/vnd anderthalben Zoll dick/vnden ein Fuß daran/vngefehr drey oder vier Schuch hoch/oben ein Creutz eines Schuchs lang/vnd oben ein Zapffen fürgang eines Zols lang/der gar satt in das Brett gange/vnd man es doch

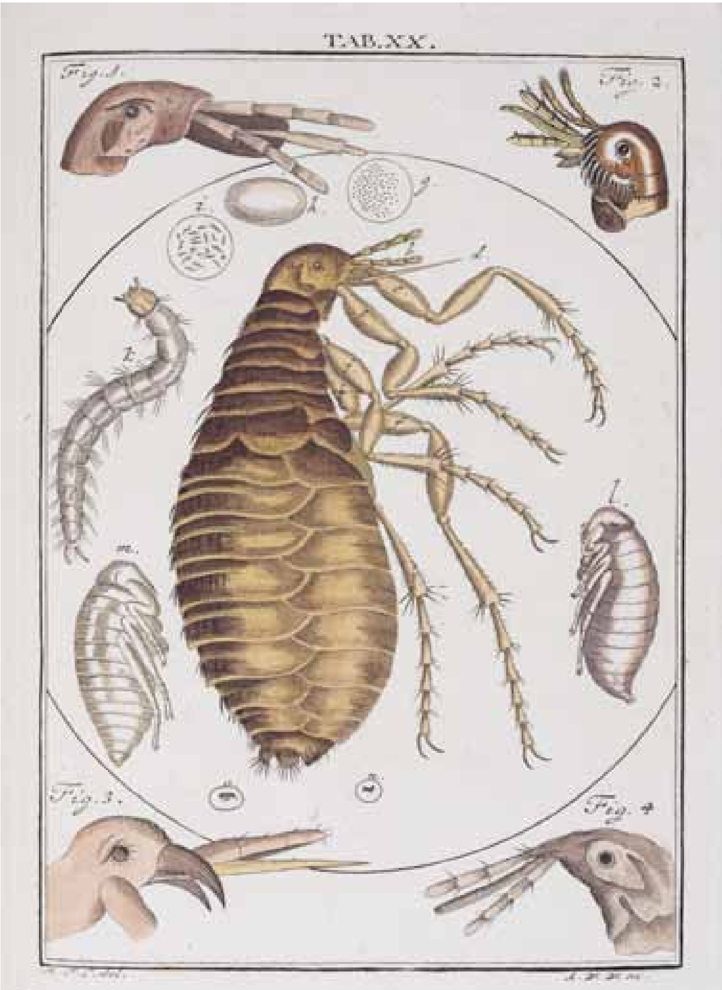
Zubler. 1607 Fabrica et usus instrumenti chorographici.

Images illuminate texts

Striking images

We have chosen a series of scientific images which have left their mark on the history of human thought and which influenced the ways in which their contemporaries saw the world.

There is a «before» and «after» the creation of these illustrations and they have been copied and re-created many times.

