

## BOOK REVIEWS

**The Collected Papers of Albert Einstein – Volume 8 – The Berlin Years: Correspondence, 1914–1918.** A. M. Heutschal. English Translation, Princeton University Press, 41 William Street, Princeton NJ 08540, USA. 1998. 714 pp. Price: US \$39.50.

The English version of Volume 8 of Albert Einstein's Collected Papers has, for editorial reasons, been published ahead of Volume 7. This is part of the projected 40 volumes covering all of his work and correspondence. It spans the years 1914–1918, which coincides exactly with the First World War, and is devoted entirely to correspondence.

On the personal front, this period saw the separation from his first wife Mileva Maric, feelings on both sides being often expressed quite acrimoniously. (The divorce came in 1919, followed soon after by Einstein's marriage to his (also divorced) cousin Elsa). Professionally, Einstein had just moved in April 1914 from a Professorship at the Eidgenössische Technische Hochschule (ETH) in Zurich to a research position created specially for him by the Prussian Academy of Sciences in Berlin. And in his science this was the period of the tortuous progress towards the final formulation of his general theory of relativity, completed in November 1915. Later in this period he was to present his ideas on the interaction of radiation and matter leading to the celebrated A and B coefficients; the first application of general relativity to cosmology; and in 1917 a profound study of the quantization rules of the old quantum theory, involving deep topological aspects of classical dynamics.

There are close to 700 letters in this volume of more than 700 pages, covering many personal, professional, public and scientific matters. One can only recall and highlight a few chosen pieces, presenting telling and memorable quotations. Among the major correspondents were Mileva Maric, Elsa Einstein, Hendrik Lorentz, Arnold Sommerfeld, Paul Ehrenfest, Tullio Levi-Civita, David Hilbert, and Willem de Sitter; and following not far behind were Max Born, Max Planck, Hermann Weyl and Felix Klein. One notes that in this phase there were as yet no exchanges with Niels Bohr – that was still in the future.

The letters between Einstein and Mileva are quite painful – they show a relationship gone awry, and plenty of petty squabbling on financial and legal matters. In a memorandum and two letters all dated 18 July 1914, Einstein stipulates very strict rules of conduct to govern social contacts between them, including such conditions as these: '... you must leave my bedroom or office immediately without protest if I so request... you commit yourself not to disparage me either in word or in deed in front of my children... . After all that has happened, a comradesly relationship with you is out of the question... . It remains possible that I'll regain a greater degree of confidence in you through proper behaviour on your part...'. So much rancour in separation. At the same time, in intimate and confiding letters to Elsa, he mentions the possibility of a divorce from Mileva, which came through only in 1919. In many letters to Mileva, Einstein details the amount of financial support he has provided for her and their sons, and at what cost to himself; and at one point he insists '... that the money in Prague be transferred to my name. I will have it credited to the children and am convinced that *this* is the safest way for the amount to go to the benefit of the children'.

Through this period, Einstein was deeply absorbed in his quest for the general relativity theory. It is well known that the way to the final result was full of wrong leads and mistaken hypotheses. Einstein had learnt the basic mathematics of Riemannian geometry and the absolute differential calculus from his Zurich classmate Marcel Grossmann, but in a July 1915 letter to Sommerfeld he says categorically that 'Grossmann will never lay claim to being co-discoverer. He only helped in guiding me through the mathematical literature but contributed nothing of substance to the results'. The extensive correspondence with the Italian mathematician Tullio Levi-Civita on the one hand, and with the master theoretical physicist Hendrik Lorentz on the other, are both profound and absorbing. On the mathematical side Levi-Civita was an accomplished master, one of the finest geometers of the Italian school; while Einstein had profound physical intuition and insight. Yet the expression

of the latter in the language of the former was exceedingly difficult, and many steps had to be retraced. It must have been this experience that Einstein had in mind when in a 1933 lecture he said: 'The years of searching in the dark for a truth that one feels but cannot express, the intense desire and the alternations of confidence and misgiving until one breaks through to clarity and understanding are known only to him who has himself experienced them'. In a March 1915 letter to Levi-Civita, Einstein says 'I also cannot help admiring the uncommon sureness with which you make use of a language that is foreign to you'; and in another place he pleads: 'I shall be delighted if next time you write to me in Italian ... even now I still enjoy being able to apply my modest knowledge of the Italian language... you can hardly imagine what a pleasure it gives me to receive such a genuine Italian letter. While reading, the finest memories of my youth come alive'. Through these letters pass claims and counter claims about the alleged tensorial behaviours of various field quantities under given groups of transformations.

One of Lorentz's very lengthy letters deals with Einstein's use of special coordinate systems while on the road to the general theory. He even chides the younger man thus: 'Are you not going a bit too far here by presenting a personal view as self-evident?' And in one of his replies Einstein says: 'If anyone had to relive exactly the same struggles here in the considerations on general relativity, I'd ardently wish that it be you'.

