

legitimate phenomenon but also in its utility as a routine intelligence tool. In the end, though, there just were not enough Colonel Johnsons in the intelligence community to sustain the program.

As disappointing as it was for Smith that the program was cancelled, his account makes clear that (a) the level of funding was never tremendously high nor did it really need to be, and (b) the government officials who controlled the program did not always push it in directions that enhanced remote viewing's usefulness or scientific validity. Given the urgent spying priorities of the post 9/11 era, I would guess that the government by now has re-funded elements of the program or at least has reached out to some former participants. But if I were a scientist and wanted to realize the promise of remote viewing and of psi generally, I would be inclined to keep the generals and the espiocrats at arm's length from now on. With so much interest in the paranormal in America today, would it really be so hard to set up a modest but serious RV research center with private financing? Its mission—to prove and to improve remote viewing's practical utility—would be relatively easy if remote viewing's utility is already as robust as its proponents claim.

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A World Without Time: The Forgotten Legacy of Gödel and Einstein by Palle Yourgrau. Basic Books, Perseus Books Group, 2005. 210 pp. \$24.00 (cloth). ISBN 0-465-09293-4.

Ever since Hawking¹ wrote *A Brief History of Time*, which sold an unexpectedly large number of copies (e.g., 10⁶), Time became a buzzword to put into a book title in hopes of achieving a similar financial publishing success. Another example among many (see my review²) is Barbour's *The End of Time*³. Other examples where Time is a hidden rather than explicit promotional ingredient include Fukuyama's *The End of History and the Last Man*⁴. The slightly facetious observation that I am pushing here, that the word Time in a title sells, is on the other hand balanced by the less-than-facetious observation that underneath it all, in my opinion, nobody really understands Time. So there is a big mystery here to write books about.

Turning to the book at hand, *A World Without Time*⁵, one should take special note of the author's admission (in Acknowledgements, viii) that he and Hao Wang⁶, a close associate of Gödel for many years and with whom Yourgrau had many discussions, both confess to finding the topic of time "uncongenial" even though it was of great interest to all three of them. I am slightly paraphrasing their passages, but when they couple their "resistance" to discuss time with each other with their "regret" that they did not do so . . . well, you have to come away with the impression that they really could never conclude much at all.

Of course, Time, as a philosophical issue, has been expositied a great deal over the centuries. See the recent survey⁷ and my review⁸ of it for some discussion of the great historical treatises that have been written about Time. When it comes to finding the true physics of Time, as contrasted to philosophical or psychological discussion about it, it is even harder to say much. One example of this situation may be found in my works⁹ as well as in those of others found in the recent volume¹⁰.

Now let us turn directly to the book at hand, but keeping in mind the context developed in the above two paragraphs. I would categorize the most valuable content of this book as not so much about Time but about the interesting biography/history, especially about Gödel. Yourgrau, by casting this history into a framework of contrasting Gödel's pure logic against Einstein's physical intuition, has thus written a useful book. It contains a lot of interesting back-and-forth between physics, logic, and philosophy. That is, we may say, between the professional belief systems of Einstein, Gödel, and Yourgrau, respectively. However, the book is principally about, and favors, Gödel and his views.

Over the years I have become simultaneously fascinated and inured to such discussions. For example, with great conviction one of my colleagues who I like a lot, a "logician", tells me that all applied mathematics is contained within pure mathematics. But he has never done any real applied mathematics. He has never solved any real engineering problem in which he must work with a team. In short, he does not know what he is talking about. Here is another example: One of my physicist friends, who knows a lot of mathematics, retired so that he could "redo all of physics", as he told me. Instead he became active in triathlons, and now I see him spending a lot of time at the gym, his body somewhat broken although still not in bad shape for his age. As a third example among countless others, consider the case of my mathematician friend, now deceased but of whom we were all fond, who went whole-hog into philosophy and, seeing all sides to various issues, soon became unable to make any decisions at all.

I once formulated the joke that physicists state their results first, and maybe later, if you are lucky, they state their assumptions. Conversely, mathematicians state their axioms, and maybe later, if you are lucky, some results. As for philosophers, I am not sure if they ever clearly state their assumptions or their results.

Lest you think I am being unduly harsh, the author himself expresses a similar view: "You can assess any position in philosophy by the relationship it proposes between being and knowing. Some traditions, like the Greek one of Plato and Aristotle, place ontology in the center, while others, like the modern period inaugurated by Descartes, put the emphasis on epistemology. Clearly, a complete philosophy will have to do justice to both. Unfortunately, there is a deep and irreducible tension between the two perspectives that make reconciliation difficult to achieve . . ." (p. 112).

Words, words, words. We are—this is not a new observation—limited by our words. In the final analysis (p. 100), Einstein stayed with his belief system (physical determinism) and Gödel stayed with his belief system (mathematical

determinism). As to Yourgrau's assertion that if one accepts Einstein's relativity as one's axioms then by Gödel's argument "time itself was merely ideal" (p. 7), well, I would assert that even mathematical proofs are also, just like words, limited in what they may assert about reality. Also, one must be very careful when interpreting mathematical proofs in terms of physical reality. In his blurb about his book, Yourgrau¹¹ states, "If Einstein succeeded in transforming time into space, Gödel would perform a trick yet more magical: He would make time disappear." Although popularization of science has its value, such a statement is pure poppycock. Einstein's theories relate time and space but do not lose one into the other. Read my exposition⁹ pointing out how, in fact, experimentally, atomic measurement of time is now more accurate than any method we have to measure space. But one does not then assert that we live in A World Without Space! So, at least from my point of view, there is no physical conclusion about Time following from Yourgrau's book, however interesting it may be in terms of its historical contributions.

