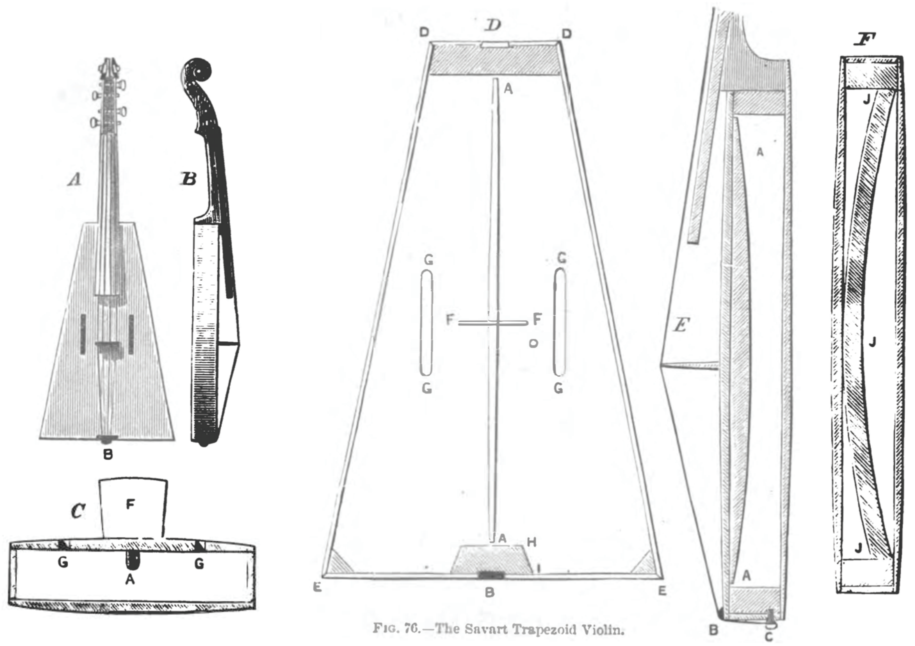
More accounts of mingling art and science

Toni Feder's excellent story "Mingling art and science opens minds" (PHYSICS TODAY, April 2021, page 24) is of special interest to me as someone who has had both a career in physics and a second career in art. Feder describes many instances where an artifact of science or of art inspires work in the other's field, and she also talks of improving dialog between those fields. But I would have liked to see stronger emphasis on the motive that drives many, if not most, scientists and artists—namely, the joy of discovery.

I was an undergraduate teacher and grant-supported physicist at Williams College for 32 years, then a sculptor for 21 years (for some examples, see www.fieldingbrown.com). The nexus between those two careers was the satisfaction I received when I actually found or did something new. When I was doing physics, that might be from a trifling bit of experimental technique or, more broadly, something publishable. When doing sculpture, it was from completing a new piece and finding it artistically pleasing.



TRAPEZOIDAL VIOLIN by Félix Savart. (Adapted from E. Heron-Allen, *Violin-Making, As It Was and Is*, E. Howe, 1914, p. 117.)

When asked about the Nobel Prize in an interview for the BBC show *Horizon*, Richard Feynman replied, "I've already got the prize. The prize is the pleasure of finding the thing out, the kick in the discovery, the observation that other people use it [my work]—those are the real things."[1,2] So I find myself in good company regarding the joy of discovery: It must be an important part of the "mingling" of art and science.

References

1. R. Feynman, *The Pleasure of Finding Things Out: The Best Short Works of Richard B. Feynman*, J. Robbins, ed., Perseus Books (1999), p. 12.
2. A. Lightman, *Probable Impossibilities: Musings on Beginnings and Endings,* Pantheon Books (2021), p. 77.

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In her article "Mingling art and science opens minds" (PHYSICS TODAY, April 2021, page 24), Toni Feder mentions many interesting intersections between visual art and science. In 1819 physicist Félix Savart (1791–1841) said, "The efforts of scientists and those of artists are going to unite to bring to perfection an art that, for so long, has been limited to blind routine."[1]

Savart is best known to physicists through the Biot–Savart law in electromagnetism. He is, however, also known for studying the acoustics of violins.[2] His friendship with luthier Jean-Baptiste Vuillaume (1798–1875) provided Savart with opportunities to investigate instruments made by Antonio Stradivari (ca. 1644–1737). Savart started asking how we could understand the performance of a violin from the plates before they are assembled.[3] He even made a trapezoidal violin (see the sketches above) whose acoustics proved that the instrument's characteristic shape serves only aesthetic purposes. For him the art is about the violin.

