Book Review

Jean-Patrick Connerade: The planetary atom, a fictional account of George Adolphus Schott the forgotten physicist. World Scientific Publishing, 2022, $58 (hardcover), $28 (softcover)

Benjamin Labatut: When we cease to understand the world (translated from the Spanish by Adrian Nathan West). New York Review Books, 2020, $17.95 (softcover)

"Historical Fiction," one of the most popular genres of literature, refers to works set in a period before the present, and which frequently take actual historical events and people as their main and/or peripheral subject matter. One website (https://celadonbooks.com/what-is-historical-fiction/) describes a sub-genre of "Biographical Historical Fiction," which "tells the fictionalized story of a real person's life." That sounds somewhat disconcerting — almost a category error! — since to the extent an account is fictional, it isn't historical, and vice-versa. Such unease may be magnified when the subject is a scientist, as reliable presentation of the scientific content is usually considered desirable (to say the least). Nonetheless, there have been many well-received fictionalized portrayals — not only novels, but also dramatic forms — of real scientists and scientific episodes. One of the best-known is the play *Copenhagen* (Frayn, 2000), which depicts (several times, somewhat differently each time) a 1941 meeting between Niels Bohr and Werner Heisenberg.

What is it about this literary mode that we find engaging? I suggest several factors that can make a work effective, including:

- Presentation of a well-known character in a new light — or introduction to a relatively unknown one — hopefully exhibiting an interesting personality.
- Accounts of historically important scientific episodes, often accompanied by some explanation of the underlying scientific concepts at a level appropriate to the target audience, and situated in some historical context.
- Outstanding writing — preferably in a distinctive authorial voice — just as in any literary genre.

Not all of these need to be present in any particular example; and faithfulness to historical "truth" need not be an absolute requirement: the demands of creative, imaginative writing may well conflict with any goals of verisimilitude — even, in some cases, of plausibility; the interesting features of a personality may be true-to-life, invented, or some of each; the "correct" context may be one that is conventionally accepted or substantially reconceived by the author. All we can really ask for, in my opinion, is *some* kind of new illumination. For instance, one of the facets that make *Copenhagen* so impressive is Frayn's theatrical construction of parallels between his alternative accounts of the meeting and Heisenberg's uncertainty principle.

Two novels that appeared in the last couple of years are both about real-life scientists; aside from that, they are about as different as they could be. One is written by a professional scientist (who is also a published poet), the other by a literary author with (to my knowledge) no scientific background; one takes as its subject a "forgotten" character, while the other considers some of the most renowned figures of 20th-century physics (along with a couple of lesser-known ones); one has received virtually no public attention, the other has been the subject of many (mostly) rave reviews, and appeared on a number of "year's best" lists. And, most centrally, one wants to

familiarize us with a neglected episode of scientific history, while the other aims more for defamiliarization (to use a term — "ostranenie" — coined by an early 20th century Russian formalist): to make us look at history we may think we understand from an entirely new perspective. Both have much to offer in terms of entertainment and edification, but ultimately I found both rather unsatisfying — again, in quite different ways.

First is *The Planetary Atom*, which seeks to (re)introduce us to George Adolphus Schott, a contemporary of Ernest Rutherford. Its author, Jean-Patrick Connerade, is a (retired) professor of physics at Imperial College, as well as an award-winning French poet (under the *nom de plume* of Chaunes). He cites two rationales for his project: first, to rekindle awareness of Schott's unjustly neglected career and contributions to physics have been; second, as a corrective for the unfortunate fact that science and literature are too often consigned to separate realms (his first chapter is titled "Scientists Versus Poets?"). That latter contention is considerably overstated — he overlooks a very large body of both artistic and scholarly work that spans the literature-science boundaries (see for example Labinger 2022) — but I will not address that point here.

