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BOOK REVIEW

The Virtue of Heresy: Confessions of a Dissident Astronomer by Hilton Ratcliffe. BookSurge Publishing, 2008, second edition. 462 pp. ASIN B0062ID1NC.

Before I even opened this book, the title reminded me of my meeting with Grote Reber, the amateur astronomer who took seriously Karl Jansky's discovery of radio noise coming from the centre of our Galaxy when most professional astronomers ignored it. As a result, Reber became, with Jansky, one of the founding fathers of radio astronomy. In our brief conversation, we quickly agreed that words like "heresy" or "orthodoxy" had no place in the vocabulary of science. Tacit in that agreement, however, was the acknowledgement that the concepts, if not the words, are alive and well in the scientific community. I do not mean that scientists burn each other at the stake—no such reports have reached my ears!—but granting councils can deny research funds, time allocation committees can deny access to experimental and observing facilities, and editors or referees can delay or even prevent publication. Readers of this Journal do not need me to persuade them that all these things happen.

At the present time, cosmology is one of the areas of science in which the practices outlined in the previous paragraph may be found. As is well known, the majority of working cosmologists believe that the universe began about 13.7 billion years ago in an event that has become irrevocably, although perhaps unfortunately, known as the Big Bang. Many of those who subscribe to this theory seem to be sure that we have almost reached a complete and final understanding of the origin and evolution of the universe and that the giant telescopes for which plans are now on the drawing-board will take us the final few steps. Notwithstanding this widespread consensus, there are a significant number of dissidents who include several who have proved themselves to be good and competent scientists and cannot be dismissed as cranks. They are the heretics and dissidents of the title of this book, the author of which, Hilton Ratcliffe, also subscribes to the "heresy." I have not worked in cosmology myself and do not claim to have all the arguments either for or against the consensus view at my fingertips, but my reading of the history of science inclines me to be cautious about any claim to have reached a final theory. Scientific cosmology is barely a century old, whether you consider it began with publication of Einstein's (1915)

general relativity theory or that of Hubble's (1929) discovery of the law of recession of the "spiral nebulae." At present, Big-Bang cosmology leaves us with at least two puzzles, known as "dark matter" and "dark energy." I think it entirely possible that they may be playing the same role in modern cosmology that epicycles eventually played in Ptolemaic cosmology, that is to say that one day they will turn out to be the clues that in some sense we are on the wrong path. I suspect that fifty or a hundred years from now the consensus in cosmology may be very different from that of today. I approached this book hoping for a reasoned and dispassionate debate of the relative merits of Big-Bang cosmology and of other theories that might replace it. Unfortunately, I was disappointed in my expectation.

My first disappointment was the discovery of a number of factual errors (mainly of an historical nature) in the early part of the book. It would be tedious to list them all and I shall content myself with describing two. First, on p. 43, there is a reference to William Herschel's "astute prediction" that the "spiral nebulae" (i.e. other galaxies) were aggregations of stars. There certainly was a lively debate throughout the eighteenth and early nineteenth centuries about the nature of nebulae, which was only finally resolved by the application of spectroscopy in the late nineteenth century, which showed that some nebulae exhibited spectra like those of stars, while others showed light concentrated in emission lines. Herschel could not have made predictions, astute or otherwise, about spiral nebulae for the simple reason that their spiral nature was not recognized until 1845, more than twenty years after his death. The discovery of spiral structure was the major discovery made by Lord Rosse's six-foot telescope in Ireland, an instrument whose otherwise disappointing performance was largely explained by its design being ahead of its time and its location being hardly the most favorable, astronomically speaking.

