political views (though Jordan remained a defender of Einstein and other Jewish scientists), most tried to continue their work despite the political situation, some realizing later rather than sooner the true evil of fascism. (Planck's son Erwin was executed for his part in the failed attempt to assassinate Hitler organized by Claus Schenk Graf von Stauffenberg.) Of course, many had no chance and were forced to emigrate, the effect perhaps best documented by a conversation between a politician and a mathematician. When asked by the minister of education Bernhard Rust whether it was true that his institute had suffered due to the exit of Jewish mathematicians, David Hilbert replied that the institute no longer existed[6].

After two decades as director of the Hamburg Observatory, during which he was also vice-president (1955–1961) of the IAU, Heckmann became the first Director General (1962–1969) of ESO (headquartered in Hamburg for a while as a result) and, later, president of the IAU (1967–1970). He held an extraordinary IAU General Assembly in Poland to commemorate the 500th anniversary of the birth of Copernicus. Heckmann was a foreign member of many academies of science and astronomical organizations, received honorary doctorates from universities in many countries as well as prestigious astronomical medals, and was a major figure in international cooperation in astronomy[7,8].

Yours faithfully,
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To the Editors of 'The Observatory'

Chess-playing armchair cosmologists

I've often used Rees's description, mentioned in the Gerald Whitrow Lecture on 2019 February 8[1], of the observable Universe shrunk to the size of the Solar System. The interesting thing, though, is that the density would be within an order of magnitude or so of that of a neutron star, thus not extremely far removed from our experience. Of course, that demonstrates how empty the Universe is, mainly between stars and within atoms: the Hubble Deep Field, where one sees the sky almost covered in galaxies, is about the same angular size as a grain of rice held at arm's length; a sky of such fields, compressed to what is still a familiar density, would form a ball of radius not much larger than that of the asteroid belt.

All in all, an enjoyable lecture, even including a reference to Lewis Carroll[2] (at least I hope so; if not, then it's not a literary allusion but rather an illusion). However, although Zwicky[3] might have first suggested dark matter about 80 years ago (actually, closer to 90 now), he wasn't the first to suggest it. The concept and sometimes even the name (perhaps in another language) had been mentioned before by the likes of Kelvin[4], Poincaré[5–7], Jeans[8], and Oort[9] (Zwicky used the German term *dunkle Materie*) and the concept of dark matter goes back at least to the discovery of Neptune due to its gravitational influence on Uranus, though to be sure the last item was not an indication that most of the mass of the Universe was in dark matter, nor did it imply matter of unknown composition.

Given the restricted length, Rees deals well with the ideas of the multiverse, fine-tuning, and the anthropic principle, but the questions indicate that there is still some confusion. Readers interested in exploring those topics in depth should consult the books by Barrow and Tipler[10] (an extensive treatise on the anthropic principle), Tegmark[11,12] (which discusses many topics related to multiverses, including fine-tuning), and Lewis and Barnes[13,14] (which discusses many topics related to fine-tuning, including Tegmark's Level II multiverse), as well as the volume on many aspects of the multiverse edited by Carr[15]. Trimble[16] has written a very enjoyable history of the multiverse idea; like Tegmark, she also has four types of multiverse, but there is not a one-to-one mapping. A very extensive recent review[17] explores "[t]he degree of fine-tuning in our universe — and others". Such topics, though explored primarily by chess players sitting in armchairs, are a very active area of research.

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REVIEWS

Cherenkov Reflections: Gamma-Ray Imaging and the Evolution of TeV Astronomy, by David Fegan (World Scientific), 2019. Pp. 321, 23·5 × 15·5 cm. Price £105 (hardbound; ISBN 978 981 3276 85 7).

The field of TeV-energy astronomy is today part of the observational landscape in a way that would have been hard to imagine when the author of this interesting book started his career. He charts the difficult, not to say at times highly frustrating, history of TeV astronomy in detail, revealing both the characters involved, and the technological developments in an entertaining way.

Using Cherenkov light to image astronomical sources grew from the study of cosmic rays. The field really grew after the discovery of atmospheric Cherenkov radiation in the 1950s by scientists looking for the sources of cosmic rays. The earliest experiments did not detect any astronomical sources, and as the author notes, it "might appear easy to dismiss these early cosmic-ray point source directionality experiments as premature or naïve, but such a judgement would be unfair". Indeed, as so often in astronomy, looking for one thing leads to another, as several Nobel prize winners can testify. Once atmospheric Cherenkov light had been discovered, turning those precious brief flashes of light into known sources took several decades of hard, determined graft by many scientists. Leading eventually to the famous *Imaging Atmospheric Cherenkov Telescope* (*IACT*) *Whipple* observatory in the USA, *via* numerous experiments around the world, including Russia, France, the UK, and Ireland, the story is truly heroic. The pioneers showed a determination that should inspire those who think astronomy is something you do simply *via* a computer screen.

There are many insights littered throughout this book, coupled with anecdotes and tales of multiple experiments, some located in what could be called 'sub-optimal' observing locations — the Harwell–UCD collaborative twin mirrors on a Bofors gun mount in a remote Irish valley being a good example. Progress came not just from technological developments but also from statistical analysis, a topic rightly highlighted in several chapters. Eventually techniques were developed to simulate air showers, remove the background, and use true imaging. These advances led to the first detections of the brightest sources, including the Crab Nebula, independently by several groups. The source list now totals several hundred, spanning many classes both Galactic and extragalactic.