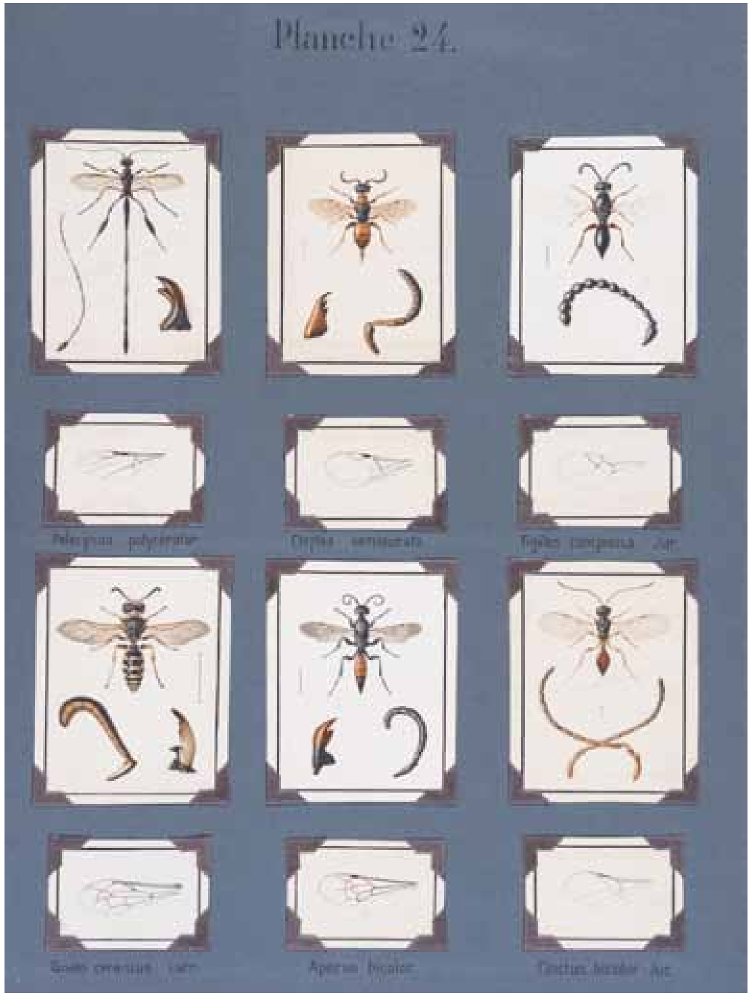


Ledermüller. 1776. Mikroskoopische Vermaaklykheden.

Creating an image

While it's obvious that scientists are involved in the production of scientific images, they are not the only ones. Many others - anonymous or named - contribute their expertise too.

There are various types of images produced for science including drawings, engravings, and photographs or by digital signal processing.



Jurine C. 1807. Les hymènoptères.

Engraving

From the 17th century it was often women's hands - wives, daughters or muses - that contributed significantly to the quality of the first sketches. The final drawing was sent to an engraver who worked on wood, copper or stone, after which it was printed and then finally coloured. A chain of expertise and skills was thus called upon in the production of an illustration.

Engraving was on a variety of supports each with specific methods, tools and constraints.

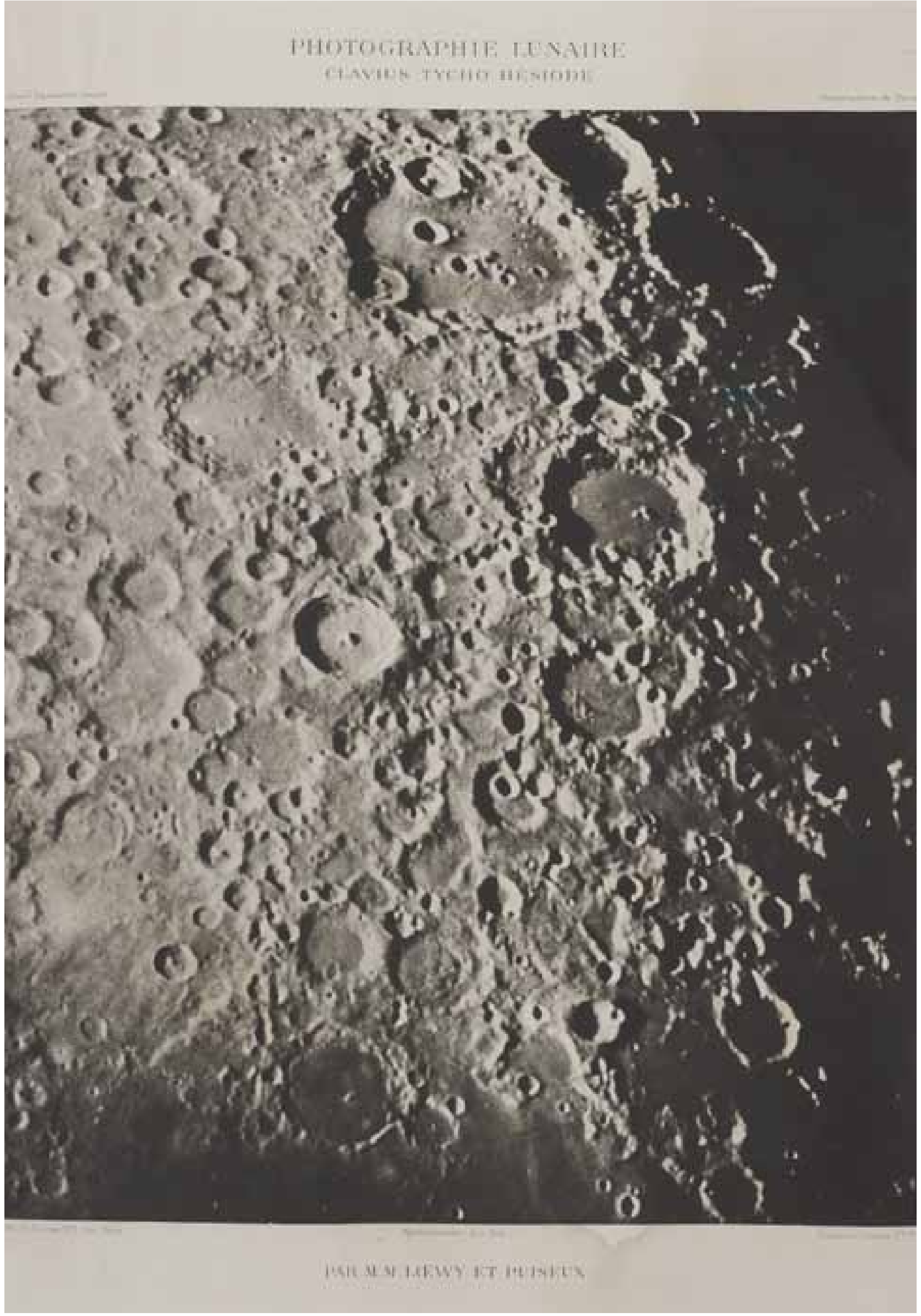
- Wood engraving requires skilled craftsmen to carve the mould. It allows images to be integrated into text and therefore large print runs.
- Copper etching is often from a drawing in drypoint on a varnished plate which is then plunged into acid. Illustrations could not be integrated into the text with this method because of the difference in thickness between the copper plate and the type, so print runs were small.
- Lithography uses chemical processes to fix ink on certain parts of a thin, treated limestone plate. Lines are directly drawn with a greasy crayon. This method allows large print runs.