The second example is more important because it totally misrepresents the views of Abbé, or Canon, Georges Lemaître (*not* Abbot as Ratcliffe insists on calling him), recognized as one of the founders of what has become Big-Bang cosmology. In 1951, the then Pope, Pius XII, made a statement welcoming what was then a barely developed Big-Bang theory as a kind of confirmation of the inner meaning of the first chapter of *Genesis*. According to Ratcliffe (p. 66), this statement was made in an address to the Pontifical Academy of Sciences of which Lemaître was President, and Ratcliffe strongly implies that it was made at Lemaître's instigation, for "he sought to express his theology in the syntax of science" (p. 61), whatever that means. In fact, as people who knew Lemaître have told me, he was a restraining influence and remonstrated with the Pope for making this statement. Even Lawrence Krauss (2012), no friend of organized religion or any kind of

theistic belief, recognizes Lemaître's restraining role in this episode. It is perhaps worth quoting Helge Kragh (2007), a thoroughly reliable historian of science on the subject of Lemaître's views on the relations of science and religion:

> As a priest and cosmologist Lemaître was very much aware of the problematic relationship between the Christian dogma of a world created by God and the scientific theory of a universe starting in a Big Bang. However, contrary to some other cosmologists (as well as theologians), he was careful not to confuse science and theology and not to use one of the fields as a legitimization for the other. Lemaître believed that science and theology were separate fields and that cosmology neither confirmed nor refuted the Christian notion of a world created by God. This he made clear in his address to the 1958 Solvay meeting, where he pointed out that theoretical cosmology "remains entirely outside any metaphysical or religious question."

Incidentally, Kragh also tells us that Lemaître did not become President of the Pontifical Academy until some years after the death of Pope Pius XII.

This no doubt unintentional misrepresentation of the views of Lemaître arises in part from Ratcliffe's fixed belief that science and religion are and always have been in a state of conflict. He appears to be totally unaware of recent scholarship by historians of science that show that this has not been the case. Two books that would introduce him to that scholarship are *Science and Religion: Some Historical Perspectives* by J. H. Brooke (1991) and *Reconstructing Nature: The Engagement of Science and Religion* by J. H. Brooke and G. Cantor (1998). This belief of his leads him into other misrepresentations. For example, on p. 139 he refers to Fred Hoyle, whom he clearly admires, as "a famous atheist." That may have been true of the young Hoyle; certainly his famous series of British Broadcasting Corporation talks in 1950 (to which I listened avidly and which were later published [Hoyle 1951]) created that impression on many listeners, but Ratcliffe should re-read the last chapter of Hoyle's (1994) autobiography, a book which he quotes in another context to be referred to later. That chapter was certainly not written by a conventional believer, but neither was it written by an atheist. Again, on p. 54, we are told that "Church and Crown forced astronomers, against their better judgement, to practice astrology." This is rather rich. At least until the invention of the telescope, astronomers and astrologers were the same people. Certainly monarchs and even popes would employ them to cast horoscopes, but the official attitude of the Church was that astrology contradicted the doctrine of human free will and was therefore false. After the Reformation, some Protestant theologians were, if anything, even more adamantly opposed to astrology. Tycho Brahe,

perhaps the greatest of all pre-telescopic observers, in early life actually argued for a limited validity of astrology *against* the Lutheran theologians of his native Denmark (Thoren 1990).

It may be argued that, unfortunate though these errors are, they are not relevant to the truth or falsity of Big-Bang cosmology, or of any other cosmological theory. They do, however, betray a carelessness about checking facts, many of which could have been quite easily checked. Even friendly readers may begin to wonder how reliable a guide Ratcliffe is, and hostile readers will leap on these errors to discredit both him and his cause.

Unfortunately, there is worse to come. Two very simple definitions are expressed in a very confused way. On p. 55 we are told "Developments in optics revealed a property of light known as *parallax* . . . " (italics in the original). It is very strange to call parallax a property of light. If it is a property of anything, that would be space. All it means is that if you move from one place to another sufficiently far away, then the direction you must look toward to see a distant object changes. No "developments in optics" were required to recognize this fact. Even before the telescope was invented, Copernicus and his critics were perfectly well aware that, if the Earth revolves around the Sun, the fixed stars must show annual parallactic motions, and the failure to detect such motions until well into the nineteenth century provided the contemporaries of Copernicus, and later of Galileo, with the strongest argument against heliocentricism. On pp. 188–189, Ratcliffe describes Newton's discussion of the Moon's motion as a combination of hypothetical rectilinear motion with an acceleration toward the Earth. He concludes this discussion with the amazing sentence: "The Moon combines two motions in a trajectory known as *angular momentum*" (italics in the original). Angular momentum is a relatively simple concept in Newtonian mechanics and is certainly *not* a trajectory.

