

“Our Models Are Our Metaphors”

Journalists, poets, playwrights, and movie makers now regularly attribute poetic qualities to mathematics and science. On a recent Tuesday, readers of *The New York Times* science section were treated, in two separate articles, to the phrases “an equation as a poetic compression of reality” and “poetic characterization of the mysteries of the universe.” Rita Dove, the U.S. Poet Laureate for 1993–95, celebrated the joy of mathematical discovery in her poem “Geometry”:

I prove a theorem and the house expands:
the windows jerk free to hover near the
ceiling,
the ceiling floats away with a sigh.

Who knows how long this love affair will last, but let us enjoy it while we can!

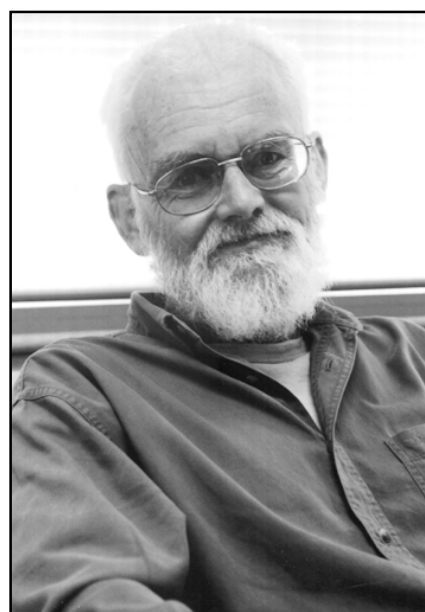
It is one thing to wax poetic about mathematics, quite another for a mathematician to be a poet in the more traditional sense. And yet a very few practicing mathematicians are also serious poets. Among them is the outstanding applied mathematician Philip Holmes, who, with his fourth collection of poetry to be published this summer, graciously agreed to be interviewed by *SIAM News*.

Born and educated in England, Holmes received his first degree from Oxford University in 1967, followed by a PhD from Southampton University in 1974. Three years later, he moved to the U.S. and a position at Cornell University. He stayed at Cornell until 1994, when he joined the Princeton faculty as a professor of mechanics and applied mathematics; from 1994 to 1997, he was director of the university’s Program in Applied and Computational Mathematics.

In broad terms, Holmes’s research area is perhaps best described as applied dynamical systems. He is an editor of the new SIAM journal of that name, and he is also the editor-in-chief of the *Journal of Nonlinear Science*. On closer inspection, his research interests are seen to include: (1) bifurcation and chaos (work on which led to his and John Guckenheimer’s well-received graduate text *Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields*; originally published by Springer in 1983, the book was reprinted for the sixth time in 2002); (2) knots and orbit genealogies in three-dimensional flows; (3) low-dimensional models of turbulence; and (4) pattern formation and nonlinear waves in continua.

A recent interest is modeling insect locomotion (think cockroaches!). Although so far the model is based on mechanics, he hopes to include neural feedback in the future. Holmes describes his research philosophy as follows: “I’m more interested in understanding the underlying qualitative features of mathematical models and their physical applications than in detailed quantitatively accurate simulations.”

Holmes has been the co-author of almost two hundred research papers and four mathematics books and, remarkably, has supervised 23 PhD students, with five more in the pipeline. He has received many honors and awards, including a Guggenheim Fellowship, and election to the American Academy of Arts and Sciences and to the Hungarian Academy of Sciences. And, not least, he is one of the five speakers invited to give plenary talks at SIAM’s 50th Anniversary Meeting. The provocative title of the talk, scheduled for Thursday, July 11, is “How Nonlinear is Science? Reflections on a Chaotic, Dynamical Century.”—*Ivar Stakgold*



One of five plenary speakers on the program for SIAM’s 50th Anniversary Meeting, Philip Holmes is also a serious poet. With his fourth collection of poetry due to be published this summer, Holmes met with Ivar Stakgold to discuss his dual careers. A transcript of the interview begins on page 8. Photographs in this article by Lois Sellers.



I.S.: Your first book of poetry appeared three years before your PhD. Did these two talents develop simultaneously? Did you ever consider making poetry your principal career?

