The voluntary nature of membership in the Institute, the existence of rival organizations competing for members and a voice in government councils, and internal divisions within the Institute itself point to the conclusion that chemistry in Britain has never possessed the essential characteristics of a profession as Russell and his colleagues define it. In this sense, *Chemists by Profession* is an account of a development that has not occurred. It richly documents the difficulties, perhaps insurmountable, that confront those who would shape a unified profession from the diverse groups who call themselves chemists.

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Galactic Dynamics

Structure and Properties of Nearby Galaxies. Papers from a symposium, Bad Münstereifel, Germany, Aug. 1977. ELLY M. BERKHUIJSEN and RICHARD WIELEBINSKI, Eds. Reidel, Boston, 1978. xviii, 308 pp., illus. Cloth, $38; paper, $24.50. International Astronomical Union Symposium No. 77.

The Large Scale Structure of the Universe. Papers from a symposium, Tallinn, Estonia, U.S.S.R., Sept. 1977. M. S. LONGAIR and J. EINASTO, Eds. Reidel, Boston, 1978. xx, 464 pp., illus. Cloth, $46; paper, $29. International Astronomical Union Symposium No. 79.

Extragalactic astronomy advances simultaneously on two fronts. For nearby galaxies, high-resolution studies reveal a wealth of details concerning the optical, infrared, radio, and x-ray properties of their nuclei, their distribution of light and mass, their past history of star formation, and material in their vicinity. In contrast, observations to the outermost distance limits reveal the large-scale distribution of matter in small groups, in large clusters, and in superclusters, the dynamical evolution of clusters, the cosmical evolution of matter, and the formation of structure in the universe. In recognition of the rapid progress in both of these directions, the International Astronomical Union sponsored the two symposiums in 1977 whose proceedings are reviewed here. In a standard format of invited papers, short notes, and floor discussion, the volumes present a wealth of recent observations, accepted theories, novel ideas, and sheer conjecture, all of which lead to a model of the universe that is both exciting and beautiful, and that could not have been presented ten years ago.

Nearby, as *Structure and Properties of Nearby Galaxies* demonstrates, the surprises are few, but the breadth of facts is impressive. In the Andromeda galaxy (M31), for example, although the detailed form of the spiral pattern still cannot be deduced (Athanassoula), the kinematics is better understood. Neutral hydrogen can be traced beyond the optical image to a distance of 30 kiloparsecs, and the rotational velocities remain high (Roberts, Whitehurst, and Cram), implying a significant mass at large nuclear distance. Closer to the nucleus, motions are complex and may arise from an earlier nuclear explosion (Shane), a warped or corrugated disk (Emerson and Newton; Whitehurst, Roberts, and Cram), or high-velocity clouds surrounding M31. Dwarf spheroidal galaxies in the vicinity of M31 are shown to resemble those in our own Local Group of galaxies (Kinman). Radio continuum observations (Berkhuijsen) detect intense radio emission from the nucleus and from the optically bright arms, with the peak intensity of the radio continuum, of HI, and of HII generally coincident and often following the dust lanes. Many concepts concerning the dynamics and evolution of galaxies are now well understood (Tinsley; Strom and Strom), although whether a heavy halo exists is still uncertain (van den Bergh).

In *The Large Scale Structure of the Universe*, the picture that emerges from studies of distant groups of galaxies begins to be revealed through studies of nearby small groups of galaxies (Tully and Fisher): there is no evidence for significant numbers of isolated "field" galaxies. More striking, there are large voids in the galaxy distribution, encompassing about one-half of the region surveyed; the number density here is down by a factor of 10^3. DeVaucouleurs, who taught us that we live in a supercluster, now has a plethora of colleagues (Rudnicki and Zieba; Abell; Tarenghi *et al.*; Tifft and Gregory; Huchra) who report on the large-scale distribution of extragalactic objects. Their work, plus that of Jõeveer and Einasto ("Has the universe the cell structure?"), but especially that of Peebles and his school, is changing our picture of the large-scale clustering of galaxies. Peebles's analysis, which is based on galaxy counts by Shane and Wirtanen, shows that the galaxies distribute themselves in interlocking lace-like cells, cells with scale lengths of 50 to 100 megaparsecs. The voids are a significant feature of the arrangement and will have to be accounted for in any theory of matter distribution.

The dynamical evolution of clusters of galaxies, with emphasis on the roles of accretion, cannibalism, violent relaxation, and interactions with the intercluster gas (Ostriker) and observational evidence for cosmical evolution of quasars (Schmidt), radio sources (Longair), and galaxies (Tinsley) also now lend themselves to some measure of observational understanding.

