



Musicians perform a composition inspired by the research of Judith Miné-Hattab.

CREATIVITY

Music of the spheres and cells

Elie Dolgin profiles a compelling collaboration between scientists and composers in Paris.

In July 2015, biophysicist Judith Miné-Hattab turned on her super-resolution microscope to test a new fluorescence-labelling technique for the first time. The thundering chords of Edvard Grieg's 1868 *Piano Concerto in A Minor* were playing in the background, through her laptop speakers. Down her eyepiece, she delighted in the sight of DNA-repair proteins waltzing around a yeast cell — in near-perfect harmony with the swirling piano arpeggios of the first movement's cadenza.

Miné-Hattab, who works at the Curie Institute in Paris, had studied piano and composition before turning to science. But she had never before realized how music and microscopic life could mesh. She decided to "reproduce this magic instant" for others.

In March this year, in the Salle Cortot concert hall in Paris, that ambition became

The Muse-IC Project
Salle Cortot, Paris.
12 March 2019.

reality. Eight musicians from the Radio France Philharmonic Orchestra and the French National Orchestra performed an original 10-minute composition based on her research by French composer Emmanuel Hieaux, alongside five pieces inspired by other scientists' discoveries — all conceived collaboratively through lab visits, e-mails and video chats.

On 21 June, a short documentary on the concert — the culmination of a project called Muse-IC — will premiere as part of World Music Day celebrations in Paris. The 23-minute film will present snippets of the performance, interlaced with interviews from the scientists and composers.

The compositions have drawn praise from musicians such as Yaniv Segal, acting

assistant conductor of the Detroit Symphony Orchestra in Michigan, and Jennifer Swartz, principal harpist for Canada's Montreal Symphony Orchestra. Swartz calls them "fulsomely engaging musically", noting how "compositional form, shapes, movement and colours" are harnessed to tell scientific stories.

Muse-IC began in mid-2016, after Miné-Hattab secured more than €60,000 (US\$67,500) in grant money from PSL University in Paris and the Curie Institute to commission musical pieces sparked by scientific advances. Issuing a call to scientists in her network, she asked for summaries of their latest research, along with images and videos.

Dozens responded. She winnowed the list to 17 researchers, whose projects ranged from fundamental physics and cosmology to basic cell biology, applied cancer research and neurosurgery. Meanwhile, some 200 composers applied. Six were chosen, each receiving €2,500 and a trip to Paris for the final concert.

UNEXPECTED HARMONY

From these two groups, meetings of minds emerged. For US composer Geoffrey Gordon, pinpointing a researcher for collaboration was "like Christmas morning" — a landscape of impossible choices. He settled on the work of Hervé Dole, an astrophysicist at the University of Paris-Sud in Orsay who studies the early formation of the Universe. So did French composer Jean-Marie Gagez. Yet, as Dole himself notes, each musician was attracted to different aspects of the material.

Gordon's piece focuses on the first seconds after the Big Bang, using seven musicians to explore the moments when the primordial Universe was expanding at an accelerated rate. Gagez, by contrast, stuck mostly to an event some 380,000 years later, when the Universe cooled off and became less dense.

The compositional process was difficult, Gagez notes, because he "attempted to be truly faithful to the topic". He read Dole's 2017 book *Le côté obscur de l'univers* (*The Dark Side of the Universe*), and visited his lab, where satellite equipment for measuring cosmological parameters is assembled. Gagez eventually decided to use just a cello, "to convey both the initial unity and the homogeneity of the Universe". The cello's four strings, for instance, represent the four fundamental forces.

Turning from the cosmic to the microscopic, the other pieces focused on cellular research. Along with Hieaux's interpretation of Miné-Hattab's work were two inspired by the research of her colleagues in the Curie Institute's Nuclear Dynamics research unit. The research of unit director Angela Taddei, which probes the least active phase of the cell cycle, spurred Alexandra du Bois's *Quiescence*. Denis Ramos, meanwhile, anchored his composition in the work of developmental geneticist Nathalie Dostatni.

Dostatni was impressed by Ramos's scientific curiosity and perusal of her papers on pattern establishment in the early fly embryo. Ramos's main inspirations, however, were video clips of a 'mitotic wave', in which a tide of nuclear division ripples across the embryo from edges to centre. To Ramos, this was very close to a phenomenon in music, in which the complex intermingling of melodic contours gives way to asynchronous lines of polyphonic texture — a pattern also heard in some of the later orchestral works of Hungarian-Austrian composer György Ligeti.

Leonid Mirny, a biophysicist at the Massachusetts Institute of Technology in Cambridge, teamed up with composer-scientist Amir Bitran, a PhD candidate studying protein folding at nearby Harvard University, on their contribution to Muse-IC. Mirny was enthralled by Bitran's interpretation of his 'loop extrusion' model of DNA organization: the sighing notes played by the string section are meant to evoke the binding and release of loop-promoting factors. "I love it," Mirny says — and he decided to stage a second performance closer to home.