P.H.: Poetry came first. After the usual teenage effusions, I started writing seriously while studying engineering science at Oxford in the mid-60s. (I bought far more poetry than engineering and physics textbooks, and probably attended as many readings as mechanics lectures.) I seriously thought of abandoning science, and had it been possible to transfer to English or the humanities, I might have done this. So I have the rigid British educational system to thank for keeping both worlds open, and making it possible for me to have a job with enough freedom (if not enough time) to continue exploring them (for almost no one makes a living as a poet).

The literary scene at Oxford was pretty lively: Isaiah Berlin lectured on Russian short stories; Constantin Trypanis (a Greek poet and scholar) invited small groups to his rooms to pick each other’s work apart; Andrei Vosnesensky visited; Robert Graves was Professor of Poetry (a visiting position—now occupied by my Princeton colleague Paul Muldoon). Michael Schmidt, who founded

Carcenet [literary publisher in the U.K., specializing in poetry], and Peter Jay, who founded Anvil Press, were fellow students. Peter saw enough in my work to write rejection letters so encouraging that I persisted. He's about to publish my fourth collection.

After my BA I returned to a final year of apprenticeship at Rolls-Royce Aero Engines in Derby. This convinced me that I would be neither successful nor happy as an engineer, so I went off to live in the Yorkshire Dales and walk around in the rain and write poems for a year. The first book came out of this. In the summer and autumn of 1969, I traveled through Europe and Turkey, mostly on foot, with the notion of reaching India. I went to Israel to spend the winter working on a kibbutz (Zikim, near the northern border of Gaza); there I met Ruth, my wife. After we'd married and it seemed prudent to get a job, I wound up once more in an engineering lab, at the Institute of Sound and Vibration Research at Southampton University. Bob White saw a spark in an indifferent engineer with literary aspirations; he encouraged and guided my PhD in experimental methods in wave propagation, and thus, perhaps accidentally and with the help of colleagues, such as David Chillingworth and David Rand in mathematics, launched me on a chaotic trajectory.

I completed my second book in Southampton, and, having failed to convince British hiring committees that I was an engineer or a mathematician (let alone a poet), I took a U.S. job-hunting tour in 1976. Cornell may not have been sure what I was, but they hired me! Ruth and I moved to Ithaca in 1977. Ruth was born in Philadelphia, so this was a homecoming of sorts.

I.S.: *Are there aspects of your childhood and family background that led you into science and poetry? Your children must reap great benefits from their unusual cultural environment; how do they respond to your dual career?*

P.H.: My parents both left school early: my father to be articled to an estate agent and auctioneer, and my mother to work in Rowntree's sweets factory in York (she was one of ten children). Neither had formal higher education, but they were great readers and my father had a hoard of classic English poetry, speeches from Shakespeare's plays, etc., committed to memory. My mother knew masses of music hall (vaudeville) songs, which she'd sing as she worked. Words, phrases, and history were clearly important, but there were no writers, and almost no university degrees in our extended family.

Our children should answer the second question! I hope that we've shown them that science, the arts, and the humanities are complementary ways of coming to grips with this awful and beautiful world.



Philip Holmes, during a spring visit to the SIAM office, read a few of his new poems to interviewer Ivar Stakgold. He'll repeat the performance at a poetry reading during SIAM's Philadelphia meeting (see end of the article for details).

I.S.: *As a highly productive applied mathematician, how do you find time for writing poetry? Does part of the answer lie in the many international conferences you are able to attend as an invited speaker? No one could have put it better than David Lodge in *Small World*: "The modern conference resembles the pilgrimage of medieval Christendom in that it allows its participants to indulge themselves in all the pleasures and diversions of travel while appearing to be austere bent on self-improvement."*

You apparently made good use of any free time!

P.H.: Should one say "find time" or "make time"? I can no longer find it, and can barely make enough to keep up with my wonderful students and postdocs, whose creativity and energy sustain the mathematical productivity. Poetic production is much slower. The new collection, sixteen years in the making, has about seventy-five pages of poems: probably less than 1600 lines all told. A hundred lines a year isn't much.