Claparède. 1868. Les Annélides.

Photography

Through their mastery of optical processes and chemical reactions together, Nicéphore Niépce and Louis Daguerre gave birth to photography around the year 1839.

The scientific world adopted the techniques immediately and photography became a means of documentation and communication, although photos were often copied by an engraver for printing. It was photolithography at the end of the 19th century which enabled direct printing of photos thanks to a process which used a grid of different sized points according to the darkness or lightness required.



Loewy et Puiseux 1896-1910. Atlas photographique de la Lune.

Camera type folding (MHS-2330)

Photography exploits reaction to light of some chemicals such as silver nitrate.

Initially, images were printed on positive paper covered in silver chloride until negative images were invented in 1840. This allowed several print runs of the same image. The first negatives were printed on glass which was replaced by celluloid film in 1885 by George Eastmann, founder of the Kodak company.

After testing, colour film was perfected in 1935 by the Lumière brothers using auto chromes (plates made for projection). Colour film was available from 1935 and became widespread in the 1950s.

Stereoscopic images, which were invented in about 1841, showed «depth». A series of images slightly offset one from another and photographed by a camera with two lenses, produced double images which, when viewed through an optical apparatus, re-established the impression of volume.

Photographing movement

When a horse is galloping at full stretch, are all its hooves off the ground at the same time?

The photographer Eadweard Muybridge (1830-1904) tried to answer this question through photography. He placed 12 cameras in a line along a track. A horse triggered the photos by passing through stretched wires. Muybridge's photos confirmed the theory of the Frenchman Etienne-Jules Marey (1830-1904), that the animal always has one hoof on the ground.

Marey then developed a photographic gun which allowed 12 successive images at 1/725th of a second with small photographic plates in the place of bullets. He then went on to develop a chronophotograph which printed several images on the same plate or on flexible paper (the forerunner of photographic film) which he adapted to a camera.

Imaging

With scientific imaging, often used in medical fields, we enter into a different world from illustration or photographs because the images, whatever their method of production, are generally created through conversion of a signal. They are therefore not the result of a direct visual experience.

X-ray photos

The discovery of X-rays in 1895 by Wilhelm Röntgen (1845-1923) marks the beginning of transmission imaging. X-rays, produced by a Crookes tube (a discharge tube), change as they pass through objects or bodies in relation to their chemical composition. The resulting image is captured and printed on film. Applications multiplied quickly: their use in dentistry began in the same year as their discovery, although the time needed for a dental X-ray was 25 minutes! The risks of overexposure (burns, cancers), especially for technicians, were also identified.

Ultrasound

Ultrasound (a mechanical wave whose frequency is too high to be perceived by the human ear) was applied to the medical exploration of soft tissue from the 1950s, notably in obstetrics.

Sound waves are reflected back to their point of departure by obstacles they encounter like an echo. Computer treatment of the sound waves, by converting different wave intensities into different tones of grey, produces an image.

Magnetic resonance imaging

Developed at the end of the 20th century, Magnetic resonance imaging (MRI) is a non-invasive and non-irradiating method for looking inside the body. It yields contrasting views of body tissue in two or three dimensions.

A powerful magnetic field generated by a superconducting magnet magnetises body tissues. Oscillating magnetic fields are then introduced. These yield measurable electromagnetic signals which differ according to the chemical composition of the zones being tested. MRI is used to examine soft tissue such as muscles, tumours and the central nervous system, particularly the brain which can be observed as it functions in real time.

