

BOOK REVIEWS

A World without Time: The Forgotten Legacy of Gödel and Einstein. Palle Yourgrau. 2005. Basic Books. Price: €19,70/US \$24.00/Can \$ 33.95/Rs 1100.

This book presents a lay account of Kurt Gödel's excursion into (general) relativity, which came about due to his decade-long close personal association with Albert Einstein at the Institute for Advanced Study, Princeton, USA, until Einstein's death in 1955. More technical accounts were published in a 1991 book¹, and later its revised edition² in 1999 by the same author. Palle Yourgrau has fluently written an engaging story woven around nine themes, which are roughly chronological from the beginning of the book to its end, although thematic integrity has given way to strict chronology, as and when appropriate.

Before taking up the title theme, seventh in the book, the author builds the background, interweaving historical, personal and philosophical threads, sometimes personifying even contemporary or modern contributions to philosophical discourse by their proponents, just like the usual style of doing so for ancients like Euclid, Parmenides, Aristotle, Plato, and even Kant, leading to economy of expression. In the seventh theme, 'The scandal of Big "T" and little "t"', T denotes cosmic time of the big bang theory (while t is the coordinate time of a local observer), although T is also briefly used for truth, to make connection with Gödel's distinction between truth and provability, as in his incompleteness theorems in logic of mathematics.

A lay account is given of the foundations of modern mathematics and logic, especially as they impact on philosophy, including Bertrand Russell's exposé of the inconsistency of self-reference in naive set theory and its subsequent repair by others via formalizing set theory, before explaining how Gödel confounded even this formalization, by showing that consistency and completeness are mutually exclusive, thus dashing to the ground David Hilbert's hopes of constructing a complete and consistent account of each branch of mathematics. This is the fourth theme, 'A spy in the house of logic'.

Kurt Gödel's propensity to go to the logical limit, be it in logic of mathematics or in relativity, is brought out well, without going into technical details, nevertheless presenting the full logic of the argument. This is a readable book, which

can be followed fruitfully by anyone who has some acquaintance with foundations of mathematics and with relativity theories of Einstein. Such familiarity is, in fact, assumed of the reader.

Gödel discovered a spinning universe as the solution to Einstein's equations of general relativity. This universe (i.e. space-time) admits what looks like a closed time-like geodesic, confounding the intuitive notion of time as a progression from (absolute) past to (absolute) future (in the language of null geodesics or light-cones), and in fact, seemingly erasing the distinction between time-like and space-like (invariant) intervals (of special relativity), so that intuitive time cannot be represented (or approximated) by the t coordinate in Gödel's spinning universe. And since this is (mathematically logically) possible for one (class of) solution(s) of Einstein's equations, all other solutions are also suspect, since the same physical laws underpin the equations (and hence all their solutions).

(Astro)physicists' first response³ was to suspect Gödel of making a mistake in his calculations (without consulting Gödel), although it turned out *they* had made a mistake, probably due to their haste in catering to their own prejudice (as shown by Howard Stein, although he found it possible to publish⁴ this only when Gödel himself intervened) (reminiscent of Eddington's prejudiced reaction to Chandrasekhar's application of quantum mechanics to stars). Gödel the astrophysicist, was however so sure of his calculations, that he tried to find out the spin of the universe, using the then best available observations, viz. orientations of images in *Hubble Atlas of Galaxies*, which also happened to be the dissertation topic of Dan Hawley, student of physical cosmologist James Peebles at the Institute for Advanced Study, Princeton, although Gödel, and Peebles and Hawley were ignorant of each other's interest in the matter, until prompted by John Wheeler of the same institute. (Later, whenever there accrued a large enough cosmological dataset, astrophysicists have used it to put a limit on the spin of our universe.)

From the modern standpoint today, when the big bang theory is embellished by inflation and considerations of dark matter and dark energy, and when the formalism of general relativity itself has seen much recent development, e.g. the distinction between coordinate singularities and essential singularities between local and global geometries of a space-time

manifold, use of Ashtekar variables, and attempts at a quantum theory of gravity, it becomes necessary to reassess Gödel's result about the ideality of relativistic time from many other angles as well.

All in all, *A World without Time* is a well-written, thought-provoking book for well-informed lay readers as well as for students of mathematics, physics, philosophy and logic, whetting the appetite to delve into earlier writings on this topic, as well as Gödel's original paper(s). Detailed Notes, Works Cited and Index at the end of the book enhance its authenticity and utility to scholars.

1. Yourgrau, P., *The Disappearance of Time: Kurt Gödel and the Idealistic Tradition in Philosophy*. Cambridge University Press, Cambridge, 1991.
2. Yourgrau, P., *Gödel meets Einstein: Time Travel in the Gödel Universe*. Open Court, 1999.
3. Chandrasekhar, S. and Wright, J. P., *Proc. Natl. Acad. Sci. USA*, 1961, **47**, 341–347.
4. Stein, H., *Philos. Sci.*, 1970, **37**, 589–601.

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Handbook of Indian Wetland Birds and their Conservation. Arun Kumar *et al.* Zoological Survey of India, 234/4, AJC Bose Road, 13th Floor, Nizam Palace, Kolkata 700 020. 2005. 468 pp. Price: Rs 1500/US \$ 80/£ 60 (Rs 975 special discount price for students, birdwatchers and scholars).

A brilliant *Handbook on the Indian Wetland Birds and their Conservation*, which was long overdue, has finally arrived. This handbook includes groups popularly known as the waterfowl, waders, shorebirds and seabirds. In addition, a number of birds such as kingfishers, raptors and some passerines, which are also ecologically dependent on wetlands have all been included here. These birds are one of the best indicators of the health of a given wetland habitat.

The handbook provides extensive information on 310 wetland bird species, including 243 waterbirds and 67 wetland-dependent and associated birds from India. Of these, 51 species are globally threatened.