Lodge's remark is certainly clever, in the context of his academic satires, and there's some truth in it. (For another cynical view, see Arthur Koestler's *The Call Girls*.) But actually I think most of us work pretty hard, even if we don't attend all the lectures. I confess to getting away from the math talks sometimes—I recall meeting with a dissident poet in Café Gerbaud in Budapest in 1987 after escaping from the International Conference on Nonlinear Oscillations one afternoon.

I make notes while on the road, but most of the serious composition and endless rewriting is done at a desk ("emotion recollected in tranquillity"—Wordsworth, "The Prelude"). It's not so different from writing papers, but without collaborators.

I.S.: *Even taking all your conferences into account, your poems describe more places than most of us could visit in a lifetime. How much is autobiographical and how much is the product of a fertile imagination?*

P.H.: I have been to almost all the places I've written about. (Wethersfield, the preacher Richard Roger's village in East Anglia, is an exception: Roger's Diary forms the central section of "The Covenant," a poem about the early Puritans in England and America, from my second book.) Much of this, especially outside the U.K. and U.S., was made possible by invitations to

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Released from school for an hour and
walking the city walls in slack, November light,
we saw four people burning a piano. An upright,
toppled on kindling. Old varnish flashed and boiled,
the strings went lax in thuds and curious shrieks.
A bottle made the rounds. We heard a fitful cheer.
We? I have a notion of companions, but can't imagine
who might have come on those long walks
escaping endless fellowship, or why this memory
should seize me now at 3 am — four figures
in an afternoon beyond the moat — the music gone
that might have been performed, all traffic
momentarily still, on a wholly other continent.

from "Brigg," *Lighting the Steps*

conferences, and it's mostly at the level of brief trips and tourism, alas. Writing about a place does help one understand the history and culture a little better, but readers with deep knowledge will probably find it rather superficial. Of course, the historical re-creations are just that: Time travel happens only in the poems!

I.S.: *Marston Morse observed that the affinity between mathematics and poetry reaches well beyond the metrical character of the latter, manifesting itself at a deeper level in the similarity of the attitudes of poets and mathematicians toward abstraction and discovery. Your fascinating article "Metaphors and Models in Science and Art"* discusses the similarities and differences between the worlds of applied mathematics and poetry. What were your principal conclusions?*

P.H.: I wasn't aware of Morse's remark, but there are certainly currents much deeper than surface form, structure, and symmetry. Abstraction (and generalization) is a strategy common to poets and mathematicians. As argued in the article, applied mathematicians have to use the language of mathematics to make extra-mathematical statements: Our models are our metaphors, in a sense. We must pay attention to the forms: We can perhaps test and bend mathematics to bring it to bear on the "real" world, but we may not transgress the mathematical rules. One's knowledge of mathematics enlarges (and limits) one's model building and analytical ability, just as knowledge of the literary tradition informs the poem: A phrase can call up a whole play of Shakespeare, as one might appeal to the ideas of variational calculus in developing a model of liquid crystals (as well as to a technical result in proving some lemma about convergent subsequences).

Intense focus on a topic is probably common to any artistic or intellectual enterprise. But we should acknowledge that this implies acts of creative neglect. One can't successfully address all the evils in the world at once: A poem about a single person's suffering can be more powerful than reports from Amnesty International. On a much different theme, one shouldn't always include all the effects in a mathematical model; a huge simulation of the "exact" equations (even if one knows them) may be no more enlightening than the experiments that led to those equations. There are virtues in simplicity, even in caricature. And as Freeman Dyson has stressed, solving the equations often leads to a deeper understanding of the model itself. Solving is not the same as simulating.

There's more play in literature and the arts, but artists and scientists alike are trying to come to terms with things around (and within) them.

Liszt at Midday, 1994

for Adam Fellegi, Zichy Jenő 41, Budapest

Darkness and loss
he brings us time in his hands
while midnight chords swoop
to the high windows

Hands that precisely let fall
flickers of stormlight in balance
then harsh shouts once more
Satan thumping the table

The reply comes pale as leaves
stripped against a bruised sky
fifty years swept into the air
in gusts of sudden light

from *Lighting the Steps*

Clear Air Turbulence

The Dakotas and then Wyoming wrinkle
under us as the air wraps about us —
only the scale differs: those fine grains
and peaks are the land's flow, where years
extend to millennia. But cliffs bring up
the plateau's stretch with a leap

and up here seconds count as the wingtips dip
and bounce, breaking sight of the wrinkled face
below, the snow blown southward off ridges.
This air we're turned and bucked in
sweeps and fills huge cells over those ranges
which now shrug again and pull straight.