Looking over the shoulder of scientists

Whatever the technique used, a scientist is the person responsible for initiating a scientific image. He or she defines the subject and the composition, and selects the elements which must be shown. The physiology of our eyes places limits on what we can see so science has tried to find ways to overcome them and reveal the invisible.

Looking at scientific images over the shoulders of scientists, we can catch a glimpse of what the eye by itself cannot see.

Drawing aids

Optical or mechanical instruments were developed to facilitate drawings under the microscope or to enlarge an image so that it could be viewed by several people at the same time.

Camera obscura

This black box device is popular with painters and artists. It reproduces a natural image by projection.

In an otherwise completely closed container, a small hole is left through which light can penetrate. An image of the outside world, but inversed and inverted, is projected onto the opposite interior wall.

In later camera obscura, the opening is replaced with a lens in order to improve the sharpness and quality of the image. A mirror at an angle of 45° was also added inside the box so that the image could be projected onto a horizontal glass screen.

Camera lucida on microscope (MHS-462)

Camera lucida

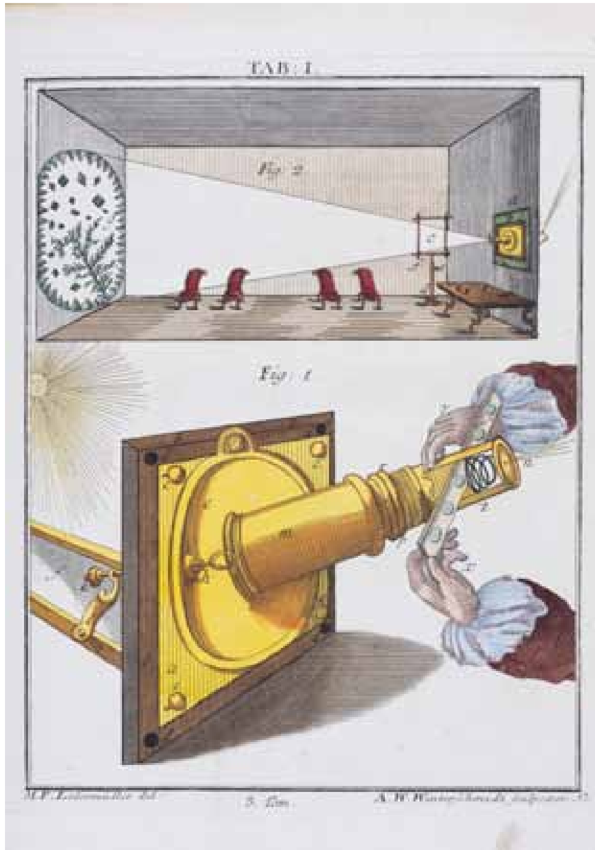
This is an optical apparatus which makes it easier to draw an object viewed under a microscope or with the naked eye. It works by superimposing the subject to be drawn upon the drawing paper. The technique was invented by Wollaston in 1806. One face of a prism is placed opposite the eyepiece of a microscope. The observer places his/her eye so that the image of the object can be seen reflected in the prism and on the drawing sheet.

This technique was initially used by artists but was adapted to microscopy from the mid-19th century. It usually takes the form of a double prism placed above the eyepiece and fixed by a ring around the optical tube.

Projection microscope

Projection microscopes appeared in the 18th century. By projecting an enlarged image onto a screen, several observers could look at it at the same time.

It is based on the same principles as a magic lantern. Light rays from a natural (the sun) or artificial (oil lamp, arc lamp) source are captured by a large collecting lens focussed on the object (usually fixed on a transparent glass slide) to be observed. The rays then pass through a lens and are enlarged. The enlarged inverted image is then projected onto a screen placed in front of the instrument.



Ledermüller. 1776. Mikroskoopische Vermaaklykheden.

Lucernal microscope

This is another type of projection microscope from the 18th century. It was invented by the father and son instrument makers, George Adams in London, towards 1770. Lit by a powerful oil lamp, this microscope projects an enlarged image of an object onto a glass plate fixed to the edge of a wooden box. The image can therefore be copied easily.

Lucernal microscope (MHS-234)

Scholars, pencil in hand

To show how important science drawings are for scientific work from the laboratory to publication, our exhibition presents several illustrious Geneva scientists and the place of scientific images in their discoveries.

Abraham Trembley

Animal regeneration, replication of experiments and the spread of knowledge

After a stay in Holland, the scientist Abraham Trembley (1710-1784) asked himself a question about the nature of hydra, called a polyp at that time: is it an animal or a plant? He tried propagation through cuttings as for plants. Having cut a hydra in two, he was surprised to note that what had seemed to be an animal (given its movements and feeding characteristics), was able to regrow the cut part.

