In the mid-19th century, scientists were not squeamish when it came to exploring physiology: on live animals, they studied how the organs worked or how the nerves transmitted impulses – and even subjected human beings to electric pulses. Yet, even without such menacing methods, a great deal of fundamentally new knowledge was discovered.

Researchers at the Max Planck Institute for the History of Science are currently documenting the history of the origins of physiology in the Virtual Laboratory on the Experimentalization of Life.

Not just the world, but man, too, was surveyed exhaustively in the 19th century: physiologists investigated the machinery of the body, its electrical and mechanical mechanisms, the muscles and the nerves. There were lively discussions about what constituted the substance of the soul, whether there was a mysterious life force that distinguished a dead organism from a living one, and how life on Earth had come to be.

All of this eventually became too much for the confines of private scholars' rooms, even though astonishingly complex experiments long continued to be conducted in student lodgings and hotel rooms. Spacious, well-equipped laboratories were established in many of Europe's cities, where scientists could carry out series of tests with the latest measuring instruments under strictly controlled conditions. "The natural sciences underwent a dramatic transformation at that time. From the rather more romantic and qualitative research of nature emerged the modern methods of laboratory research as it is basically still practiced today: precision, repeatability, controlled conditions. Scientists attach enormous importance to all of these things," explains Henning Schmidgen, a science historian at the Max Planck Institute for the History of Science in Berlin.

Schmidgen and his fellow researcher Julia Kursell are working on a huge virtual archive on the origins of physiology, the "Virtual Laboratory: Essays and Resources on the Experimentalization of Life," or VL for short. The VL covers the period between 1830 and 1930, a scientific heyday in Germany, framed between the revival of natural science after Hegel's death and the start of Nazi rule. More than 30,000 documents, manuscripts, entire volumes of journals and books, as well as the experiments themselves and the instruments that were available, can be found here with just a few mouse clicks.

A visit to the VL can replace a complicated journey to the various collections on the history of science and through the museums of the world, saving travel costs and the valuable originals in equal measure. Furthermore, the VL has the world's most extensive collection of catalogues containing descriptions of measuring in-
A modest idea becomes a major undertaking

There is a chimera on the home page, half frog, half machine, with an austere “Enter” underneath, marking the way into the rest of the website. From there, the main navigation is reached, where the literature can be searched by keyword or author, manuscripts leafed through, a demonstration viewed of how the instruments worked, and frogs’ legs made to twitch – all made possible by simple animations. The project was sponsored by the Volkswagen Foundation for the Life project also take their digital equipment to wherever the fundamental优越性 of European man. A person’s moral condition, mental health, and even their criminal tendencies were also identified based on physical attributes. Scientists suspected a close connection between psyche and body, meaning that deficits in mental capacity or social behavior would necessarily be reflected in deformed skulls or weak muscles. This popular thesis fascinated Friedrich Nietzsche – his übermensch was not only mentally fit but also physically – and the words and phrases he personally underlined in Charles Fére’s work De génèse et criminalité can be viewed in the VL.

One of the most exciting finds is a blood pressure curve, on which Mosso himself explained the sudden rise with the note: “The professor’s coming.” The approaching steps of Mosso’s then-supervisor, audible through the door, had obviously made the test subject “The professor’s coming.” The approaching steps of Mosso’s then-supervisor, audible through the door, had obviously made the test subject's moral condition, mental health, and even their criminal tendencies were also identified based on physical attributes. Scientists suspected a close connection between psyche and body, meaning that deficits in mental capacity or social behavior would necessarily be reflected in deformed skulls or weak muscles. This popular thesis fascinated Friedrich Nietzsche – his übermensch was not only mentally fit but also physically – and the words and phrases he personally underlined in Charles Fére’s work De génèse et criminalité can be viewed in the VL.

Mosso’s bequest include photos of the pain-contorted faces of human guinea pigs in the Album dei Dolori and pictures taken during his investigation of fatigue on mountain bikes. Henning Schmidgen and Julia Kursell are working on making the VL even bigger, although they are thinking more along the lines of an eminently compact bonsai rather than a rampant climber like Wikipedia. The necessary “gardening” – in addition to the actual scientific work, some of which they likewise do in the VL – entails considerable effort. “We receive a lot of offers, but not every kind of original manuscript, document or catalog is of interest to us, so we are extremely selective,” emphasizes Schmidgen.

Some of the works, studies and essays that students, scientists or even laypersons write with the help of the VL can be published there if they fit in with the subjects covered, contain new ideas and are persuasive. However, all contributions are subject to critical discussion; the works pass back and forth between Kursell, Schmidgen and the authors. In this sense, the VL is like a preliminary stage of an electronic journal, which Kursell and Schmidgen say is certainly one option for the future. Novices might find it useful, having taken an initial stroll through the VL, to take a look at one of the comprehensive essays that have made it into the VL. In these essays, scientists examine various hypotheses, uncover connections between the events of the day and what was going on in the laboratories, and document their interpretations with numerous anecdotes and quotes gathered from the VL or elsewhere. The VL is, after all, a forum for experts. Beginners can easily get lost in the illegible handwritten notes, unable to see the forest for the trees, and even the twitching frogs’ legs, bleeding rabbits and other spectacular experiments can get wearisome – the animations are sparing and merely demonstrate the principle. What is exciting, though, is what can be derived from the raw material. For this, however, mountains of literature must be digested, which requires quite some time and knowledge.