Unseen, the patterns stagger and break up;
what we would impose on them breaks up.
How can the air's heated, turning chaos be seen
as a fit end to its local order? And even granting this,
I still know that, in flight, volumes and pressures
far less properly described keep us alive.

Why wish to explain them, if we can rely on
what's not understood? We can't. The plane drops
an instant. We're forced again to look
past the surface, the hills and knotted air.
to the blank place, always just ahead, where
if only for a moment, the heart stops.

from *The Green Road* (1986)

I.S.: *Social issues also play a role in some of your poetry—I'm thinking of "The Swaledale Levels," the series dealing with the history of lead mining in Northern England. Do you regard yourself as a social activist?*

P.H.: No—I've signed petitions and spoken out against injustice, but I am not an organiser or effective advocate. I hope that some of the poems may help illuminate and plead for our common humanity, but sometimes I feel that W.H. Auden had it almost right when he said, in his elegy on Yeats: "Poetry makes nothing happen." But then he continued: "It survives, / a way of happening, a mouth." We all have to compromise between doing what we should and what we can. I can do a little math and a little less poetry. I'm grateful that I've been given the time and space to do this much.

I.S.: *Mathematics and science occasionally enter your work directly, as in your series of poems "An Imaginary History of Science." It is notoriously difficult to treat these subjects for a general audience, but you appear to be succeeding. Do you have any suggestions for mathematicians trying to write for such a readership?*

P.H.: Don't get too technical! My approach is pretty oblique, and focuses on the human side of science; vanity, courage, and pettiness, for example, in the poem "Celestial Mechanics," spoken by an imagined Italian monk. (In our book *Celestial Encounters*,[†]

*Centre de Recherches Mathématiques, *CRM Proceedings and Lecture Notes*, Vol. 11, 1997.

[†]Reviewed in *SIAM News*, Vol. 30, No. 5, June 1997; <http://www.siam.org/siamnews/bookrevs/celmech.htm>.

an account of dynamical systems and its origins in celestial mechanics, Florin Diacu and I did perhaps get too technical. It's not exactly a best seller!)

I.S.: *Your poetry seems to rely more on rhythm and meter than on rhyme. In your Kyoto poems you were of course bound by the strictures of Haiku, but do you usually decide the form of a poem before writing or do you let inspiration guide you?*

P.H.: The subject or an image usually comes first: sometimes just a line or two. The form suggests itself as the poem begins to build. I use forms—regular stanzas, rhythm, rhyme or half-rhyme, alliteration, stress patterns—a lot, but often in an oblique way: laying down rules and then breaking them, letting the message struggle and dance with the medium. Form, sound, and other musical aspects of language can give great power and breadth to a poem, but they shouldn't get in the way. I mutter and chant aloud, especially while revising.

There are two villanelles in the new book—a very constrained form of three-line stanzas, with two lines repeated sequentially to close each stanza and forming the final rhyming couplet of the quatrain that ends the poem. So you have only two rhymes in 19 lines! Dylan Thomas's "Do not go gentle into that good night" is a fine "modern" example. In mine I break most of the rules, but I hope the form gives the poems some additional resonance.

I.S.: *In your splendid new collection, Lighting the Steps, you have expanded your scope with respect to both form and content. What are your literary goals for the near future?*

P.H.: To turn a mess of notes made in Prague two years ago into a poem. For this I'll have to make, and hold onto, more than 15 minutes of uninterrupted time!

Models abound in the program for the SIAM 50th Anniversary and 2002 Annual Meeting, but metaphors haven't been neglected. A poetry reading has been scheduled for the evening of Monday, July 8, 8:00 to 9:00, featuring Philip Holmes and two other mathematician/poets from the Philadelphia area: Jet Wimp of Drexel University and Marion Cohen of Rosemont College and the University of the Sciences in Philadelphia.

Philip Holmes's new book, Lighting the Steps, will be available later this summer (orders@anvilpresspoetry.com); see <http://www.anvilpresspoetry.com> for additional information.