

are covered mainly in part 3, which deals with tests of general relativity, post-Newtonian celestial mechanics, gravitational radiation, and stellar structure, and in part 5, which deals with cosmology. Together these two parts comprise roughly half the book. I was especially impressed with Weinberg's presentation of post-Newtonian celestial mechanics. It contains one of the clearest discussions of the slow-motion approximation to be found anywhere. The treatment of gravitational radiation is also very good as far as it goes. Many of the calculations in this section appear to be original and are a valuable contribution to the subject. This section is especially useful for understanding current attempts to detect gravitational radiation. The long discussion of cosmology in part 5 is also extremely useful. It of course contains a review of classical cosmology. But its main value lies in the presentation of the recent developments to be found in chapter 15. The scope of this presentation can be judged by the list of over 300 references at the end of this chapter; of these, only about 20 predate 1960. There are even references to papers that had not appeared in print at the time of publication. I found the sections on the thermal history of the early universe, helium synthesis, formation of galaxies, and the theory of small fluctuations particularly helpful as introductions to these subjects.

In view of the excellent discussions contained in the sections of this book devoted to applications it is disappointing to find that the presentation of the principles does not achieve the same level of excellence. I find here that there is both too much material and not enough. There are many long sections devoted to derivations that can be found in any of a number of texts on tensor calculus and differential geometry. These derivations are always clearly presented and often novel, but they tend to obscure the essential ideas. The long discussion of symmetric spaces, for example, leaves the reader with no clear understanding of what he needs to know of this subject in order to understand the properties of various cosmological models. On the other hand, many of Weinberg's discussions leave one with the feeling that all questions of principle have been answered and that the future of general relativity lies solely in its applications. I believe that this difficulty stems in part from the fact that much of the

material on the principles derives from books written prior to 1950. Since then a considerable amount of work has been done that has increased our understanding of the foundations of general relativity, but very little of this material is discussed in this book. For example, although a large amount of work has been done on the initial value problem, the discussion of it here is limited to just over one page with no references given. At the end we are told that the initial value problem "can be programmed for an automatic computer, once we find an initial metric at $x^0 = t$ that satisfies the constraints." But it is just the problem of finding this initial metric, which only now seems close to a solution, that causes all the difficulty. It also lies at the heart of the quantization problem, but it is completely ignored in the section on quantization. Likewise, the section on gravitational radiation, though containing many interesting results, is concerned solely with the linearized theory. It ignores all the really hard problems and the large amount of work by Bondi, Sachs, and others on these problems. Finally, the author's discussion of the principle of general covariance is, I think, quite misleading. He resurrects an old argument of Kretschmann which has been seriously questioned by several authors, and which, if true, would rule out one of the strongest arguments for Einstein's equations for the metric.

To sum up, then, I would say that anyone seriously interested in modern cosmology and relativistic astrophysics will want to own a copy of this book. In these areas it is one of the best there is. One will have to look elsewhere, however, to find out what has happened in other areas of general relativity during the past 25 years.

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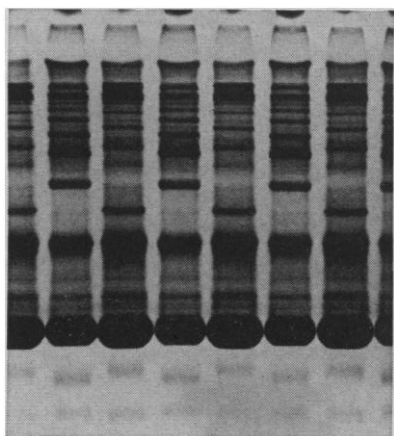
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(Continued on page 1260)



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the effect of mechanical stirring on aerosol formation in chambers, the inhibition of aerosol formation that occurs with certain hydrocarbon mixtures, and the effect of primary aerosols on the formation of secondary aerosols.

The final session of the workshop was concerned with the role of atmospheric measurements in modeling. Eschenroeder discussed the type of field measurements required for model verification. He recommended that vertical profiles of temperature and pollutant concentrations be obtained and that more numerous hydrocarbon measurements be taken. He also suggested that atmospheric removal processes for NO_x should be identified and the influence of concentration inhomogeneities upon atmospheric reaction rates should be determined.

W. A. Perkins (Metronics Associates, Inc.) discussed the measurement program planned for the Los Angeles Basin during the 1973 smog season. The objective of this program is to provide a data base suitable for developing and testing photochemical models. In this study a block of air will be followed by ground and air mobile units as it traverses an area. Aerometric measurements will be made of the pollutants in this air mass. By following an air parcel, rather than sampling from ground stations, one can observe directly changes in the nature of the pollutants as they undergo reaction.

R. C. Sklarew (EPA) ended the session with a discussion of some of the difficulties that the Meteorology Laboratory must solve before the full potential of photochemical models can be realized. One of the problems of current concern is the incorporation of chemistry into the models. Chemical reactions can be handled with relative ease by utilization of the trajectory approach. However, errors in following the chemistry can result if the grid approach is used. Another difficulty that must be resolved is that the effects of local point sources are presently handled by smearing the emissions over a wide area, giving poor resolution to the models. The efforts presently being made to resolve these difficulties were discussed.

The proceedings of this workshop, including presentations and discussions, are available upon request.

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(Continued from page 1229)

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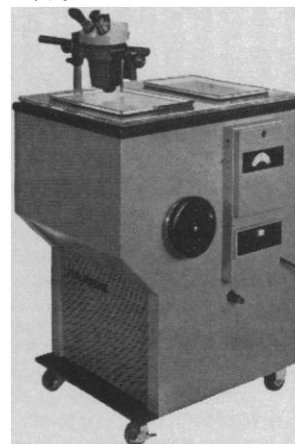
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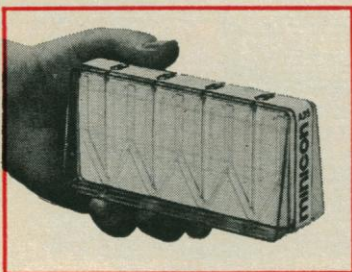
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