It is part of history that towards the end in November 1915, David Hilbert too joined in the race towards the general theory. Claims of priority in this matter have only very recently been settled in favour of Einstein as the first discoverer of the general field equations of gravity. Einstein rightly criticized Hilbert's approach as too closely tied to a specific model for matter (the Mie theory); and in a triumphant 18 November 1915 letter he told Hilbert: 'Today I am presenting to the Academy a paper in which I derive quantitatively out of general relativity, without any guiding hypothesis, the perihelion motion of Mercury discovered by Le Verrier. No gravitation theory had achieved this until now'. Einstein's elation is captured in these well-known lines to

Sommerfeld: '... in the last month I had one of the most stimulating, exhausting times of my life, indeed also one of the most successful. I could not think of writing' (28 November 1915); '... You will be convinced of the general theory of relativity when you have studied it. That is why I am not mentioning a word in its defense' (8 February 1916).

Karl Schwarzschild's exact solution for the field of a gravitating mass came soon after Einstein's work; and the latter's appreciation of the result was thus expressed: 'I would not have expected that the exact solution to this problem could be formulated so simply. The mathematical treatment of the subject appeals to me exceedingly'. This incident really seems a precursor to C. G. Darwin's finding the exact solution to the relativistic wave equation for the electron in a Coulomb field, which Dirac had left undone after discovering the equation itself! Of Hermann Weyl's systematic exposition of the general theory in his book *Space, Time, Matter*, Einstein had this to say: 'I am reading with genuine delight the correction proofs of your book, which I am receiving sheet by sheet. It is like a symphonic masterpiece. Every word has its relation to the whole, and the design of the work is grand. What a magnificent method the infinitesimal parallel displacement of vectors is for deriving the Riemann tensor! How naturally it all comes out' (8 March 1918); 'Busily involved in studying the details of your book, I constantly admire anew the beauty and elegance of your derivations' (18 April 1918).

There is some correspondence with the great Swiss-French writer Romain Rolland (who incidentally was so drawn to India), on matters of war, politics, conscience and the role of the intellectual in trying times. These remind us of the backdrop against which the scientific advances were being made. On 15 September 1915, Einstein wrote to Rolland: 'One of the most disheartening phenomena of this terrible time is that in many cases intellectuals have completely lost their composure'. And in a 23 August 1917 letter Rolland says: '... Evil spreads like a splotch of oil... I am awaiting salvation (if it is meant to come) from other - social - forces; and if it does not come, ... by God! it will not have been the first time that a pow-

erful civilization has crumbled. Life will know very well how to blossom again from the ruins ... The soul is never conquered - except when it consents to it. It is ahead of its times'. In a public appeal to Hilbert and many others on these issues, Einstein proclaims: 'This serious situation places those, who through fortunate intellectual achievements have gained an elevated position among scholars throughout the entire civilized world, before a mission they must not evade: They must make a public declaration that could serve as support and consolation for those who in their solitude have not yet lost their belief in moral progress'.

So many names who have passed into the history of physics and other realms come alive in these pages. For those of an older generation, here is proof that with the current decline in the art of correspondence, the expression and hammering out of profound ideas through such dialogue is likely to suffer. One is also left with a strong impression of a supremely gifted intellect having to concern itself also with the petty and the mundane concerns of life. Grappling with the profoundest questions of nature is no insurance against having to also deal with and resolve personal relationships, and arrange one's material affairs with some degree of satisfaction. A complete, a full life is made up of all of these.

N. MUKUNDA

*Centre for Theoretical Studies and  
Department of Physics,  
Indian Institute of Science,  
Bangalore 560 012, India*

---

**Annual Review of Plant Physiology and Plant Molecular Biology 1998.** Annual Reviews Inc., 4139, El Camino Way, Palo Alto, CA 94603-0139, USA. Vol. 49. 832 pp. Price: Individuals, US \$65. Institutions, US \$130.

---

Like children who look forward to receiving a gift on their birthday, many of us look forward to seeing the new *Annual Review of Plant Physiology and Plant Molecular Biology*.

The present volume has 28 chapters and a prefatory chapter by Sussex on

'Plant Development'. In fact, there are four other chapters that also deal with the same theme. Mandoli discusses the body plan and development in *Acetabularia*, an organism that has fascinated developmental biologists for a long time. This chapter describes in detail the spatial and temporal controls in development and is one among the few chapters in this volume with good explanatory and summary figures. Koonneef *et al.* have summarized the work on flowering, especially its onset and the timing. They clearly emphasize the importance of molecular genetics in understanding this complex developmental process. Figure 2 in this chapter amply demonstrates how different gene products, and their interaction with each other is essential to convert a vegetative meristem to a reproductive one. Gasser *et al.* have described the genetic regulation of ovule development in sexual plant reproduction.

Leon *et al.* have discussed the overriding influence of nucleus in the development of mitochondria and chloroplasts. In fact, during the last few years many new genetic loci have been defined whose function in early chloroplast development is not known. In another chapter, the role and functions of brassinosteroids during plant development is discussed by Clouse and Sasse. Although research on brassinosteroids was started 3 decades ago, and a review on this was published in this series in 1988 by Bhusan Mandava (an Indian scientist working at the USDA, Beltsville), yet it is only during the last few years, through the application of molecular genetics, that the importance of this group of regulators has been convincingly shown in normal plant development. In *Arabidopsis*, brassinosteroids signal transduction has been elucidated and is well described in this chapter.

Besides these topics, there are six more chapters that deal with signal transduction, development and gene expression. Schwechheimer *et al.* deal with plant transcription factors. The mechanism of ABA-mediated signal transduction is covered by Leung and Giraudat. ABA is an important hormone having a role in seed maturation and mediates many stress-related responses. Although ABA receptor is not yet known, the intermediates in ABA-signal