Since Connerade was unable to find much "hard" biographical information about Schott, he decided upon a fictional treatment:

> [We know so little about him that the best option is to reinvent his biography, using his scientific contribution to guide us as to what might have been the context and the important events of his life. This is no longer the work of a scientist or a historian. It becomes a subject for a novelist, because it rests on a complex combination of imagination, psychology and understanding of how scientific advances really occur. (p. *vii*)

Schott received his training at Trinity College, Cambridge, where Rutherford was subsequently a postgraduate student (Schott was a few years older than Rutherford). According to Connerade, he was "one of the most brilliant scholars" (p. 8) in mathematics there , but then, somewhat surprisingly, took a position at "an obscure new provincial school," the University of Aberystwith in Wales. In Connerade's telling, the two first met when Schott traveled to Manchester (pp. 8-17) to discuss Rutherford's "planetary atom" model, in which electrons circle about a massive central nucleus, based on findings that on bombarding a gold foil with alpha particles, some were found to bounce back at angles approaching 180°. Schott (along with others at the time) saw what he felt to be a fatal flaw in the model: according to Maxwell's theory, circulating electrons would necessarily radiate energy, so such an atom could not possibly be stable; whereas Rutherford was reluctant (to say the least) to accept challenges based "only" on theory to conclusions derived from experimentation.

Much of Schott's subsequent career was devoted to theoretical exploration of that issue; he remained skeptical even after Bohr's invocation of quantum mechanical behavior had accounted (to most people's satisfaction) for atomic stability. In that sense, the title chosen for the book seems rather ironic (intentionally?). Some of his earlier work appeared in a 1912 book, which received relatively little attention at the time (or later). An elaborate treatment was finally published in 1933 — just four years before his death — under the title "The Electromagnetic Field of a Moving Uniformly and Rigidly Electrified Sphere and its Radiationless Orbits."

Connerade identifies Schott's main misfortune as having been too far ahead of his time: his theoretical work anticipated the 1947 observation of synchrotron radiation, but by then Schott's work had been largely forgotten; Julius Schwinger was credited with the explanation:

> If Schwinger's paper had been read a little more carefully, one might have noticed that Schott's name actually did appear in tiny letters in a footnote….nobody noticed and nobody knew who he was anyway, so why bother to chase up a footnote? (p. 207)

and Schott has largely remained in obscurity since. This rehabilitation project is unquestionably worthwhile, and the book is generally a pleasant read; but evaluated in light of my proposed criteria for successful fictional scientific biography, it falls a little short.

Schott is not depicted with any sort of compelling character, one of the desiderata suggested above; but that's consistent with one of the book's points: that Schott deserves to be remembered *despite* being personally relatively uninteresting. Connerade applies his creative skills to fill out Schott's bare-bones biography in a number of ways, including a good deal of family background, a post-WWI involvement with a financial con man, and especially a long-running relationship between Schott and Rutherford's daughter Eileen, who is portrayed as being deeply involved in her father's scientific work (even though she doesn't understand it at all) and taking sides in the resulting controversies; Schott ends up disappointed when she marries another of Rutherford's protegés. This last invention — the most elaborate — is pretty much the only suggestion of any relationship we are shown, presumably intended to help humanize him. (As Schott was more than 30 years older than Eileen, who would have been only around 10 at the time of their first supposed encounter, I must say this comes across as a little creepy to contemporary sensibilities — maybe not a great choice for casting Schott in the most favorable light.)

The Planetary Atom does do a fairly good job on the background and context of Schott's work: most of the relevant scientists are at least mentioned, although not much actual science is expounded in the main narrative (there is an "Afterword" that summarizes the history of the relevant science, from Democritus to the 20th century, in a few pages). A few scientists and incidents are presented in more detail: there are extended conversations between Schott and Rutherford; various items of correspondence (between Schott and Einstein, Rutherford and Marie Curie, and others); a lengthy account of how Rutherford came to be appointed at Manchester; *etc*. It is not always clear what parts of this are factual; the larger share, I suspect, were invented, like the biographical details. Frayn's comments in his postscript to *Copenhagen* that "Where a work of fiction features historical characters and historical events it's reasonable to want to know how much of it is fiction and how much of it is history" (Frayn, 2000, 95). It would have been helpful if Connerade had provided some source materials (as Frayn does) so the reader could better distinguish.

