by the Berlin Museum für Naturkunde (Museum of Natural History), painstakingly labouring over his recreations of insects and their larvae. Each took a year to complete.

Keller worked first in plasticine, from which he cast a model in plaster. This plaster reference model he then recast in papier maché. Some details he added, cast in wax, with wings and bristles in celluloid and galalith (an early plastic material used in jewellery). Finally he coloured the surfaces, sometimes with additional gilding. The levels of patience and manual control Keller exercised were incredible. His fly, for example, boasts 2,653 bristles.

It may surprise some to find that papier maché — a material now associated with messy child's play — was used in such a refined manner for scientific modelling. It was developed as a serious medium by the anatomist Louis Auzoux of Paris. He was looking for a cheap and portable alternative to the wax models that graced only the best funded schools of medicine. During the 1820s Auzoux perfected his technique, mixing powdered stone and flax fibres into his paper pulp. The resulting models of bodies, with removable parts, were light, strong and flexible, and could be coloured and labelled.

Auzoux set up a factory and shop to manufacture and distribute his models worldwide, progressively extending his production to zoological and botanical examples. His large-scale insects proved especially popular. His shop in the Rue du Medecine in Paris survived into the 1990s; its remaining specimens were auctioned in 1998.

Although they used similar media and sometimes the same insect subjects, Keller and Auzoux stood at different ends of the modelling business. Auzoux produced on a commercial scale; Keller was a sculptor of monumental one-off portraits. Each model is a masterpiece, with no effort spared. It is difficult to see how such a skilled artisan could survive in today's museums, with their emphasis on cost analysis. Keller's exacting models may be things of the past, yet they are far from obsolete. Like the great habitat dioramas, they exercise a magnetic attraction.

Are Keller's models art or science? They are truly both. In the Museum für Gegenwart we tend to see their artistry; in the Museum für Naturkunde their scientific dimension. But Keller's artistry is always apparent in his observations of nature — and his scientific observations are central to his art. ■

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INNOVATION

The ideas lab

Jascha Hoffman reads about some creative research environments that led to unexpected discoveries.

Biomedical engineer David Edwards is regarded as an innovation guru. His various achievements include bringing to the market new ways to deliver drugs to the lungs, as well as setting up Le Laboratoire, a forward-looking institution in Paris that seeks to harness the creativity of science and art (see *Nature* 449, 789; 2007). His growing empire of labs, galleries and non-profit organizations stretches from Paris to Cape Town to Cambridge, Massachusetts, where he lectures at Harvard University.

His latest book, *The Lab*, calls for a new breed of small, flexible institutions to support interdisciplinary researchers whom Edwards calls “artsScientists”. Motivated by curiosity and passion, such researchers make unexpected discoveries that blur the conventional lines between science, business and art. Rather than prescribing the details of how such a lab should function, Edwards offers examples from his own experience: ingenious humanitarian projects, culinary novelties and science-based art installations.

Edwards's ideal laboratory requires large doses of supervision from experienced innovators. At Harvard, he has mentored undergraduates during their pursuit of ambitious humanitarian projects, including the development of soil-powered lighting for African villages using microbial fuel cells; the invention of a sleek water vessel whose collapsible skin was inspired by the design of living cells; and the creation of a soccer ball that generates electricity when you kick it. He is also on the board of Medicine in Need, an international non-profit organization that is pursuing an inhalable vaccine for tuberculosis.

One can sense the creative zeal when Edwards turns to his work on culinary technology. He describes a series of inventive soirées in Paris where guests were treated to caviar-like ‘flavour beads’ encapsulated in calcium alginate, or martinis that were turned to mist by ultrasound waves from piezoelectric crystals. The most popular of his foodstuff experiments is Le Whif, a form of breathable chocolate developed

with French chef Thierry Marx, inspired by Edwards's earlier research on inhalable drugs. Delayed by faulty inhalers that spewed cough-inducing clouds of cocoa powder, a working version of Le Whif went on sale this year.

As the curator of Le Laboratoire, Edwards also pairs conceptual artists with open-minded scientists. The results, displayed at his galleries in Paris and Cambridge, Massachusetts, are well intentioned but often incoherent. He describes in the book how he led Indian artist Shilpa Gupta to collaborate with Harvard psychologist and neuroscientist Mahzarin Banaji on an investigation of the biology of fear, resulting in an installation that required thousands of microphones to be strung from the ceiling. The puzzling opacity of such works brings to

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mind the comment of Swiss art curator Hans Ulrich Obrist: “Bringing art to science gives you a good chance of having neither.”

Edwards's prose can be heavy with jargon and self-promotion. Whereas his previous book *Artscience* (Harvard University Press, 2008; see *Nature* 451, 246; 2008) presented a series of vignettes of researchers working at the edges of their disciplines, the focus on Edwards's own endeavours in *The Lab* can feel narrow. Yet his enthusiasm is infectious. He comes across as a free-spirited inventor and educator. He is also a pragmatist, conceding that an emphasis on the creative process, and a high tolerance for failure, may make it harder for inventive researchers to achieve financial autonomy.

In these austere times, Edwards takes a firm stance on the importance of the imagination: “If the lab sacrifices the playful, contemplative, daring, irreverent atmosphere of the creative band in order to gain sustainability,” he writes, “the organization may survive, but the lab will cease to exist.” ■

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