But this book contains much interesting reading about philosophy and its relation to science and, more to the point, about how Gödel and Einstein viewed the relationship of philosophy to science. Both were ontologists, in the Plato camp, believers in a deterministic reality. Both strongly believed in human intuition as the guiding and even governing mechanism for discovering and determining truth. For example, Einstein summarily rejected Gödel's strange solutions to his special and general relativity field equations. This was consistent with Einstein's general suspicion of mathematics. Einstein was a physicist at heart. Gödel, on the other hand, was a mathematician and suspicious of natural science. Thus both placed their intuitive beliefs above their tools. It strikes me that at the highest levels of science, science becomes opinion. The sought answers, so important yet bafflingly unknown, force us back into our personal dogmas.

The most interesting chapter to me is Chapter 7: The scandal of Big "T" and little "t". Here we get a description of Gödel's interaction with Einstein's relativistic field equations. Big "T" is "intuitive" time = dynamic time = event time = A-series time = subjective time = epistemological Time (excuse my equalities, which are not Yourgrau's). Here I have oversimplified for the reader. Little "t" is "objective" time = calendar time = clock time = B-series time = ontological time = the "t" that occurs in the mathematical equations of physics. Gödel formulated a model (p. 124) involving the averaged motion of matter regarded as a privileged reference frame and a (geometrically based) notion of time relative to those mean motions, called cosmic time. But in terms of these manifolds, you can return by travelling quickly enough to your past. This contradicts the notion of intuitive time as it is used in relativity theory. Thus one could say it raises a "logic red flag" in the face of the relativity equations. As Yourgrau puts it, "Einstein's theory is inconsistent with the reality of time in the intuitive sense" (p. 132). In this way, to him, Gödel found inconsistencies between our notion of Big "T" time and the little "t" time of the equations, and he did so for both special and general relativity.

Personally, I have come to the opinion that one should not rely so much these days on the geometrization of physics. Although it has certainly been an extremely important *modus operandi* in 20th century physics, I wonder if we do not now need new approaches. I realize my opinion flies in the face of string theory and much of "classical physics". But I conjecture⁹ that physical time is stochastic. From the quantum mechanical point of view, where space is stochastic, why should time not also be?

To conclude, I would like to augment Yourgrau's exposition by bringing to the reader's attention the recent contributions of Chaitin¹². To be succinct here, let us state chronologically the progression

Hilbert → Gödel → Turing → Chaitin,

and the corresponding attributes

completeness → incompleteness → incomputability → unknowability.

In his own words, Chaitin discovered "that some mathematical statements are true for no reason, they're true by accident"^{12(p. v)}. When I first happened upon Chaitin and this viewpoint a few years ago, it immediately struck a resonance within me. That does not mean it is absolute truth, nor even that it is the preferred position. But I never understood the absoluteness that many logicians, and many theoretical physicists, ascribe to their statements. Somehow they always assumed that *their* contexts were *the* context. So it was like a breath of fresh air for me to discover Chaitin and his viewpoint. From that viewpoint, although not directly, it also seemed to me that the much maligned intuitionist logic viewpoint of Brouwer was given a renewed validity¹³.

Moreover, even Gödel's focused mental precision supported the intuitionist logic of Brouwer. As pointed out in a recent review¹⁴, a short paper by Gödel¹⁵ (not cited in the book under review) showed, at least for arithmetic, that Brouwer's axioms extended rather than restricted classical mathematical logic.

I would like to go further and assert, far beyond just mathematical logic, the same larger, richer value of intuition over formal reasoning as a general proposition in physical science and human affairs. Just because we cannot codify our intuition does not mean that it does not exist. It may be inconsistent, but it may also be more complete. And as an accumulated underlying partially conscious—partially unconscious experience and knowledge base, its overall intellectual value far exceeds any single rational deductive process that one may bring to bear on a scientific or human problem. Recently¹⁶ I have illustrated this thesis with examples of intuitive reasoning, which led to Nobel Prizes.

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Every four years during the past quarter century, people interested in Bayesian statistics have met in Spain to share the latest research and methods. Sponsored by the University of Valencia, these occasions have come to be known as the Valencia meetings. In addition to the usual communication of scientific knowledge, the meetings are renowned for their camaraderie and atmosphere (for a taste, please google on "Valencia Cabaret"). The Valencia meetings have rapidly grown in size as interest in using Bayesian methods has increased. The best papers from each meeting, after rigorous refereeing, have been published in book form. This is the seventh volume in the series.

This volume contains 23 invited and 31 contributed papers out of over 350 papers given either orally or as poster papers at the seventh Valencia meeting. Because the meeting covered the whole gamut of modern Bayesian analysis, the subject matter is quite varied; but the topics provide the reader with a snapshot view of where the cutting-edge research in the field of Bayesian statistics is at the moment.

The contributions include both theory and applications. Foundational issues such as priors, exchangeability, posterior consistency, and Bayesian non-parametrics are discussed, as are objective Bayesian methods. The latter is of