He documented his research in a notebook with the aid of sketches. He sent «kits» of polyps to other researchers and quite precise information about his work, both the method employed and the results, so that they could replicate his experiments.

He finally published his observations and conclusions on animal regeneration in 1774, supported by illustrations (by Pieter Lyonet) and extracts from his experimental notebook in the form of tables.

Ledermüller. 1776. Mikroskoopische Vermaaklykheden.

Horace-Bénédict de Saussure

The inconspicuous discovery of mitosis ... without illustrations

In 1765, the great naturalist Horace-Bénédict de Saussure (1740-1799) studied «animalcules», creatures found in the water in which he soaked his plants, under the microscope. He recorded his work in his journal in writing and sketches.

This was the setting in which he observed and described the reproduction methods of single-cell organisms. This was cell division, termed mitosis in 1880 after observation of the process with more accurate equipment.

During a trip to London, de Saussure informally communicated his discovery to members of the Royal Society but he did not publish it. Some of the scholars present repeated the observations without knowing all the technical details. One of them, the naturalist John Ellis (1714-1776), published an article on the subject with an illustration.

Charles Bonnet, Saussure's uncle, invited him to describe his experiment which he did in September 1769 but without any drawings. Bonnet included the paper in the re-edition of his Palingénésie philosophique in 1770. The experiment was repeated by others and plates were produced.

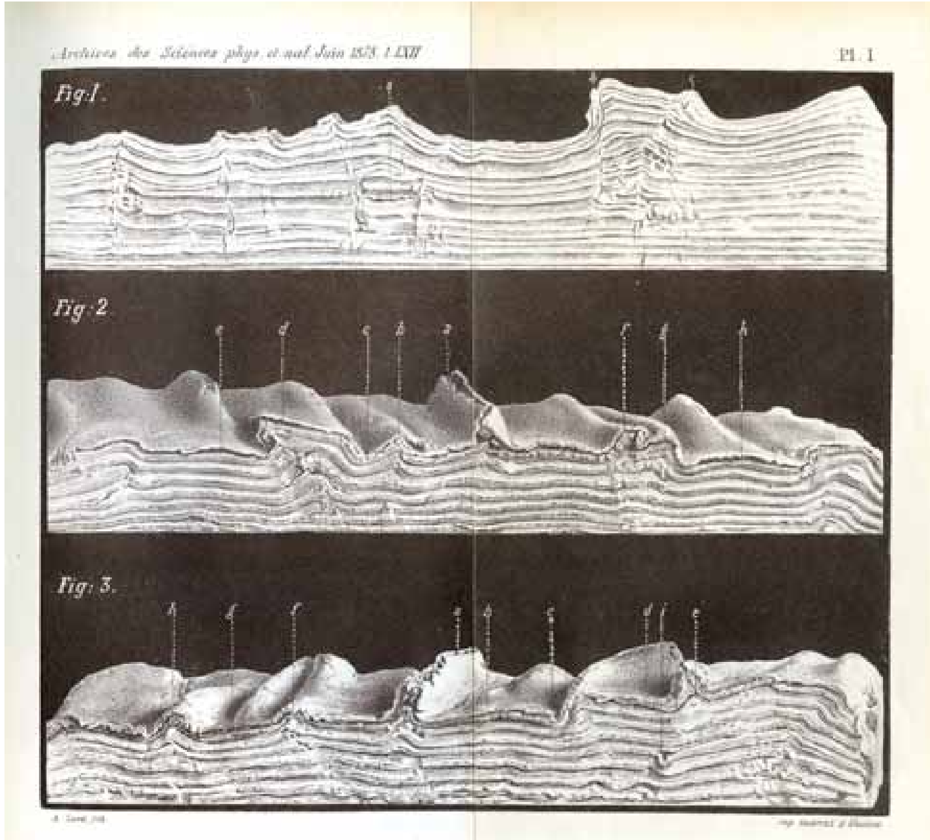
The failure to publish in a scientific journal and especially to offer drawings or plates to synthesise the observations, was the reason behind the failure to communicate this remarkable discovery.

Alphonse Favre

Drawing the geological map of the Geneva region and offering a model of the Alpine folds

The geologist Alphonse Favre (1815-1890) followed in the steps of Horace-Bénédict de Saussure in his studies of Mont-Blanc, the Salève and a map of the geology of the Canton of Geneva.

Alphonse Favre's observations were very precise. He recorded measurements taken during his field surveys in small notebooks alongside his notes and drawings of sections and landscapes. He used these later to produce a synthesis. He enriched his fieldwork by the study of fossils, using them as indicators of the sequence of geological events.