References

1. F. Savart, *Mémoire sur la construction des instrumens à cordes et à archets* (*Dissertation on the Construction of String and Bow Instruments*), Librairie Encyclopédique de Roret (1819), p. 77. See also F. Savart, *Ann. Chim. Phys.* **12**, 225 (1819).
2. V. A. McKusick, H. K. Wiskind, *J. Hist. Med. Allied Sci.* **14**, 411 (1959).

3. C. M. Hutchins, *J. Acoust. Soc. Am.* **73**, 1421 (1983).

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Physicists' real-world contributions

Rajan Menon's letter "Nobels neglect fluid dynamics" (PHYSICS TODAY, January 2021, page 10) correctly points out how the importance of physicists' real-world contributions have been undervalued in the physics community. Many physicists apparently have the misunderstanding that finding elementary forces among particles solves the world's problems. The reality is far from it.

Since Isaac Newton's time, it's been well known that the three-body system cannot be solved analytically, and numerical approaches can lead to chaos. The real world consists of infinitely many–body systems whose temporal evolution is intrinsically unsolvable. Even for the simplest hydrodynamics systems, the Navier–Stokes equation, which is only an approximate model, is not solvable. Plasmas are much more rich in their time evolution, and a large number of fundamental discoveries in that area have not been properly appreciated in the physics community. Some unexpected discoveries in nonlinear continuous media certainly deserve higher valuation in terms of their real-world contributions; conspicuous examples include the applications of optical solitons in high-speed transcontinental communications and the influence that self-organization of plasma turbulence has had on fusion confinement.

So far the only reliable universal law of physics in nonlinearly interacting many-body systems remains the second law of thermodynamics, which states that the entropy of an isolated system will not spontaneously decrease. That law's unique stature simply shows that a real physical system is unpredictable, so any new discoveries that go against the entropy law for at least a limited period of time deserve more attention. For example, in quasi-two-dimensional hydrodynamics systems, such as planetary atmospheres, a quantity called the enstrophy (the squared vorticity) is conserved in addition to the total energy, and the entropy can be defined with regard to either the uncertainty in the energy spectrum or the uncertainty in the enstrophy spectrum. The maximum-entropy state of enstrophy can lead to ordered structure in the energy spectrum and to nontrivial states such as zonal flows observed on the Jovian surface.

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Tales in tech transfer

I was pleased to see Toni Feder's piece in the February 2021 issue of PHYSICS TODAY on technology transfer (page 24). I have held tech transfer positions in industry and academia for more than 20 years. Tech transfer has been a very satisfying career for me. Moreover, it is a field that is particularly well suited to my background as an experimental physicist.

When speaking to physics students about my career, I like to tell the story of my time as a member of a team that included experienced engineers. We were fortunate enough to be inundated with projects across a broad spectrum of technologies. Although I was self-conscious about my lack of deep technical knowledge compared with my colleagues with traditional engineering backgrounds, I was very pleased to hear the way our boss would describe our team: "When we have a silicon invention, we give it to our silicon expert. When we have a photonics invention, we give it to our photonics expert. And when we don't have any expertise in an invention, we give it to our physicist."

I have found that the strong fundamentals and "outside the box" problem solving that I developed in my physics training have enabled me to come "up to speed" quickly across a broad range of inventions that run the gamut from nerve-regeneration devices to pollutant-capture technologies to high-performance concrete compositions and beyond. That flexibility is a vital skill for a tech transfer professional.

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Correction

May 2021, page 27—The building in the photo is erroneously identified as Cambridge University's Cavendish Laboratory. In fact, in Ernest Rutherford's day, the photographed building housed the department of engineering's Electrical Laboratory, which was later subsumed into the department of physical chemistry. Today the building houses the department of history and philosophy of science and the Whipple Museum of the History of Science. Below is the actual entrance to the Cavendish. (Photo by R. T. Phillips.) PT