Perhaps these examples are just unfortunate turns of phrase that escaped revision—we can all make that sort of slip—but my review copy is a second edition and there has been an opportunity to make revisions. Did no reviewer of the first edition comment on these things? Once again, Ratcliffe has given ammunition to his foes and embarrassed his friends. Later in the book he is going to discuss the quantum analogue of angular momentum, namely, *spin*, even questioning its reality (p. 373). Why should we trust him on that matter if he does not understand the classical concept?

There are deeper levels of inconsistency in the book. Ratcliffe appears to believe that there is a conspiracy to prevent publication of cosmological theories other than those based on some version of the Big Bang, and I have already conceded that he has some grounds for that belief. On the other hand, he assures us that there are hundreds of cosmologists throughout the

world who dissent from the consensus. Judging by the references scattered through the book, they do eventually find an outlet for their ideas.

Ratcliffe has little time for the "cosmological principle." As enunciated by E. A. Milne, this is a statement that *on a sufficiently large scale* the universe is homogeneous and isotropic. Perhaps Ratcliffe is right to be cautious about that. He does not discuss the *perfect cosmological principle*, first enunciated, I believe, by Hermann Bondi, which extends the ideas of homogeneity and isotropy to all times. It was, in fact, a basic tenet of early versions of steady-state cosmology. A consequence is that throughout all of time the universe will appear to be much the same to any observers that there may be. Clearly, this latter principle puts even stricter constraints on cosmological theories and will not hold in the kind of evolving universe envisaged in Big-Bang cosmology. Yet, in his opening chapter, which is avowedly a science-fiction episode, Ratcliffe imagines that he has been transported back in time to before the Big Bang is supposed to have happened, only to find that the universe looks much the same as our present-day one with which he is familiar. In other words, although the cosmological principle is not valid, its stricter relative, the perfect cosmological principle, holds.

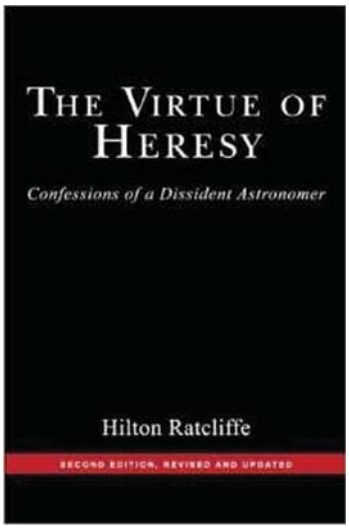
Perhaps the greatest inconsistency, however, arises from Ratcliffe's belief that the universe is designed. He does not mean, as many neo-Darwinian evolutionists do, that there is only an appearance of design, but that the appearance is reality. I am inclined to agree with him, but the inconsistency lies in his total rejection of the idea of a designer. Instead, he postulates something called the "X-stream" which is never clearly defined (I do not know if the near pun on "extreme" is intentional) but appears to contain all the templates needed to produce the designs we observe. The X-Stream is, in fact, Ratcliffe's god—not a very interesting god likely to inspire awe and worship, but nonetheless a god introduced to explain a design that is otherwise inexplicable. Ratcliffe can no more demonstrate the X-Stream's existence than Christians or Moslems can "prove" the existence of the God they worship.

