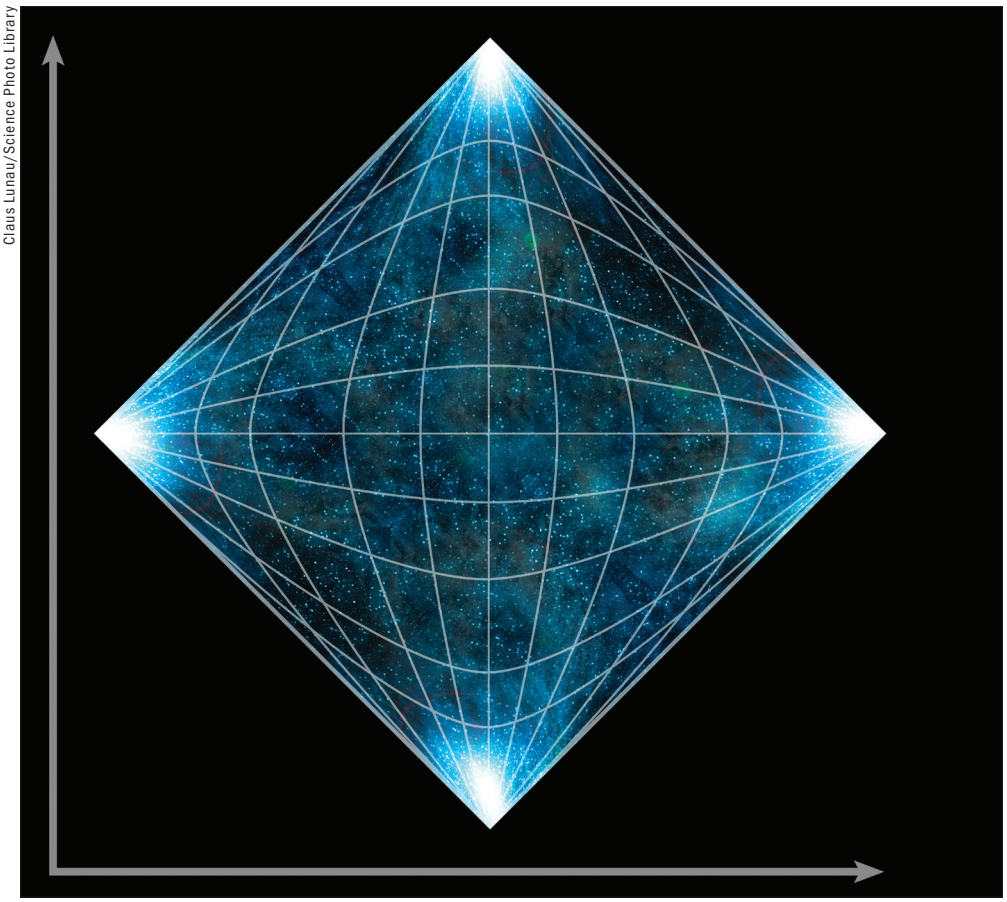
Chanda Prescod-Weinstein

Finding the right boundaries



Claus Lunau/Science Photo Library

Edge case
Penrose's overview of high-energy and gravitational physics is also a very personal tome.

Fashion, Faith and Fantasy in the New Physics of the Universe
Roger Penrose
2016 Princeton University Press
£19.95/$29.95hb
520pp

To truly immerse oneself in Roger Penrose's *Fashion, Faith and Fantasy in the New Physics of the Universe* is to fully experience the agony and joy of the theoretical physicist's quest to reckon with the problem of quantum gravity. The search for a way to unite quantum mechanics and relativity drives the work of many physicists, especially ambitious and optimistic young PhD students. Indeed, there is something romantic about the effort, like a hero's quest to make a lasting mark on the field by thinking deeply and then riding home triumphantly with the answer in hand.