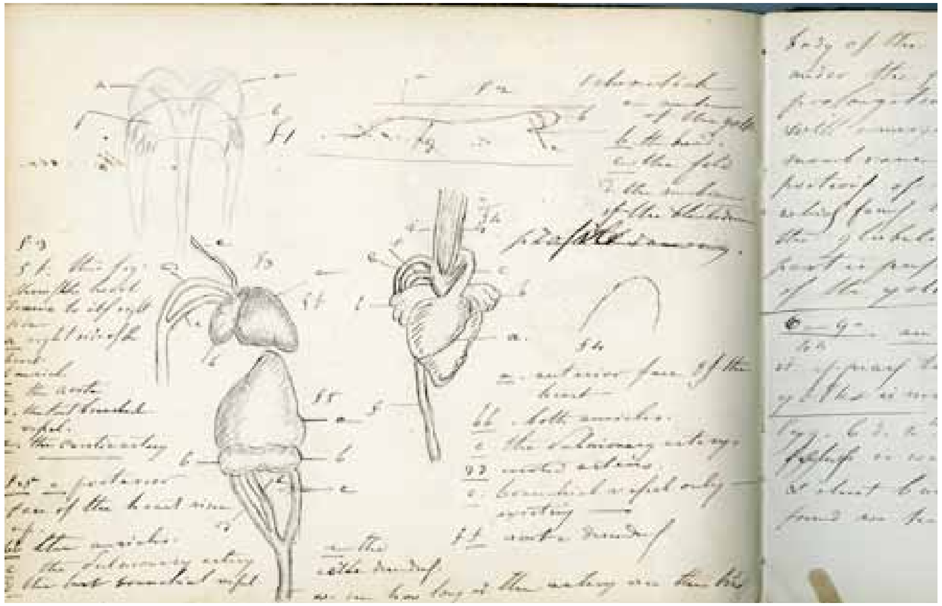
Favre. 1878. Archives des sciences.

Thinking that geological folding was caused by shrinkage of rocks as the earth cooled after its creation, Favre developed an experimental clay model in 1878 which was placed on tightly stretched rubber

Jean-Louis Prévost

Experimental embryology

Jean-Louis Prévost (1790-1850), a doctor of medicine considered to be one of the pioneers of biochemistry, was deeply involved in research on animal physiology in addition to his medical practice. He worked in partnership with the French chemist Jean-Baptiste Dumas notably on



Prévost. 1844. Physiological objects.

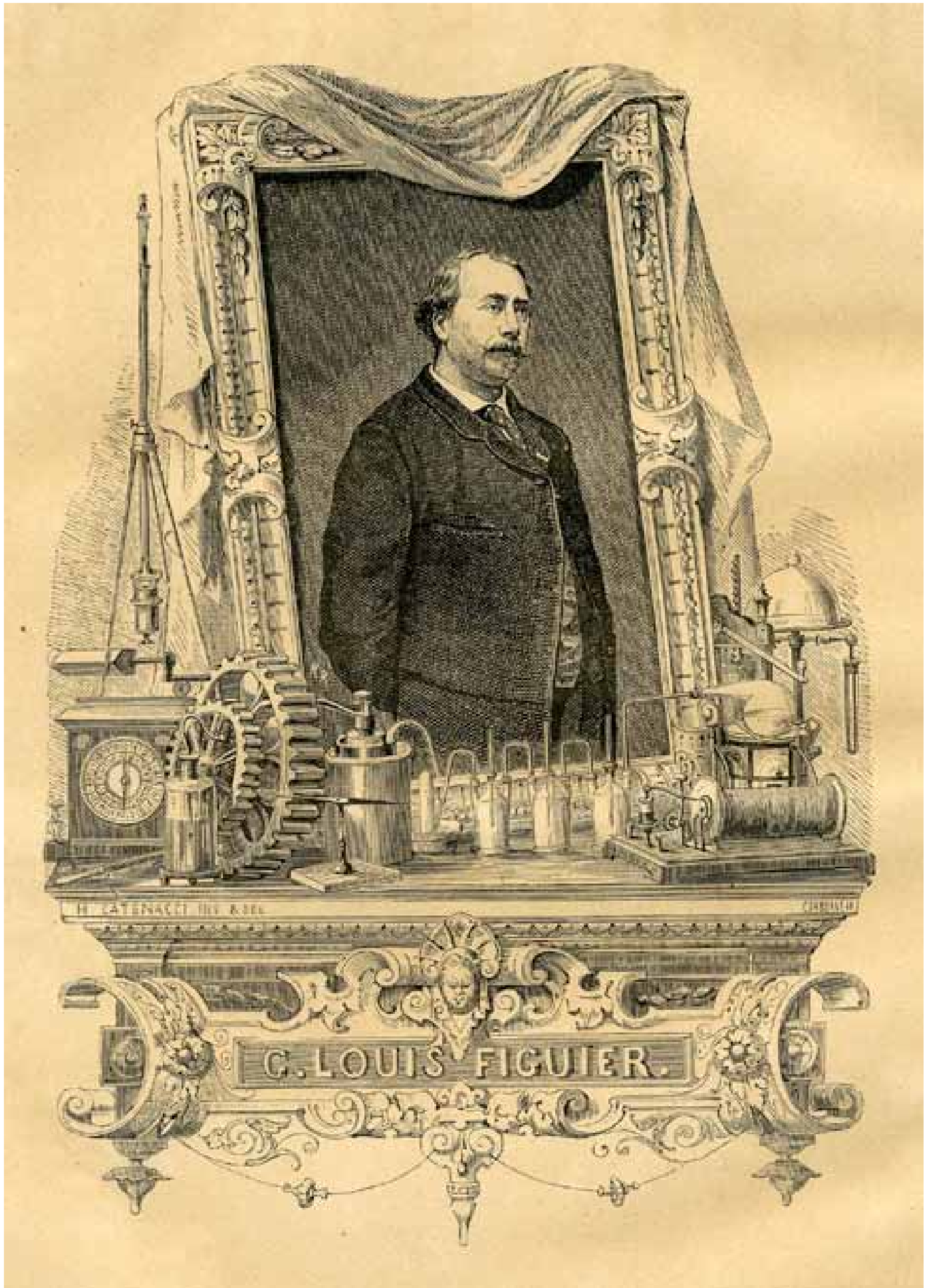
animal fertilisation during which they clarified the role of spermatozoa. They demonstrated that parents contribute both ovules and spermatozoa and not either one or the other. This theory opened the door to the study of genetics in the future.