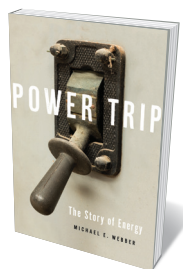
On 12 April, as part of 60th-anniversary celebrations for Harvard's biophysics graduate programme, the Boston-based ensemble Callithumpian Consort performed Bitran's *When DNA Makes Loops* to a rapt audience of faculty members, students and alumni. Bitran had previously seen music and science as occupying "different parts of my brain". Now, he says, the project has sharpened his ability to distil research topics in biophysics to their essence, while opening him to new musical inspiration.

Science communicators applaud the project's multidisciplinary nature. Writer and broadcaster Jay Ingram, who co-founded the science and arts outreach organization Beakerhead in Calgary, Canada, feels that the creative processes in music and science are similar. He wondered, however, whether the compositions "have some sort of unique sound" that reflects their origins.

Segal thinks they do. Some composers interpreted the underlying scientific premise literally, some more metaphorically, he notes. That range of musical choices mirrors the diversity of research topics. Miné-Hattab hopes that that, in turn, will seed audience awareness of the curiosity-driven world of the lab. This realm is closed to most, but through Muse-IC, its cosmic and cellular wonders are being opened by a small chamber ensemble. ■

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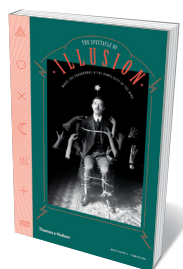
Books in brief



Power Trip

Michael E. Webber BASIC (2019)

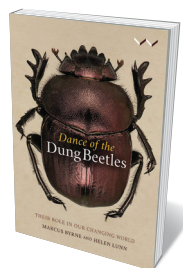
Energy is invisible. Yet, argues mechanical engineer Michael Webber, it has built civilization — for better and worse, as he describes in gritty chapters on water, food, transportation, wealth, cities and security (including war). Bottled water, for example, demands energy for processing, sealing and refrigeration, but the lion's share goes on manufacturing the plastic container. That makes it 1,000–2,000 times as energy-intensive per litre as tap water, depending on how far it's shipped. Technical fixes for global over-consumption are analysed, but as Webber notes, there is no magic bullet.



The Spectacle of Illusion

Matthew L. Tompkins THAMES & HUDSON (2019)

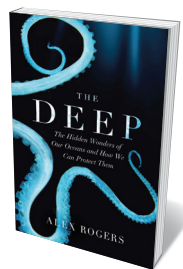
Physician and writer Arthur Conan Doyle, creator of arch-rationalist Sherlock Holmes, was a friend of legendary magician and escape artist Harry Houdini. Ironically, Doyle evangelized for the paranormal — even as Houdini used illusion to expose it as fraudulent. Yet the belief gripped distinguished scientists of the era, from physicist William Crookes to naturalist Alfred Russel Wallace. All this and more invigorates experimental psychologist and magician Matthew Tompkins's lavishly illustrated companion to *Smoke and Mirrors*, an exhibition about magic currently at London's Wellcome Collection.



Dance of the Dung Beetles

Marcus Byrne and Helen Lunn WITS UNIVERSITY PRESS (2019)

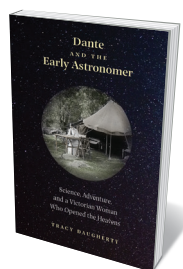
Dung beetles — which fascinated Charles Darwin — were once divine symbols. In ancient Egypt, Khepri (god of the rising Sun) had a scarab-beetle head because the insect 'danced' balls of dung across the Earth, just as the Sun moved across the sky. The beetle is thought later to have metamorphosed into zodiac sign Cancer, the crab. Now, thanks to experiments by entomologists such as Marcus Byrne, we know that dung beetles can navigate by the Milky Way. His collaboration with writer Helen Lunn, eye-catchingly illustrated, is a captivating compound of science, history and myth.



The Deep

Alex Rogers WILDFIRE (2019)

Just 10% of an estimated 2 million marine species have been described, and a mere 0.0001% of the deep-sea floor has been sampled. Twelve astronauts have visited the Moon, but only three divers have reached the lowest point of the sea bed, Challenger Deep in the Mariana Trench. Alex Rogers' authoritative, hands-on study brims with such findings. A marine biologist and environmental activist, Rogers mixes wonder with wake-up calls about overfishing, pollution, invasive species and climate change, along with proposals for protection. Regrettably, there are no maps or index.



Dante and the Early Astronomer

Tracy Daugherty YALE UNIVERSITY PRESS (2019)

Victorian scholar Mary Evershed was a published amateur astronomer gripped by Renaissance poet Dante Alighieri. Her 1914 *Dante and the Early Astronomers*, reviewed in these pages (see *Nature* **94**, 359–360; 1914), is still admired for clarifying the sensual astronomical references in Dante's *Divine Comedy*. Literature professor Tracy Daugherty brings Evershed to life, but he is less assured on the astronomy, especially Albert Einstein's general theory of relativity — which was questioned by Evershed's husband John, a professional astronomer in India under British rule. **Andrew Robinson**