The problem of course is that after nearly a century, the task has not only proved theoretically and experimentally insurmountable (so far), but it has also come with difficult sociological challenges. The story of quantum gravity is therefore not only about the joys of mastering difficult calculations, asking deep questions and exploring fantastical possibilities. It is also about wrestling for resources; taking unpopular and sometimes career-ending risks; and struggling to understand independence in the midst of a herd.

The decision by Princeton University Press to publish this work is an interesting one. The text lacks a natural audience, but for those who come to it and are willing to do the hard work of reading it, there are potential rewards. The book is offered as an overview of the boundaries of what we know in high-energy and gravitational physics, with a scientific critique and commentary on the sociological dynamics around these ideas. Penrose takes the view that getting beyond the boundary will require making sure that we are actually at the right one. To that end, he offers protracted semi-technical introductions to string theory, quantum mechanics, modern cosmology and his own pet programme, twistor theory.

Each of these introductions is very evidently biased by Penrose's own perspective, and by what other practitioners in the field might call his misunderstandings. *Fashion* is based on a lecture Penrose gave in the early 2000s in which he expressed views that have since been challenged repeatedly by fellow physicists. Unfortunately, the book does not really wrestle with any of those challenges. Instead, Penrose sets up the "fashion", "faith" and "fantasy" entirely from his perspective, knocks them down and ignores any factors that might upend his logic.

As an elder statesman of the field who has already left a lasting impression, it is possible that Penrose has earned the right to do this. When I was a young and optimistic student of loop quantum gravity who was excited to be seated near him at a dinner, I asked Penrose how he had come up with his majestic space–time diagrams, known as Penrose diagrams. He told me that he needed to draw space–time in order to understand it – that was all. Indeed, the book is replete with phenomenal visual representations of the physics under discussion, a reminder of Penrose's ability to see and describe physics in a unique way.

A great strength of these discussions is that they include some of the best introductions to difficult topics that can be found in the semi-technical or amateur-oriented literature. For example, Penrose's discussion of Feynman diagrams is very intuitive. He offers a historic perspective that can only come with having spent decades in the theoretical physics trenches, and his holistic views on the ties between the various branches of physics may help senior undergraduates or beginning graduate students gain some perspective on what they know.

Ultimately, what is most valuable about the book is the excellent example he offers in how to ask questions. He certainly raises more questions than he answers, and I found the answers he provides to be inadequate more than once. For example, Penrose believes that modern cosmology's reliance on inflationary theory as a building block of our cosmic timeline is overly fantastical. He portrays us cosmologists as uniformly and simply invested in inflation, untroubled by open problems related to it, even though

we are all troubled by many of the issues he raises. Despite this, I found that even as I disagreed with Penrose, he forced to me to think, and think deeply, about the fundamental assumptions I have relied upon as a researcher and the axioms I was taught as a student.

While the text has supposedly been made accessible by avoiding the use of differential calculus, in reality, one cannot follow it without knowing the material in a lengthy appendix. Within a few pages, this appendix introduces the concept of fibre bundles, which can be difficult for even a PhD-level physicist to fully wrap their mind around. Penrose's optimism and expressed desire that the interested amateur will be able to navigate the text is admirable, but on reading, it seems unrealistic. An open admission that this text is intended for readers with a background in physics would have strengthened it. Certainly, such an admission would have shrunk the number of potential purchasers, but it would also have given the author more freedom to make his point.

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Readers who struggle to follow the technical prose may, however, still appreciate the sociological commentary. Penrose is right to question the significant impact that the hyper focus on fashionable string theory has had on the physics community. He notes that the pressure to publish or perish and the feedback loop between this pressure and receiving funding is made all the worse by what may have been an excessive emphasis on one approach.

Similarly, questions raised about the faith we have in quantum mechanics are worth thinking through, even though here, again, Penrose refuses to grapple with critiques of his viewpoint. The one-sidedness in the author's thinking is a general weakness of the book, and this makes it difficult to suggest that a non-expert or student read it without guidance. If one is not expert on the topics discussed, it is possible to be misled by Penrose's biases. On the other hand, in some sense, this is exactly the phenomenon the text was meant to warn us about.