Chronology represents a particularly problematic aspect of separating fact from invention. The story is not told linearly, and Connerade is very loose with dates, generally omitting any indication of when key events take place, with consequent ambiguity, and even distortion. Schott's main work is introduced following the account of his first meeting with Rutherford, where they discussed the planetary atom model; hence that meeting would have taken place around the time it was first promulgated (Rutherford 1911), during or after 1911. The work is described as leading to recognition in the form of the Adams Prize (p. 143), a prestigious award

for mathematics given by the University of Cambridge — but Schott actually received that award in 1909, so the sequence implicit in the narrative is inconsistent with history. There are quite a few such examples, including:

> Otto Hahn, who had, in his own laboratory, discovered nuclear fission, came to work with Rutherford's team at the McGill University for a few months. (p. 69)

> There had been a riot in Manchester….known as the Peterloo massacre….This was industrial England in the times of George Orwell and Karl Marx. (p. 92)

Of course Hahn did not discover fission until several decades after his time with Rutherford at McGill (1905-1906), while the Peterloo massacre (1819) was nowhere near the times of either Marx or Orwell (who themselves were separated by a century). Surely Connerade knew all of this, so why did he write it so carelessly?

Finally, the writing can be characterized as serviceable at best. The precept of "show, don't tell" is almost never observed; characters rarely sound like real people in their dialogues and internal thoughts; there are a number of English imprecisions. Among the latter: several times Schott is described as having a "discrete" (*sic*) personality (pp. *ix*, 9, 145), which wouldn't be the best choice of word ("modest" or "reserved" would be more appropriate) even if correctly spelled; "inconsequential" is taken to mean illogical (p. 28) rather than unimportant, a much more common usage; and so on. According to the title page the book was originally written in French, as *L'Atome Planetaire*; presumably (since no other credit is given) the author chose to translate it himself. That may not have been the wisest decision: considering that the author has won prizes for his (French) poetry, the literary quality falls rather short of expectations.

In contrast, Chilean author Benjamín Labatut's *When We Cease to Understand the World* was translated (from Spanish; the original title is *Un Verdor Terrible*) by a skilled professional. The author describes it as "a work of fiction based on real events," consisting of five main sections in which "the quantity of fiction grows throughout the book" (p. 189). Chapter 1, "Prussian Blue," summarizes (non-chronologically) the history of cyanide, from Scheele through Zyklon B, with particular emphasis on Fritz Haber's role in gas warfare (an oft-told story in many venues) as well as some notable cyanide-employing suicides (Hermann Goering, Alan Turing), and also spins off many anecdotal episodes — the discovery of Prussian Blue by Swiss pigmenter Johann Jacob Diesbach; the introduction of silkworms to Germany by Johann Leonhard Frisch, who first made his fortune selling Prussian Blue; the death of Napoleon on St. Helena, thought to be caused by emanations from the walls of his residence painted with arsenic-based "Scheele's green;" and others linked (some rather tenuously) to the central theme. Labatut's style is clearly evident right from this opening story, as is another ubiquitous tendency: in his exposition of both scientific and historic details, precision too often yields to vivid language. For example:

> Faced with utter defeat, staggered by the new horror they had called down upon the world, [the Reich leadership] chose a quick escape, biting down on cyanide capsules and choking to death on the sweet scent of almonds that the poison gives off. (p. 10)

> Haber was the first to obtain nitrogen, the main nutrient required for plant growth, directly from the air….Today, nearly fifty percent of the nitrogen atoms are artificially created. (pp. 27-28)

There are *many* such passages throughout the book that read well, but are not quite (or not at all) correct.

Nonetheless, according to the author, this chapter (unlike those that follow) hews closely to fact: it "contains only one fictional paragraph" (p. 189). I strongly suspect that one is the last:

> Among the few personal possessions Fritz Haber had with him when he died was a letter written to his wife. In it, he confessed that he felt an unbearable guilt; not for the part he had played, directly or indirectly, in the death of untold human beings, but because his method of extracting nitrogen from the air had so altered the natural equilibrium of the planet that he feared the world's future belonged not to mankind but to plants, as all that was needed was a drop in population to pre-modern levels for just a few decades to allow them to grow without limit, taking advantage of the excess nutrients humanity had bestowed upon them to spread out across the earth and cover it completely, suffocating all forms of life beneath a terrible verdure. (p. 92)

This seems a *most* unlikely sentiment on Haber's part, who was intensely proud of his work in nitrogen fixation — particularly ascribing it to a putative letter to his wife Clara, who predeceased him (also by suicide) by nearly 20 years. Also, it makes no sense scientifically: if the world reverted to pre-modernity, why would the Haber process continue to be practiced? It is much more likely that it represents the author's own ideas, which are represented further in the concluding section; note also that the last three words of the extract are the (translated) original book title.

