Scholz, Erhard (ed.) *Hermann Weyl's Raum-Zeit-Materie and a General Introduction to his Scientific Work* (Basel: Birkhäuser, 2001). 405 pp. pb. DM 78. ISBN 3-7643-6476-9.

Review by Leo Corry, *Centaurus* 2001

"It happens rarely that an individual is capable of pioneering work in several fields. Hermann Weyl was just such an individual, a profound thinker of wide intellectual range, a giant of our times. His vision was unique and penetrating not only in mathematics, but also in mathematical physics and in philosophy of science. … The sheer range of his genius and his persistent search for a harmonious, intelligible architecture of the physical universe at once links him to the last great universalist mathematicians and thinkers of the nineteenth century such as Hilbert and Poincaré, and stands as a promise and anticipation of the future development of science and mathematics."

This concise description of the immense scientific stature of Hermann Weyl, one of the towering figures of science in the first half of the twentieth century, opens the second part of this recently published collection of articles, edited by Erhard Scholz, and it forcefully encapsulates the reasons why any historical study of the work of Weyl as a whole is such a demanding challenge for both the prospective historians and their readers. Individual aspects of Weyl's work have been investigated previously and also two already published collections attempt to address the more general task of providing a panoramic view of his contributions. Yet, as a combination of thorough scholarly standards and breadth of scope in dealing with Weyl's work, this collection is certainly the first of its kind. This reason alone (and there indeed are many others) would suffice to make it into a most valuable book that deserves close attention from the side of historians of science, philosophers, and scientists as well.

In the first of the two main parts of the book four different authors present historical discussions of several issues related with Weyl's *Raum-Zeit-Materie*. First, Skúli Sigurdsson's "Journeys in Spacetime" analyses the broad intellectual background against which the significance of Weyl's famous book should be understood. This background, Sigurdsson means to stress, comprises not only heavy mathematical machinery and a complex interplay of physical considerations, but also a thoughtful embedding of his conceptions within a delicate system of philosophical nuances.

Next, Erhard Scholz's article deals with the intricate interrelations among three central pillars of Weyl's work: his constructivist approach to the essence of the real continuum, his development of a purely infinitesimal geometry as starting point for his gauge field theory, and his analysis of the space problem. Scholz stresses how these interrelations affected, and were affected by, the significant changes that these ideas separately underwent along the years.

Hubert Goenner's article discusses Weyl's seminal contributions to the early relativistic cosmological debate, and in particular the introduction, only in 1923 in the fifth edition of

R-Z-M, of the so-called “Weyl Hypothesis”. Goenner explains how Weyl’s ideas emerged out of contemporary debates in the recently created field, while stressing their relationship to Einstein’s and de Sitter’s work. In an appendix, Goenner also provides additional mathematical details concerning the ideas discussed in his paper.

In the closing paper of the first part, Norbert Straumann discusses a topic not actually treated in *R-Z-M*, yet directly and naturally arising form it, namely, Weyl’s attempt to redefine the relationship between space, time and matter, in the framework of the newly developed quantum mechanics. In addressing this problem in the late 1920s, Weyl revised some of the ideas developed in his earlier work on gauge geometry and elaborated them in a direction that he explicitly saw as an alternative to Einstein’s then current theory of distant parallelism.

The second part of this collection is a book-length essay by Robert Coleman and Herbert Korté, bearing the ambitious title “Hermann Weyl: Mathematician, Physicist, Philosopher”. No less ambitious is the contents of their contribution, which covers an astonishing variety of topics arising in Weyl’s intellectual activities: real analysis and number theory, Riemann surfaces and complex function theory, differential geometry and relativity theory, Lie groups and quantum mechanics, and foundation of mathematics. Besides the interest that this piece may offer as a broad overview of Weyl’s scientific work to begin with, some of the specific issues discussed in it are addressed, as the editor clearly states in the introduction, from a novel and controversial point of view that enhance their appeal to potential readers. An interesting case in point is the views put forward by the authors in their discussion of the problem of space, a view which is basically opposed to the more traditional one, espoused by Erhard Scholz himself in the relevant part of his own contribution to this collection (see especially p. 87).

It seems evident that all the authors involved in creating this impressive book command a total domain of the subtleties and intricacies of the complex issues under discussion. This is of course an obvious, but largely non-trivial, pre-condition for successfully taking up the task. Yet, the collection is heterogeneous in several senses and one may expect that the various articles will appeal in different ways to different kinds of potential readers. Thus, the more “historically-oriented” among the readers may come to feel more at ease with the approach adopted in the contributions of Sigurdsson and Scholz. For one thing, these two contributions make the most extensive and systematic use of the profuse, recent historical literature on the development of physics and mathematics during the relevant period. Coleman and Korté, on the other hand, address their complex topic from a quite different perspective, one that, perhaps, can be dubbed here as more “philosophical”. This is manifest in the kind of questions discussed and the kind of arguments adduced, as well as in the kind of secondary sources quoted. Then, in what to some extent amounts to a middle ground between the two former approaches, Straumann and Goenner will certainly appeal,

above all, to a kind of reader that Goenner himself describes as “a physicist interested in history”.

Another sense in which the book will be received differently by different readerships concerns the plain, yet significant, fact that the articles are written in different languages: Scholz’s and Straumann’s in German and the rest in English. Sigurdsson explains his own reasons for preferring to quote, in his English article, mainly in the German original, whereas Coleman and Korté took pains to translate every German passage quoted. No doubt all of these are legitimate editor’s choices, yet they are choices to which potential readers may react in different ways.

Finally, different readers may come to differently regret, according to their own immediate scopes of interests, the absence of discussions concerning a small number of topics pertaining to Weyl’s scientific world that were not covered in detail in any of the pieces of the collection. Scholz, to be sure, does not claim to have exhausted the subject and he gives additional references to the existing literature on Weyl. Of particular interest in this regard is Tom Hawkins’ recent book on the history of the theory of Lie groups, in which a major portion is devoted to the contributions of Weyl to the field.

This collection of essays on the work of Hermann Weyl represents a major contribution to the historiography of mathematics and mathematical physics in the early twentieth century, and very likely it will become an indispensable source of reference for any future work in the field.