Another inconsistency concerns neutron stars. On p. 235 Ratcliffe writes of a model for the Sun that has a neutron star at its core, whereas on p. 253 (perhaps the permutation is significant!) he asks "What if there is no such thing as a neutron star?" Ratcliffe wants to put a neutron star at the core of the Sun because he wants that core to be iron-rich and he believes that the neutron star being a supernova remnant would be so. This may seem a far cry from the question of which cosmological theory is the best, but of course one of the claimed successes of Big-Bang cosmology is its prediction of the primordial helium abundance, which is consistent

with the proportion of helium found in most of the stars we observe now. In support of a low hydrogen abundance for the Sun, Ratcliffe refers to Hoyle's (1994:153–154) autobiography and an account of a conversation he had with Eddington in 1940. Both of them believed that the interior of the Sun contained about 35 percent hydrogen and 65 percent iron, and, as Hoyle says, such a composition can be made to account for the Sun's luminosity. The Sun's luminosity can also be accounted for with (approximately) 75 percent hydrogen, 25 percent helium, and no more than 2 percent of all the other elements combined. Ratcliffe doesn't tell us that Hoyle ends the account of his conversation with the remark ". . . I was able to show, to my surprise, that the high-hydrogen, low-iron solution was to be preferred for interiors as well as atmospheres." In fact, attention was first drawn to the high-hydrogen solution by Cecilia Payne (later Payne-Gaposchkin) in the late 1920s. Astronomers of the generation of Eddington and H. N. Russell had difficulty accepting it, as is recounted by DeVorkin (2000) who, incidentally, quotes Lyman Spitzer as saying that the predominance of hydrogen in the universe was widely accepted as early as 1930.

It would be foolish and unscientific to deny the possibility that some stellar composition radically different from that which most of us now assume could account just as well for the observations, but we do now have grids of models based on the 75 per cent or so of hydrogen, that represent well both the main-sequence stars and those that have begun to evolve off that sequence. Stellar masses, radii, and luminosities are now all much better known than they were in 1940 when Hoyle and Eddington had their conversation, and the model calculations have been submitted to just the sort of empirical tests that Ratcliffe maintains all scientific theories should face. Until the advocates of other models have produced a similar grid and tested them against both the color-magnitude diagrams of star clusters, and the quantitative data from well-observed binary systems, it is neither perverse nor dogmatic for astronomers to prefer the models that have passed empirical tests.

Chapter 2 of the book contains Ratcliffe's basic assumptions, presented as dogmatically as any manifesto by the supporters of Big-Bang cosmology. It is not so much a statement of his heretical credo as, to continue the religious metaphor suggested by the book's title, a sweeping prophetic call to get rid of all foreign idols and to return to the true faith—and the true faith turns out to be Newtonian mechanics, complete with its absolute time and space. ("Space goes on for ever, and time with it," p. 27.) Indeed, the last two chapters of the book are critiques, respectively, of relativity theory and quantum theory. These critiques were adumbrated in Chapter 2 where, again on p. 27 and going on to the next page, we read: "Reality is independent of



observation or consciousness and has no discernible or conceivable limits." Again, on p. 32: "In all of existence, there are only *four* things: *Space, Energy, Force, Time*" (italics in the original). Matter is considered to be a form of energy; while consciousness, and even the X-stream, appear to have vanished. On p. 382 we are told: "Consciousness is not kinetic and is incapable of dynamic effect." Perhaps that is news to some readers of this Journal! Only on the very last page of the book is there a suggestion that consciousness might be important after all.

Given the assumptions and attitudes presented in the last paragraph, it is scarcely surprising that Ratcliffe has problems with the relativity of space and time and the possibility that the act of observation may, for example, determine the spin of an electron. Nevertheless, I think he was unwise to include the last two chapters in his book. It is one thing to question the prevailing consensus on the origin and evolution of the universe, and quite another to dismiss virtually all the work of the twentieth century in theoretical physics. By attacking so many targets, Ratcliffe distracts attention from what to him, surely, is the most important point and once again makes it easy for those who disagree with him to discredit both him and the cause that he has at heart.