The next two sections are about a (medium-well-known) astrophysicist and two (somewhat-less-well-known) mathematicians, respectively. "Schwarzschild's Singularity" tells of Karl Schwarzschild's finding an exact solution to Einstein's equations of general relativity — an achievement Einstein himself had not yet managed — while serving as a field officer in the German army during WWI. The "singularity" of the title refers to his finding that when too much mass becomes concentrated in too small a space

> [S]pace-time would not simply bend; it would tear apart. The star would go on compressing and its density would increase till the force of gravity became so powerful that space would becomeinfitinetely curved, closing in on itself. The result would be an inescapable abyss permanently cut off from the rest of the universe. (p. 39)

— what we now call a black hole.

Labatut portrays Schwarzschild as a tortured soul who nonetheless had a remarkable — though relatively brief — scientific career; he was appointed to a university professorship at 28 — the youngest in Germany at the time (p. 45). Despite dying young (at 42, during the war), "He published 112 articles in total during his lifetime, more than virtually any other scientist in the twentieth century" (p. 53), undoubtedly a most impressive output for his age and the period (although the second half the the sentence is obviously a wild exaggeration). But he found the implications of his singularity, both for the universe and for humanity, unbearable. Labatut reports an encounter between Schwarzschild and

German mathematician Richard Courant, in a military hospital shortly before Schwarzschild's death:

> According to Schwarzschild, the most frightful thing about mass at its most extreme degree of concentration was not the way it altered the form of space, or the strange effects it exerted on time; the true horror, he said, was that the singularity was a blind spot, fundamentally unknowable….Physics no longer had any meaning.…If matter were prone to birthing monsters of this kind…were there correlations with the human psyche? Could a sufficient concentration of human will — millions of people exploited for a single end with their minds compressed into the same psychic space — unleash something comparable to the singularity? Schwarzschild was convinced that such a thing was not only possible, but was actually taking place in the Fatherland. (pp. 55-56)

Most likely this connection between Schwarzschild's science and the future rise of Nazism is a pure invention — there *was* a documented meeting of Schwarzschild and Courant during the war, but apparently not under the circumstances Labatut describes (Chandresekhar 1974) — but the passage is compelling even if not strictly factual.

Chapter 3, "The Heart of the Heart," initially seems to be about a (living) Japanese mathematician, Shinichi Mochizuki, who most notably claimed a proof of "a + b = c", an important conjecture in number theory (which Labatut doesn't try to explain). The proof has not been accepted — or even understood — by a consensus of the community; Labatut depicts him as reacting by withdrawing from the academic world ("his growing social phobia and the isolation he worked in") and giving up his position at the University of Kyoto (which didn't in fact happen, at least according to Wikipedia) in an "incomprehensible and capricious gesture" (p. 65). But then, in a complete swerve, we find that chapter is really about a different mathematician altogether. Indeed, we learn much later, in the Acknowledgments, that Labatut

> did take inspiration from certain aspects of [Mochizuki's] work to enter the mind of Alexander Grothendieck, but most of what is said here about him, his biography, and his research is fiction. (p. 189)

According to Labatut (again going rather over the top in superlatives):

> Between 1958 and 1973, Alexander Grothendieck towered over mathematics like a veritable colossus, convincing the finest minds of his generation to put aside their own research projects and ambitions and join his radical quest to unearth the structures underlying all mathematical objects. (p. 66)

until, like Schwarzschild (and most of the other semi-fictionalized characters in the book):

> Grothendieck could not stop fretting over the possible effects that his own ideas could have on the world. What new horrors would spring forth from the total comprehension that he sought? What would mankind do if it could reach the heart of the heart?....In the following years, he abandoned his family, disavowed his friends, repudiated his colleagues, and fled the rest of the world (p. 75).

The next chapter is really the heart of the book, if not of the heart: it comprises nearly half its total length and shares the (English version's) title "When We Cease to Understand the World." Here Labatut portrays (his version of) developments in quantum mechanics during the 1920s — what another author has called the "struggle for the soul of physics" (Segrè 2007). As in the other chapters, Labatut starts from established historical figures —primarily Schrödinger and Heisenberg, with a smaller section on de Broglie — and spins elaborate fantasies that *might* explain how they came to their highly counterintuitive interpretations of how the world works.