The two scientists were also interested in practical applications of electricity (for example in dissolving bladder stones) in the decades that followed Volta's invention of the battery.

In praise of scientists: Science on stage

Scientific images were not only created to communicate data and theories between researchers, some were designed to inform the public or to tell stories about discoveries.

In the 19th century, ideas of progress were symbolised by images of science as benevolent and triumphant. Some authors such as Louis Figuier and Camille Flammarion specialised in this domain portraying scholars in their laboratories or during dramatic moments in their lives.



Figuier. 1867-70. Les merveilles de la science.

My science images

We invite you to continue your vist to our exhibition around a circuit in the park outside the Museum building where you will find images from contemporary science.

Ten scientists who work closely with the Museum have been invited to choose two images each, according to their own criteria, which they think are particularly significant. You can find them in the Perle du Lac park. Each of them has been interviewed about the images they selected and about the reasons for their choice. You can watch the interviews on the YouTube Museum Geneve (playlist: mes images de science) or on the post below them.

Enjoy the rest of your visit and enjoy your walk!

The person who never tired of drawing the sky

Taking the opportunity offered by the Images of Science theme, the History of Science Museum has chosen to pay tribute to Maurice du Martheray (1892-1955), amateur astronomer, founder of the Société d'astronomie de Genève and author of several thousand sketches and drawings of the sun, Mars, Jupiter and the moon.

Maurice du Martheray

Maurice du Martheray (1892-1955) was a dentist in the Canton of Vaud but he also found time to devote many hours to astronomy. He was one of the three co-founders of the Société astronomique de Genève (SAG) in 1923. At the time, the society was called the Société astronomique Flammarion de Genève in recognition of Camille Flammarion's mission to popularise and communicate scientific knowledge.

