Physics and poetry revisited

In his editorial "Physics and poetry" (Physics Today, April 2022, page 8), Charles Day states that he found "barely a handful" of poems related to physical phenomena in the online poem collection of the Poetry Foundation. He might have had better luck looking in 19th-century sources.

We are the editors of the MIT website the Net Advance of Physics, which includes a section called "Watchers of the Moon"[1] (an allusion to the famous paintings by Caspar David Friedrich). It is an anthology of science-themed poetry from the (very) long 19th century, which we define as 1750–1925. The lower limit is arbitrary; the upper limit has to do with copyright law. The section features poems by the usual suspects (William Wordsworth, Edgar Allan Poe, and so on), but also by obscure and forgotten writers. The quality, it need hardly be said, spans a similarly broad range.

We have also included the verse of James Clerk Maxwell and other literarily inclined scientists. We suspect our page "The One of Time, of Space the Three: The Collected Poems of Sir William Rowan Hamilton" might be of particular interest to physicists and mathematicians. Because of our linguistic limitations, "Watchers of the Moon" presently includes only poetry in English (with a few translations); we would welcome suggestions for 19th-century poems from other cultural and linguistic backgrounds.

Reference

1. The Net Advance of Physics Retro, "Watchers of the Moon: Poetry and Mathematical Physics in the Long Nineteenth Century," https://web.mit.edu/redingtn/www/netadv/SPpoetry.html.

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TWO MEN CONTEMPLATING THE MOON, by Caspar David Friedrich, oil on canvas (1819), Dresden State Art Collections/public domain.

In his April 2022 editorial (page 8), Charles Day opens with a quote from Paul Dirac: "The aim of science is to make difficult things understandable in a simpler way; the aim of poetry is to state simple things in an incomprehensible way. The two are incompatible." As a poet with a bachelor's in applied math, I find Dirac's comment to be clever but misguided.

Doubtless many poets would say that physics makes the simple incomprehensible. Comprehension is a function of training, and mathematical formulation remains baffling to many. Meanwhile, we should always be suspicious of the Dunning–Kruger effect when judging others' fields as dealing with especially simple matters, particularly when we can see that we do not understand the results.

Poets have diverse aims, not primarily obfuscatory. Some poets explore the limits of language, seeking to say that which is unsayable in everyday speech—a task tackled elegantly by quantum formalism in a domain for which our vernacular has not evolved. The very syntax of human language obscures fundamental understanding of the "really real world" beyond the prosaic and the mesoscale.

Dirac was 13 years old when the poet Hugo Ball presented his "Dada Manifesto" (1916) in pursuit of "poems that are meant to dispense with conventional language." Such "experimental poetry" may reveal aspects of how language functions or how the brain constructs meaning. Poetic diction may be deliberately dissociated from lyric expression to examine language distinct from confounding factors of sentiment (see, for example, the Language poets of the 1960s and

1970s, such as Ron Silliman, Lyn Hejinian, and Bernadette Mayer).

Incomprehensible? Yes, often. But it misses the mark to say that the simple has been made so. Poetry is a kind of laboratory environment where language can be brought to exhibit all sorts of odd behaviors that won't occur in plain prose. The process may appear bizarre, and the results ambiguous. Surely a physicist can relate.

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Charles Day's column, "Physics and poetry," in the April 2022 issue (page 8) is correct to push back on claims that the two are "incompatible" (attributed to Paul Dirac). But I disagree with one of his later statements, "Physics is abstraction. Its use for metaphor and simile is limited."

Physics is rich with metaphors, its very abstraction itself perhaps accounting for many of them. The pendulum as an oscillation about a mean between two limits on either side of an equilibrium is a hoary metaphor in ordinary language and the social sciences. It gets an even wider meaning in the hands of a physicist who sees the same mathematics and physics of harmonic oscillations in contexts far from material bobs on strings or swaying branches. Richard Feynman, a name that Day rightly invokes, rendered poetically many a physical theme and saw in the design of a Japanese gate a poetic "explanation" for broken symmetry in nature as seen in theoretical physics.[1] Some other examples of metaphors across physics are in my book, *The Beauty of Physics: Patterns, Principles, and Perspectives* (2014).

Reference

1. R. P. Feynman, *Six Not-So-Easy Pieces: Einstein's Relativity, Symmetry, and Space-Time*, Basic Books (2011), p. 47.

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The clean-energy challenge

The Issues and Events item "Electrification of cars and trucks likely won't disrupt the grid" (Physics Today, April 2022, page 22) by David Kramer is timely and accurate as far as it goes. But by omitting mention of nonhighway transportation, and the rest of the economy for that matter, it unintentionally makes the growth in electricity usage on the path to decarbonization of our economy seem to be nearly business as usual. Several recent studies, however, show that a carbon-neutral US economy in 2050 will require around four times as much electricity as we use today.[1–3]

Synthesis of chemical fuel for aviation, military, and nonhighway vehicles will require more electricity than the electrification of highway vehicles discussed in Kramer's story. The electrification of homes, businesses, and industry—including synthesis of hydrocarbon feedstocks—will require twice as much again. That prodigious increase in generation, transmission, and, hopefully, storage is most certainly different from what was needed to support the introduction of air conditioning.

The new electric grid will be much larger and will operate very differently from the old one. Power will be transmitted longer distances from regions where sunlight and wind are abundant. Roughly half that power will be for battery charging and a massive new electrochemical industry, both amenable to load management to match the remaining intermittence of renewable power supply. The tendency to treat decarbonization of economic sectors in isolation and thereby miss the big picture is in part a reflection of the incremental approach in our policy. To plan and finance the greatest industrial build-out since the railroad boom of the late 19th century, we must have a comprehensive policy that sets clear goals and brings long-term investor confidence. And we need it soon. We only have 30 years to complete the project!

References

1. E. Larson et al., *Net-Zero America: Potential Pathways, Infrastructure, and Impacts*, Princeton U. (29 October 2021).
2. M. Ram et al., *Global Energy System Based on 100% Renewable Energy: Power, Heat, Transport and Desalination Sectors*, Lappeenranta U. Technology and Energy Watch Group (March 2019).
3. J. H. Williams et al., *AGU Adv.* **2**, e2020AV000284 (2021).

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David Kramer has in the past two years written several items discussing components of the clean-energy challenge. One from the April 2022 issue is on charging electric vehicles, or EVs (page 22), and another from the September 2021 issue is on energy storage (page 20).

While the stories are informative, both are missing context. For example, the story on EVs doesn't discuss how they are only as clean and efficient as the process by which the required electricity is produced. The storage story fails to acknowledge that grid-scale storage capacity adequate to power cities or countries is not and will not be available in the foreseeable future. Even more importantly, dependence on storage is not acceptable, even if attainable, because no one knows the duration of future wind and solar droughts.

I urge Physics Today to do more to rationalize the discussion of renewable energy.

That renewable energy is intermittent is not contentious. That renewable energy sources must be complemented by storage or backup is not contentious. That grid-scale storage is unavailable at urban scale may be more contentious but is nonetheless true. Relying on backup implies that whenever renewables are producing power, their backup (which is paid for) sits idle. Thus, renewables don't increase capacity; they duplicate dispatchable (always available) sources. That duplication is responsible