science and technology. The result is that anything concerning science in the media houses is not taken seriously'. In addition, there are headings like 'Offhand treatment in science', 'No conception of science', 'Outdated editors', 'Science needs to be diluted', etc. Some tight copy-editing could have helped. There is just too much of verbiage.

In the section on 'A blueprint for more science in the media', Salwi calls for a lofty and impractical infrastructure. His wish-list includes a Media Resource Centre encompassing Science Media Resources Centre, Science Audio-Visual Resources Centre with posts like Director, Assistant Director, etc.; a Science in the Media Fund to be collected from research laboratories/institutes, corporate houses, trusts, etc. to be given to media persons for sponsored columns. Also, three-month foreign jaunts for science communicators. Salwi admits that the demands are impractical.

There is a section containing 40 pages of recommendations about how to improve science communication status in the country. These are too many for anybody to pay serious attention. Science coverage is demand-driven. The media barons would probably be interested in science, if there are more indigenous success stories. Launching of Indian satellites, for instance, gets tremendous coverage, more so, if we put a satellite of a developed country into orbit. The SARS issue got good coverage as well. More indigenous science will engage science journalists full time, thus helping them skip the occasional non-science beat the paper assigns to keep them busy. Science coverage in developed countries like the US has flourished because of the huge amount of science done and harmony among the generators of information – scientists, scientific agencies, universities, industry and the media. What is more, academic bodies take interest. The US National Academy of Sciences has been consistently encouraging scientist–media interactions, promoting science coverage in the press, as also by providing expert panels to journalists for ready consultation. Not surprisingly, there are enough news-breaks to engage even freelance science writers. And there is fierce competition to file exclusive stories. Science writers are well-organized (there is even a cancer writers' forum) and strong enough to influence policy.

The coverage of science in Indian media needs more indigenous R&D and a culture of innovation-driven research by Indian scientists, as more home-grown discoveries would generate interest in everyone associated with science and media. Increased support to the public-funded laboratories and R&D in industry, and more media-friendliness through cutting a bit of the red tape by the government would help. Hopefully, newspapers would consider science as important as, say, the death of a Hollywood hero of yesteryears. Coverage of science is hard grind and there is a clear need for serious science scribes who should look beyond the handouts. For example, despite the erratic weather predictions there is hardly any serious scientific analysis as to why the meteorological agencies are consistently off the mark in their predictions. Or the recent CAG report on the non-commercialization of IPR and new technologies generated in the Indian laboratories. Salwi's prescription of more of everything, including sops by government will just not work unless science coverage becomes more professional. That there is not even a vibrant forum of science communicators in India speaks volumes of the dismal state of affairs. Salwi has some key messages that unfortunately get lost in the verbiage. Perhaps, the next edition would take care of that.

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Einstein from B to Z. John Stachel. Birkhauser-Verlag, P.O. Box 133, CH 4010, Basel, Switzerland. 2002. 556 pp. Price not stated.

This is a collection of 37 published and unpublished articles on Albert Einstein and his works by John Stachel and his collaborators. Stachel is currently the Director of the Boston University Center for Einstein Studies. The book is a sequel to eight earlier volumes published by the Center, under the editorship of Don Howard and John Stachel.

The volume covering 556 pages is presented in eight parts, depicting different aspects of Einstein's colourful personality, his outstanding scientific works, and his interaction with and opinion on other scientists. In the introduction itself Stachel says, 'From the mists of obscurity and myth, there starts to emerge the portrait of a human being, of his strengths and weaknesses and of his often-contradictory strivings (for example, defiance of authority in physics co-existed with a longing for recognition of his work), who is a thousand times more interesting than the saintly figure of the legend'. And there is also emerging a much cleaner picture of the development of his ideas about relativity, both special and general theory, and about quantum theory – his greatest contribution to 'modern physics'. The book does not present the articles in a chronological series as they appeared; they are grouped thematically. Also some of the articles have contents which are partially repetitive.

