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Title

Evolutionary Phenomena in Galaxies. J. E. Beckman and B. E. J. Pagel, Eds. Cambridge University Press, New York, 1989. viii, 468 pp., illus. \$69.50. Based on an institute, Tenerife, Canary Islands.

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dates back only a little more than 20 years. Before the pioneering work of Beatrice M. Tinsley in 1967–68, a typical astronomical text did not even contain an index entry for “galactic evolution”; and here we have a whole book on the now-mature subject. The volume includes the invited review papers presented at a conference held in the Canary Islands in July 1988. The locale has resulted in galactic evolution with a strong European flavor. Of the 29 papers, 24 have authors located in Common Market countries, 4 in the United States, and 1 in Australia.

Because the subject has been around for a while, the book contains few surprises, and most of what it says could have been collected from other sources. The flip side of this coin is that the volume is likely to remain a good picture of our understanding of the subjects covered for some time. The core topics addressed are: stellar populations, ages, and dynamics for our own galaxy; stellar populations in other galaxies; processes of star formation from interstellar gas; the feedback of heavy elements and energy from supernovae; and chemical evolution of galaxies. Shorter sections consider whether the nuclei of the Milky Way and other galaxies contain black holes and the effects of close encounters between galaxies.

As conference proceedings go, this one is rather well indexed (for individual astronomical objects, chemical elements, and spectral lines, as well as according to broad subject headings). Thus one can use it easily to check up on the current status of one's favorite old astronomical problems. For instance, a classic one is the relative paucity of metal-poor stars in the Milky Way (still true for disk stars, though not for the halo, and best explained by continuous infall to the disk of pure hydrogen and helium gas, according to Bernard E. J. Pagel).

Another is the correct explanation for the concentration of heavy elements like oxygen, nitrogen, and sulfur toward the centers of galaxies (neither varying the star formation rate and mass spectrum nor allowing gas to flow inward yields a perfect fit to the data, according to Angeles I. Diaz and Francesca Matteucci). And the relationship between spiral arm patterns and other properties of galaxies is sufficiently complex, according to Bruce G. and Debra Meloy Elmegreen, that several different physical processes (including bar driving, density waves, and galactic interactions) must be capable of generating arms.

The real focus of puzzlement in the astrophysics of galaxies has, however, shifted from evolution to formation. According to the opening contribution by Martin Rees, “We do not know why such things as galaxies should exist at all.” That is, the physical

processes that cause the most conspicuous large objects to be the sizes, masses, shapes, and densities of the galaxies we see have not yet been identified. The situation is really even worse—no matter which processes you choose to invoke, we don't really see how the galaxies can have formed by the present time in a universe previously as homogeneous as the microwave background radiation says ours must have been. That 90% or more of the matter in typical galaxies is non-luminous and can be traced only through its gravitational effects on the stars and gas does not, at least in the short run, help. A list of astronomers working on and thinking about galaxy formation over the past decade would run into the hundreds. But if the right basic idea has been proposed, it is currently hidden by the trees. I would bet only about 50-50 that the proceedings of a conference on galaxy formation dated 2002 will present a subject as organized and settled as the evolutionary phenomena discussed in this volume.

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Changing Galaxies

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The recognition that galaxies change measurably in composition and appearance over the time span we can study and that the changes are both calculable and important