For example, cultural scientist Christof Windgatter describes in his essay entitled “... with mathematic precision” how high the expectations of the simple measurement of physical strength were in those days. Scientists carried, for instance, dynamometers with them on their expeditions around the world in order to compare the strength of foreign peoples with the muscle power of European mariners, a comparison that usually came out in favor of the trained sailors and was taken as proof of the ways to easily get lost in the illegible handwritten notes, unable to see the forest for the trees, and even the twitching frogs’ legs, bleeding rabbits and other spectacular experiments can get wearisome – the animations are sparing and merely demonstrate the principle. What is exciting, though, is what can be derived from the raw material. For this, however, mountains of literature must be digested, which requires quite some time and knowledge.

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Francisco De Gennaro, an Italian anatomist andartist, designed the image of the human guinea pig on the right. He is known for his works on the anatomy of the nervous system. De Gennaro also worked on the development of the first realistic anatomical models, which were used for teaching purposes. His work was highly influential in the field of medical and scientific illustration. The image in the VL represents one of his famous illustrations, depicting a guinea pig under anesthesia, which was part of his research on the effects of anesthesia on the nervous system.

In the early days, the VL, in charge of the technical side of things, he came up with the idea for a project to create a virtual laboratory, available on the Internet to any interested party, but particularly positioned as a common global platform for scientific historians. In the early days, the VL, with its maritimes, a comparison that usually came out in favor of the trained sailors and was taken as proof of

The apparatus was used to measure the blood pressure of rabbits at the Physiological Institute in Leipzig in the late 19th century. It is known as a Joslyn apparatus, named after Joslyn, a prominent physiologist of the time. The apparatus consists of a rabbit holder, a rigid frame, and a manometer. The rabbit is fixed in the holder, and its femoral artery is cannulated. Blood pressure is measured through the cannula, which is attached to a manometer. This apparatus was used to study the dynamics of the circulatory system and to understand the effects of various factors on blood pressure. The Joslyn apparatus is a key piece of equipment in the history of physiological research and is still used today in laboratories around the world.
Even the subtlest of emotional stirrings follow natural laws

If living beings were machines, then physiology was an organic physics. The prevailing opinion of the day was that measuring physical parameters enabled scientists to determine people’s frame of mind and character traits. Conversely, it was believed that certain stimuli must invoke certain expressions of mood: by applying an alternating current, it was possible to make a man whose face was paralyzed appear to smile, as demonstrated by Duchenne de Boulogne, a doctor and researcher at the Salpêtrière asylum in Paris.

“In the past, people thought that the human spirit was able to act independently of the laws of nature,” wrote Francis Galton, a cousin of Charles Darwin, in his seminal work The Hereditary Genius. Now, he believed, it was possible to prove that even the subtlest of emotional stirrings, abilities, and even criminal tendencies were determined by nothing other than the laws of nature. Galton promoted the idea of eugenics, or human breeding that would produce increasingly superior humans in the course of controlled, accelerated evolution from generation to generation, as he cynically propagated back then. “Not only was the scientific world on the move, the whole of society was, as well. Farmers were migrating to the cities in search of work in factories. Industrialization was rapidly rising – and with it, the number of people needed of oiling, and were accepted as such. Unlike in the UK, no discussion of animal rights and vivisection was parallel, and this promotes new ideas and provides impulses for the development of new research issues,” says Julia Kursell.

To the amateur, the VL represents a huge cache of curiosities. For scientists, however, it is a research tool with which they can play out even outlandish working hypotheses. The VL provides them with a quicker and easier way of viewing countless manuscripts, refuting claims, making connections. In the myLab section, they can hold the manuscripts they are working on, prepare hypotheses and subsequently review them. In the process, they might even end up submitting a piece of work that adds to the controlled growth of the VL.

The VL is accessed more than 3,000 times a day. Its users include museums, private persons, science historians and students. For legal practitioners, too, not to mention philosophers, scientists from the fields of medicine, biology and physiology, and journalists, the VL is a treasure trove of ideas for interesting lectures and essays. “Everything is available simultaneously and in parallel, and this promotes new ideas and provides impulses for the development of new research issues,” says Julia Kursell.

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Aurora Rüsen

Curio cabinet and treasure trove

This classic experimental setup was used by late-19th century physiologists to study fatigue: With one finger of a hand that was otherwise fixed in position, the test person had to repeatedly lift a weight. The pen – left in the picture – was used to record the movements on a continuous strip of paper.