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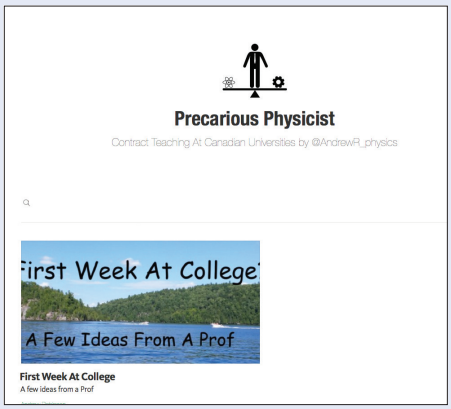
Web life: *Precarious Physicist*



URL: medium.com/precarious-physicist

So what is this site about?

If teaching physics to undergraduate students strikes you as a secure, well-respected and at least somewhat highly paid job, the *Precarious Physicist* blog will challenge your assumptions. Its author, Andrew Robinson, is one of a large and growing number of university lecturers who work on short-term contracts with relatively poor pay, high teaching loads and little prospect of permanent employment. Or, as Robinson puts it: "Hello. My name is Andrew. I am 54 years old, have a PhD and I have a crap job in academia."

That's...blunt.

Indeed. But it's also hard to disagree. As Robinson explains, his job as a contract instructor in physics at Carleton University in Ottawa, Canada, is "completely casualized labour. I have to reapply for my own job every four months; I have very poor benefits compared to tenured staff; I have no promotion or career development prospects at all". By his calculation, Robinson also teaches "twice as many courses as tenured staff for around a third of their salary", and although he has won awards for his teaching, he feels that his opinions on pedagogy "do not matter" to the university.

If it's that terrible, why doesn't he quit?

In part, it's the students, who Robinson describes on his blog as "wonderful...the only reason I still do this job". But there are personal factors, too. Robinson is originally from the UK, but he moved to Canada after his Canadian wife got a tenure-track job in physics at the University of Saskatchewan. "We had the classic two-body problem," Robinson told *Physics World*. "I got into teaching by accident." Asked to cover his wife's physics course when she went on maternity leave, he discovered that he liked teaching and was good at it. Later, Saskatchewan gave him annual contracts to teach large lecture courses for first-year students – a job he describes as "a good match". After a few years, however, their second child's health problems forced them to move to be near family in Ottawa. Once there, Robinson found that conditions for contract teaching staff were much less favourable than those he'd experienced previously, but "there aren't really any other jobs for a 50-something PhD scientist in Ottawa", he says. In Canada, he adds, "a PhD is regarded much more as training to be a professor than it is in the UK or Europe".

What topics does it cover?

In addition to the "crap job in academia" post quoted above, Robinson has analysed how his stipend and benefits stack up against those of his tenured or tenure-track colleagues (badly); skewered an essay that advised faculty to step away from the "frantic pace" of modern academia ("I don't have this luxury"); and discussed the financial disincentives of trying new things in his classroom ("a huge uncompensated task"). But he also regularly writes about physics teaching, and his posts on this topic are as kind and patient as his diatribes against his employer are pointed and sarcastic.

Why should I visit?

Numbers of "contingent" (that is, neither permanent nor potentially permanent) faculty have been rising for years in many parts of the world. According to the American Association of University Professors, more than 70% of university-level instructors in the US are now in non-tenure-track jobs. Looking at it from the university's point of view, this trend makes perfect sense: contract or adjunct faculty are cheap, well qualified and often very good at what they do, so why would they hire anyone else? Economic arguments aside, though, *Precarious Physicist* makes a powerful case that the current system is both unfair and unsustainable, and Robinson is taking a risk by writing it. As he repeatedly points out, his employer could decide at any moment not to renew his contract. Under the circumstances, paying attention seems like the very least the rest of us can do.