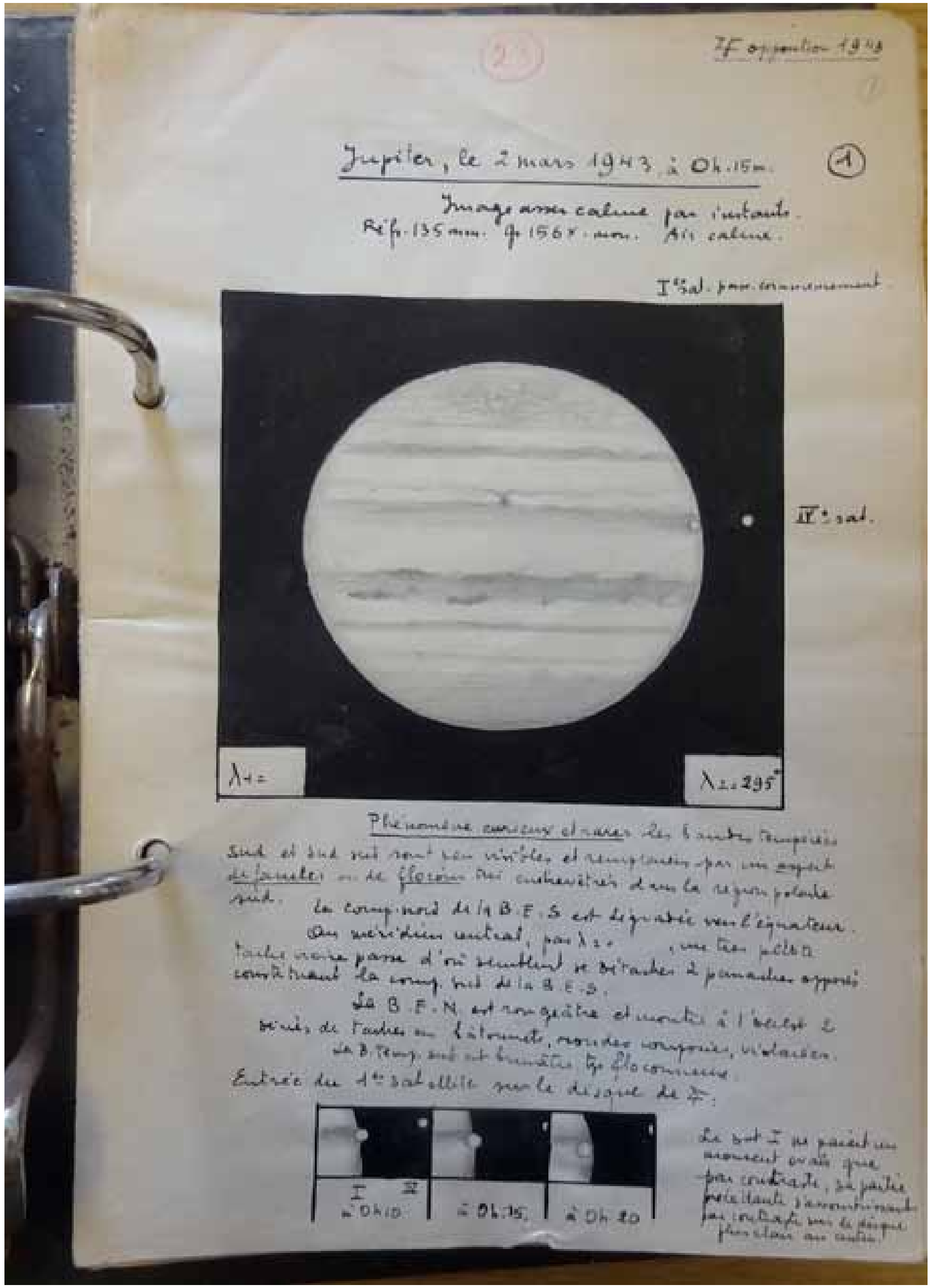
Du Martheray was General Secretary of the Society for 32 years and during that time dedicated many days and nights to astronomy. Over 40 years he produced thousands of observations and drawings of the sun, in particular of its sunspots and their position on the surface. Several hundred drawings and sketches found in the archives of the SAG show that he also did a great deal of research on other stars such as the planets of Mars, Jupiter and the moon.

The instruments of the Société astronomique de Genève

du Martheray generally used two instruments for his observations: a «Schaer telescope with a 21 cm aperture» and a telescope of 135mm in diameter. Only the telescope has been found. Other instruments preserved at the Société astronomique de Genève are French telescopes dating to the beginning of the 20th century from well-known Parisian optical workshops. Made for amateurs, these are often mentioned in the popular works of Camille Flammarion who recommended them as a first step in astronomical studies.

Camille Flammarion

Camille Flammarion (1842-1925) was an engraver and photographer and then a student in astronomy at the Observatoire de Paris. He became one of



Dumartheray astronomical dairy (SAG collections).

the most famous scientific popularisers in the 19th century. He published numerous works and articles which helped to make astronomy accessible to the public. His «Astronomie populaire» became a best-seller and was printed in 130,000 copies. He came from a humble background and held only a simple baccalaureate. Flammarion is sometimes considered the founding father of the enthusiasm for astronomy which appeared at the beginning of the 20th century alongside the more rigorous academic astronomy of the universities.

Thanks to a private gift, Flammarion built his own observatory in 1882 on an estate near Paris. He was also the founder of the Société astronomique de France in 1887 which had 3500 members by 1925. This society gave birth to many similar ones in France and in other countries including the Société Flammarion de Genève founded in 1923 by Martheray.