Part I deals with the human side of Einstein and portrays his early life, his Jewish identity, his very early scientific work, his religiosity, social views and his response and reaction to fame. When Einstein was 70, he summed up his feelings about fame in a letter to a relative, 'It is a curious thing to see how one appears from perspective of others. It was my fate that my accomplishments have been overvalued beyond all bounds for incomprehensible reasons. Humanity needs a few romantic idols as spots of light in the drab field of earthly existence. I have been turned into such a spot of light. The particular choice of person is inexplicable and unimportant'.

The answer to one of the articles in the popular press that created some confusion recently, is available in the article entitled 'Albert Einstein and Mileva Mariæ: A collaboration that failed to de-velop'. Mileva was a co-student of Einstein at Heidelberg. Learning physics and mathematics and working together as partners in the laboratories of Henrich Friedrich Weber, they fell in love with each other and much against the wishes of their parents, got married in 1903. By

1914, when Einstein had become an Assistant Professor at Bern, affairs had taken a different turn. Mariærealized that one of the chief attractions for Einstein to move to Bern was his cousin Elsa Lowenthal. Mariæleft for Zurich with her two sons, never to live again with Einstein as his wife. During the years that they were together as students and as husband and wife, Mariæwas 'a sounding board for Einstein's ideas' – a role also played on occasions by his friends Michele Besso and Conrad Habicht. To the question about why a collaboration did not develop, Stachel suggests (i) her talents in physics were modest, (ii) she lost her inner self-confidence and drive necessary to pursue a career in science in the face of many obstacles that women faced and (iii) after marriage, Einstein failed to encourage her to pursue an independent scientific career.

In his book *Subtle is the Lord*, Abraham Pais remarks 'I am sure that Einstein's strongest source of identity after science, was to be a Jew, increasingly so as the years went by'. Einstein registered officially as 'Konfessionslos' (without religious affiliation) when he was 16, and generally continued to do so thereafter. However, he did not hesitate to register as Jewish when necessity demanded. Later, he often described his belief system by the phrase 'cosmic religion'.

Einstein accepted a variant of cultural Zionism. This fitted well with his longing for an idealized human community. Stachel concludes 'Einstein's lifelong devotion to humanist ideals and his attempts to apply them to the complex social problems of his time demand the highest respect. In spite of any weakness one may find in his outlook, Einstein's call for Jewish self-respect in the lands of the diaspora, his support for a secular humanistic Judaism, his conciliatory views on Jewish–Arab relations and his suggestions on finding the path to peace in the Middle East, are still of more than purely historical interest – particularly to his fellow Jews. Rather than unthinking adulation to his every word or cynical manipulation of Einstein myth, we can honour him best by reading and pondering his words, modifying or rejecting what we find to be the obsolete, and using in our current struggles what we find to be lasting values'.

The article 'Einstein on civil liberty' is just two pages long, but has a lot to tell about the threat to loss of civil liberties in the United States during the Nixon era and the role of Einstein in stemming the social tyranny. The author presents in the section on 'Einstein and the research passion', Einstein's views on the nature of the creative process, the kinship and the difference between artistic and scientific creativity. Einstein's address to Max Planck on his 60th birthday in 1918, runs as follows:

'Man tries to make for himself in the fashion that suits him best, a simplified and intelligible picture of the world; he tries to some extent substitute this cosmos of his for the world of experience and thus to overcome it. This is what the painter, the poet, the speculative philosopher and the natural scientist do, each in his own fashion. Each makes this cosmos and its construction the pivot of his emotional life, in order to find in this way the peace and security which he cannot find in the narrow whirlpool of personal experience'.

Part II deals with 'Editing of Einstein's papers' and gives details about the Einstein Archive housed at the Institute for Advanced Study in Princeton.