As recounted here, Schrödinger has a sojourn at a tuberculosis sanitarium in 1925, where he became deeply involved with the young daughter of the director (shades of Schott and Eileen Rutherford?!), beginning in a tutorial role, but evolving into an erotic obsession:

> They continued their lessons in the evenings….He could hardly resist the urge to touch her, but he tried to remain completely immobile to prevent her taking fright…. Schrödinger would masturbate as soon as she had left the room, when he could still close his eyes and see her sitting by his side. (p. 136)

While all this is going on, he progresses towards his great achievement — the wave equation — but it appears to arise mostly out of his unconscious:

> He got up in ill humour and picked up the papers he had thrown to the floor the day before….He was incapable of untangling which argument led to which conclusion; all that was clear was the equation on the final page — which seemed to capture perfectly the movement of an electron insider an atom — but there was no evident connection between it and what he had written before. Nothing like this had ever happened to him. How could he have created something that not even he himself could understand? It was madness! (p. 132)
>
> Schrödinger knew it was the discovery he had longed for his entire life, but he had no way of defending it. He had not derived his equation from any pre-existing principles. His thinking had not departed from any known basis. The equation itself was a principle, and his mind had pulled it from nothing. (p. 147)

The basic facts — that Schrödinger did check himself into the sanitorium, and that he did have a sexual companion (not identified) — appear to be well established (Segrè 2007, 140); but the irrational origin of the wave equation concept seems more likely to have been pulled from nothing by Labatut's mind.

Similarly, both Heisenberg's matrix formulation and his uncertainty principle are depicted as arising from episodes of near-madness. In the first, also in 1925, Heisenberg retreats to the island of Heligoland (more commonly spelled Helgoland) to try to cure himself of debilitating allergies. There he continues to suffer from his illness — in a fit of delirium he imagines himself in the presence of Goethe and the Persian poet, Hafez — following which:

> Heisenberg woke in the middle of the night. His fever had broken and his mind was exceptionally clear….He approached his desk, opened his notebook and saw

> that he had finished every one of his matrices, though he did not know how he had constructed half of them….He had no idea how he had arrived at his results, but there they were, written in his own hand (pp. 105-107).

Heisenberg's own account of his epiphany, as quoted by Segrè, could hardly be more different:

> There was a moment in Helgoland in which the inspiration came to me….It was rather late at night. I laboriously did the calculations and they checked. I then went out to lie on a rock looking out at the sea, saw the Sun rise and was happy. (Segrè 2007, 131-132)

Of course, we are by no means obliged to take Heisenberg's account at face value; but as in the Schrödinger narrative, Labatut's appeal to the unconscious appears to be entirely invented.

A couple of years later, working (and vigorously disagreeing) with Bohr in Copenhagen, Heisenberg finds himself in an unsavory bar, where a "man dressed in black" induces him to drink a mysterious green potion, and then proceeds to berate him for the state of the world, which science has brought about:

> The tragedies, the massacres, the horrors….And to whom do we owe this magnificent inferno if not to you, to people like you? Tell me, Professor, when did all this madness begin? When did we cease to understand the world? (pp. 156-157)

He flees, and experiences a hallucination under the influence of the drug:

> When he opened [his eyes], tiny orbs of light floated in the air around him, glimmering like a parade of fireflies….Most of them disappeared immediately, but some lasted long enough to leave a small trail….Heisenberg noticed that these traces were no continuous lines, but a series of individual points that seemed to be leaping from place to place instantaneously, without passing through the intermediate space. Hypnotized by these hallucinations, he sensed his mind merging with the things he observed: every point of these traces appeared without cause, and the complete trajectory existed in his mind alone, which wove the distinct instances together. (pp. 157-158)

Shortly afterwards he describes his thus-inspired understanding to Bohr:

> [H]e had realized that quantum objects had no fixed identity, but instead dwelt in a space of possibilities. An electron, Heisenberg explained, did not exist in a single place, but in many, and had not one velocity, but several. (p. 159)

