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Mathematical cosmology and extragalactic astronomy, by Irving Ezra Segal, Pure and Applied Mathematics, vol. 68, Academic Press, New York, 1976, ix + 204 pp., $22.50.

For more than half a century it has been observed that there exist shifts in frequency of light emitted by distant sources. The redshift parameter z is defined as the fractional *increase* in wave length

$$z \equiv \delta\lambda/\lambda_1 = (\lambda_0 - \lambda_1)/\lambda_1$$

where λ_1 is the wave length of the emitted light and λ_0 is that of the received light. If ν_1 and ν_0 are the corresponding frequencies we may write

$$1 + z = \nu_1/\nu_0.$$

Segal devotes approximately the first half of this book to a discussion of the implications that the requirements of causality and symmetry have on any cosmological theory. In addition this part of the book contains a derivation of the variation of the redshift z as a function of the distance ρ from the point of emission in accordance with the law $z = \tan^2[(\rho/2R)]$ where R is the "radius of the Universe". He deduces from this law the functional dependence of a variety of observed quantities such as the apparent luminosities, number counts and apparent angular diameters on z. The remainder of the book is devoted to comparing these predicted relations with observations. For small z, Segal's redshift distance law differs markedly from the linear law proposed by Hubble, which in turn is in accordance with the expanding universe models predicted by general relativity, i.e. the Einstein theory of gravitation.

In order to be able to point out the relation between the latter theory and chronometric theory, the one propounded by Segal, it is appropriate to summarize some features of the general relativistic treatment of the expanding universe. The Einstein theory states that the arena in terms of which physical theories are to be described is a four-dimensional manifold called space-time with a Lorentzian metric

$$ds^2 = g_{\mu\nu}\, dx^\mu dx^\nu.$$

The metric tensor $g_{\mu\nu}$ describes the gravitational field and is determined by the field equations

$$R_{\mu\nu} - (R/2)g_{\mu\nu} + \Lambda g_{\mu\nu} = -KT_{\mu\nu}$$

where $R_{\mu\nu}$ and R are the Ricci tensor and scalar curvature computed from $g_{\mu\nu}$. $T_{\mu\nu}$ is the stress-energy tensor describing the sources of the gravitational field, K is the Einstein gravitational constant and Λ is the cosmological constant. Λ was introduced into the theory by Einstein in his first discussions of the cosmological problem. He subsequently felt very strongly that $\Lambda = 0$ and that his introduction of this constant was one of his most serious errors (cf. [**1**]).