Part III entitled 'Survey of Einstein's work' covers the formative years of Einstein and also the later Einstein as an opponent of field theory. The influence of the works of Maxwell, Lorentz and Mach on Einstein is brought out, as well as the sophisticated discussions that Einstein had with Mariæ and his close friends Besso, Maurice Solovine and Habicht, who had banded together to form the 'Olympia Academy' to discuss fundamental issues in science. Among the books that influenced Einstein during his formative years, the author lists: Karl Pearson's *Grammar of Science*, Mach's *Analyse der Empfindungen and Mechanik*, Mill's *Logic*, Hume's *A Treatise of Human Nature*, Spinoza's *Ethica*, Rieman's *Über die Hypothesen*, Clifford's *On The Nature of Things-in-Themselves*, Dedikind's *Was Sind Und Was sollen die Zahlen?*, and Poincaré's *La Science et l'hypothese*.

In the second essay in this part entitled 'The other Einstein: Einstein contra field theory', Stachel portrays Einstein, the author of the space–time continuum field theory, as one who questions the fundamental significance of space–time continuum itself. Stachel ends this section with the last published words of Einstein, 'one can give good reasons why reality cannot at all be represented by a continuous field. From the quantum phenomena it appears to follow with certainty that a finite system of finite energy can be completely described by a finite set of numbers (quantum numbers). This does not seem to be in accordance with a continuum theory, and must lead to an attempt to find a purely algebraic theory for the description of reality. But nobody knows how to obtain the basis of such a theory'. Did this other Einstein have the last word?

Parts IV and V deal with special and general theories of relativity. The crucial questions that have been raised often are whether or not Einstein was aware of the results of the Michelson–Morley experiment, whether he had read the relevant papers of Lorentz and what exactly was the influence of Mach, Poincaré, Hume on his ideas. What has surprised many is the unique marvel of a 25-year-old clerk in a patent office producing four outstanding papers in a single year, 1905! The answer perhaps was in Einstein's remark about creative process: 'A new idea comes suddenly and in a rather interesting way. That means it is not reached by conscious logical conclusions, ... Intuition is nothing but the outcome of earlier intellectual experience'.

Based on newly discovered correspondence between Mariæ and Einstein, the author comes to the conclusion that Einstein did know about the Michelson–Morley experiment by 1899. While he quoted the Michelson–Morley experiment as evidence for the relativity principle, Einstein never cited it as evidence for the principle of constancy of light.

In Part V on general relativity, Stachel narrates the genesis of general relativity, Einstein's search for general covariance, Einstein–Hilbert priority questions and Einstein's early work on gravitational lensing, a phenomenon which has come into the forefront only in the last thirty years or so. In December 1915, Einstein wrote to Hilbert, 'There has been a certain resentment between us, the cause of which I do not know. I have fought against the feeling of bitterness associated with it and indeed with complete success. I again think of you with undiminished kindness and I ask you to attempt the same with me. It is objectively a pity, if the genuine chaps who have

liberated themselves to some extent from this shabby world are not giving pleasure to each other'.

What a noble and gentlemanly way of ending a controversy over an important issue of priority!

It is well known that Einstein had a half-century-long struggle with the quantum of light. In desperation in 1951 he wrote be Besso, 'The whole fifty years of brooding [Gr *ü* belei] have not brought me nearer to answer the question "what are light quanta"…'.

In Part VI, Stachel gives a historic account of this struggle beginning with the controversy on the Bohr model and proceeding to the complication of the wave–particle duality, the role of the observer in quantum mechanics, the EPR dilemma and the reconciliation of gravitation and quantization. The longstanding discontent with quantum mechanics is evident from the statement that Einstein made at the Solvey Congress of 1911:

'We are all agreed that the so-called quantum theory of today is indeed a useful tool, but no theory in the ordinary meaning of the word, at any rate not a theory that could now be developed in a coherent manner. On the other hand, it has been proven that classical mechanics, … as expressed in Lagrange's and Hamilton's equations no longer can be regarded as a usable system for theoretical representation of all physical phenomena … . So the question arises: on the validity of which general principles of physics, may we hope to rely in the field of concern to us [i.e. quantum phenomena]'?