In Big-Bang cosmology we have a prime example of a paradigm in the sense that that word was used by Kuhn (1962). Most scientists work within a paradigm doing what Kuhn called "normal science." I did so myself in my studies of interacting binary systems. It is, after all, given only to a very few to make groundbreaking studies that open up entirely new fields of research or radically change the way that we look at old ones. There is nothing wrong with working within a paradigm. If that paradigm is wrong or inadequate, the anomalies within it will eventually bring it down—as epicycles did for heliocentric cosmology and as I have suggested "dark matter" and "dark energy" may one day do for Big-Bang cosmology. Only if those who work within the paradigm come to believe that it represents ultimate truth and should be unquestioned does any problem arise. Ratcliffe obviously believes that this has happened with modern cosmology and that is a reasonable belief to hold, but I would have been happier if less of his book had been devoted to trying to make so much of modern science look

ridiculous, and rather more to showing how other theories might be superior.

In one sense the problem is with our peer-review system. The leaders of "normal science" also are those most likely to be refereeing papers, editing journals, and reviewing applications for research grants and telescope time. Being human, they tend to prefer those who toe the party line. We have to have some form of peer review. Observing or experimental facilities are expensive to build, maintain, and run, and the money to do all that usually comes from the public purse. Journals are likewise expensive to produce and have limited space. We do have a responsibility to make sure that all these resources are used as wisely as possible. Even this Journal, devoted to giving a voice to scientifically unpopular views, employs referees. It is almost inevitable that points of view contradicting the current consensus in any area of mainstream science will be marginalized unless referees and committee members make a special effort to realize that a consensus may be wrong. Asked to review a research proposal by Wittgenstein, Bertrand Russell (1968) wrote the following:

> The theories contained in this new work of Wittgenstein's are novel, very original, and indubitably important. Whether they are true, I do not know. As a logician who likes simplicity, I should wish to think that they are not, but from what I have read of them I am quite sure that he ought to have an opportunity to work them out, since when completed they may easily prove to constitute a whole new philosophy.

I would like all editors, referees, and committee members to keep framed copies of that quotation on their desks, for it encapsulates the spirit that should animate all who engage in such activities. I freely acknowledge that I have not always lived up to that spirit myself and have made errors of judgement in both ways. Each such failure brings us closer to establishing the "orthodoxy" and marginalizing the "heretics" which, as Reber and I agreed, is contrary to the true spirit of science. Now is a time to consider these matters carefully, because the existence of the Internet and the rise of desktop publishing are inevitably changing the ways in which scientific results and theories are being disseminated. As I have already hinted, the "heretics" of cosmology do seem to get their ideas into print one way or another. The problem is not so much in producing a book as in distributing it. I doubt if many people working within the Big-Bang paradigm are even aware of the existence of this book of Ratcliffe's.

One final comment is that, in some ways, this book reminded me of a Presidential address delivered to the Royal Astronomical Society by Herbert Dingle (1953), Professor of the History and Philosophy of Science at the University of London. Dingle no more liked the mainstream cosmology of

his day than Ratcliffe likes that of ours. He was also possessed of a rapier wit that he displayed to the full in this address—great fun to read and to listen to, so long as you are not the target! Some of Ratcliffe's criticisms echo what Dingle wrote more than sixty years ago. In particular, he praised the mathematical ingenuity of cosmologists while arguing that it had misled them to lose all contact with reality. The cosmological principle he renamed the "cosmological assumption," and the perfect cosmological principle became the "cosmological presumption"! Dingle's target, however, was not Big-Bang cosmology, which had not then developed to the extent it has today. Steady-State cosmology was not only still considered viable but was actually preferred by many. Dingle's targets, rather, were E. A. Milne and his kinematic relativity, and Hoyle, Bondi, and Gold and their steady-state theories. Now fashion has turned full circle as Ratcliffe uses Dingle's arguments to defend Hoyle, in particular, against those who adhere to the current consensus in cosmology.

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