The last — and shortest — section is titled "The Night Gardener;" unlike the others, it does not depict any historically real personage. Or perhaps it does: it is narrated by a Chilean who may well represent the author himself. As the preceding chapters have been rather disjoint (there are a few connections scattered throughout — Schwarzschild dies of

a disease that may have been partly due to gas exposure (p. 41); Grothendieck's father died from Zyklon B in Auschwitz (p. 68); *etc*. — in addition to the thematic links discussed above), this chapter serves in part to tie them together, beginning with a brief passage harking back to the last paragraph of the first one, as well as to the original Spanish title of the book:

> It is a vegetable plague, spreading from tree to tree….Let it burn and watch the flames reach up to the sky, for left alone it will consume the world, feeding on the death of others, nurtured by all the green grass turned grey. (p. 175)

The narrator tells of finding bodies of dead dogs, poisoned with cyanide, and of how poorly his garden grows; most significantly, he encounters a man tending his garden in the moonlight, who tells him "we should be wary of plants," recounts the story of Fritz Haber — as inventor of both modern-day fertilizers and gas warfare, and complains that:

> Even scientists no longer comprehend the world. Take quantum mechanics, the crown jewel of our species, the most accurate, far-ranging and beautiful of all our physical theories….We know how to use it, it works as if by some strange miracle, and yet there is not a human soul, alive or dead, who actually gets it. The mind cannot come to grips with its paradoxes and contradictions, It's as if the theory had fallen to earth from another planet, and we simply scamper around it like apes, toying and playing with it, but with no true understanding. (p. 187)

I have quoted rather extensively from this book, in an attempt to show its artistic quality, and also how far the author's vision deviates from both (generally accepted) factual history and any view of science that I (and, I expect, most of the readers of this journal) hold. Whereas Connerade's book is "a celebration of science" that "treats the selfless pursuit of scientific investigation as a human passion equal to others in life" (p. *ix*), Labatut highlights the irrational side of science, and the harm caused by the most fundamental studies — even by mathematics:

> The night gardener used to be a mathematician….but had quit altogether after encountering the work of Alexander Grothendieck….[his] decision to drop out of life was secondary to the sudden realization that it was mathematics — not nuclear weapons, computers, biological warfare or our climate Armageddon — which was changing our world to the point where, in a couple of decades at most, we would simply not be able to grasp what being human really meant. Not that we ever did, he said, but things are getting worse. (pp. 186-187)

Does all this represent a truly anti-science attitude, or a useful corrective to an overly scientistic worldview? Probably some of each. How then should we evaluate a work that presents striking depictions of quite distorted personages and events; how much relative weight should be allocated to impressive writing *vs*. historical distortion? As I noted earlier, most reviewers — even in scientific media — have come down on the positive side. I was bemused by a capsule review in *Physics Today*, and the particular offense the reviewer chose to call out:

> Labatut clearly did his homework in the figures he writes about, which makes it slightly disappointing that he repeats the common error of crediting the development of matrix mechanics solely to Heisenberg…it was Max Born and Pascual Jordan who recognized that Heisenberg's initial work could be mathematically represented with that formalism. Historical quibbles aside, Labatut's truly unique blend of fact and fiction can only be described as a literary tour de force. It should not be missed. (Dahn 2022)

I would hardly choose that as Labatut's most egregious factual fault; and I would be rather less charitable about the overall tenor of the book — particularly the repeated portrayal of difficult concepts emerging from the irrational unconscious rather than anything we might recognize as scientific thinking — but I wouldn't quarrel with calling it a "literary tour de force." Readers will need to decide for themselves whether it should not be missed.

References

Chandresekhar, Subrahmanyan. "Development of General Relativity." *Nature* **252** (Nov. 1), 1974: 15-17.

Dahn, Ryan. Review of *When We Cease to Understand the World*. *Physics Today* **75** (1), 2022: 53.

Frayn, Michael: *Copenhagen*. Anchor, New York (2000).

Labinger, Jay: *Connecting Literature and Science*. Routledge, New York (2022).

Rutherford, Ernest: "The scattering of α and β particles by matter and the structure of the atom." *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*. Series 6. **21** (125), 1911: 669–688.

Schott, George Adolphus: *Electromagnetic Radiation and the Mechanical Reactions Arising from It*. Cambridge (UK), Cambridge University Press (1912).

Segrè, Gino. *Faust in Copenhagen: A Struggle for the Soul of Physics*. New York: Viking (2007).