In the section on 'Einstein and quantum mechanics'. Stachel comes to the interesting conclusion '… After 1930, Einstein never denied the great explanatory power of quantum mechanics, nor challenged its validity; but he did not agree that this success required the acceptance of the underlying conceptual structure as the basis for all further progress in theoretical physics'. In 1954, Einstein wrote to Besso, 'I consider it entirely possible that physics cannot be based on the field concept, that is on continuous structure. Then nothing will remain of my whole castle in air, including the theory of gravitation, but also nothing of the rest of contemporary physics'.

In Section VII, Stachel has made a comparison between Einstein and other great scientists like Newton, Eddington, Infeld, Lanczos and Bose, who did their monumental works in quite different environments, opportunities for learning and researching. Stachel comments that while Newton created the mathematics necessary to develop his ideas about mechanics and gravitation, Einstein, though an able pupil and practitioner, was never really creative in mathematics. Eddington, who was also a relativist and cosmologist, had interactions with Einstein at various points of time. However, each regarded the other as dogmatic and inconsistent on their cosmological theories. The equally long section on Infeld, the author of the famous book *Quest*, a student of Einstein and a long collaborator, gives an indepth account of the struggle of scientists from countries like Poland, who had to face the Nazi oppression on Jews. Though Einstein was not happy with the publication of *Quest* and chastised Infeld for some of its contents, he still says at the end of his letter '… Now since it has happened, don't have too many afterthoughts. It is meritorious to pitilessly expose wrongs and mendacity. And the grass grows quickly on what has already happened, especially in America'.

The Hungarian physicist Lanczos, who worked in the areas of relativity, field theory and cosmology, was another scientist from Eastern Europe who interacted with Einstein from the 1920s. What is revealing is a letter which Einstein wrote to Lanczos in 1935. '… I am interested in your publication, but cannot understand how as a Jew you still publish in Germany. This is really a sort of betrayal. The German intellectuals have behaved disgracefully in connection with all the dreadful injustices and have richly merited being boycotted. If foreign non-Jews don't do it, that is sad enough.'

The last article in this section is on S. N. Bose, whose derivation of Planck's law is described by Abraham Pais as 'the fourth and last of the revolutionary papers of the old quantum theory'. It is this paper that primed Einstein to exploit its implications to quantum theory of ideal gas and also recognize the limitations of the old quantum theory. The article summarizes succinctly the historical facts relating to the manner in which interaction developed between Einstein and Bose. This account of Stachel removes much of the confusion that exists between the relative roles of Einstein and Bose in the formulation of the Bose–Einstein statistics.

One of the chief merits of this book is the authenticity it brings to the views expressed by Stachel and others on Einstein and his works, by giving extensive references to the related matters in books, letters and publications. It is a must for every scientific library, to all who are interested in the historical development of theoretical physics in the 20th Century, particularly on relativity, quantum mechanics and cosmology. The book has profuse information on many aspects of Einstein's early years that are not available in other books. It has a flavour that is appealing to the young and old, to newcomers to the field of physics and cosmology, and also to mature scientists who have studied in depth relativity and quantum mechanics. The quotations from Einstein on many aspects of life and human relations are particularly enthralling.

For completeness, Stachel has also included his reviews on the two books, *Subtle is the Lord: The Science and Life of Albert Einstein* by Abraham Pais, and *Albert Einstein: A Biography* by Albert Fösling.

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The Extravagant Universe. Robert P. Kirshner. Princeton University Press, 41 William Street, Princeton, NJ 08540, USA. 2002. 282 pp. Price not stated.

Visitors to the Giant Meterwave Radio Telescope, after having spent half an hour or more exhausting their curiosity regarding black holes, the big bang, extra solar planets and extra-terrestrial life, almost invariably ask some variant of the