Widely differing theories of the large-scale structure and evolution of the universe from the several Moscow groups (Zeldovich; Doroshkevich, Saar, and Shandarin; Ozernoy; Chernin) are imaginative and exciting. The points at which they mesh with observations must still be established; whether the physics of the very early universe can be understood is not yet clear.

Both of these volumes contain a wealth of information accumulated only in the last few years, and the index to the galaxies and clusters discussed in *Structure and Properties of Nearby Galaxies* deserves a special thanks. The proceedings make informative and interesting reading. The problems are far from solved, and these papers serve to illuminate the questions as well as to provide their present answers. Zeldovich, the optimist, concludes that at "the next symposium somewhere in the early eighties one can be pretty sure that the question of the formation of galaxies and clusters will be solved." We'll see.

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Cosmogony

The Origin of the Solar System. Papers from a NATO Advanced Study Institute, Newcastle upon Tyne, England, March 1976. S. F. DERMOTT, Ed. Wiley-Interscience, New York, 1978. xviii, 668 pp., illus. $69.

For much of its history, cosmogony was a field for the entrepreneur. The goal was to explain the large-scale structure of the solar system. With only dynamical constraints, this seemed within the powers of the individual; collaboration and specialization were rendered superfluous by the scarcity of data. Within the last two decades, new observational techniques, especially the use of spacecraft, the development of subtle chemical and isotopic analyses, and increases in computational capacity, have radically al-

tered the field. It is now both possible and necessary to address specific problems; cosmogony is becoming the domain of the specialist. The "grand design" is not an end in itself but must be regarded as a mere working hypothesis.

This volume begins in the classical style. H. Alfvén, A. G. W. Cameron, W. H. McCrea, A. J. R. Prentice, and M. M. Woolfson present general theories, each claiming to account for the major features of the solar system. Most of this material has been published previously. A single chapter reviewing these and other general theories would have been preferable. The reader will find more value in the remaining two-thirds of the volume, which contains some two dozen pieces of the puzzle. Most of these show little obvious relation to the comprehensive theories or to each other, but each is potentially significant.

T Tauri objects are young stars, believed to resemble the early sun. In a cautious review of their observational properties, G. H. Herbig warns that "as confusing or unwelcome as these [properties] may be, it is unscientific to ignore them. And one is not free to pick and choose: if the 'T Tauri solar wind' is found useful in scouring out the solar nebula, then one must also accept and contend with the other properties of T Tauri stars." Three of these stars have been observed to suddenly increase in brightness by two orders of magnitude. Statistical arguments suggest that such outbursts are common, but their cause is unknown. We do not know if the young sun was so erratic, nor do we know the effects of such behavior on any surrounding preplanetary matter.

Time is a crucial constraint. T. Kirsten provides a clear and thorough review of the various radiometric dating methods. The data suggest, but do not demand, a "spike" of nucleosynthesis by a nearby supernova shortly before the formation of the solar system. Iodine-xenon dating indicates that meteorites formed during an interval of 20 million years; curiously, the "primitive" chondrites do not appear to be systematically older than the metamorphosed achondrites and irons.

The chemistry and mineralogy of meteorites, reviewed by J. W. Larimer, contain clues to the physical state of the solar nebula. Elemental abundance patterns suggest complex histories of condensation, fractionation, and partial remelting. The carbon-oxygen ratio may have varied with location. Trace element ratios imply condensation at pressures of the order 10^{-6} to 10^{-3} bar; this range is too broad to constrain the mass of the nebula.

No volume devoted to cosmogony can seriously claim completeness, but the coverage of this one is notably uneven. These proceedings present a basically Euro-American viewpoint. Presumably, the NATO sponsorship precluded any participation by Soviet scientists. Their work is virtually unreferenced, except in A. W. Harris's review of accretion dynamics. A lesser-known but vigorous Japanese group is also unrepresented. Some topics are addressed from a single viewpoint; for example, D. C. Tozer's paper on the thermal evolution of terrestrial planets is not a review of the field but a detailed exposition of Tozer's theories. Regrettably, the lively discussions that followed each presentation are not included in the book.

That the papers were prepared two and a half years ago is noticeable in the treatment of some subjects: R. B. Larson's review of protostar collapse calculations and D. C. Black's review of isotopic anomalies already appear outdated. The book is handsomely finished and nearly free of typographical errors, but I would have preferred a less elegant result, produced more rapidly. Cosmogony is, in essence, the production of order from chaos. At this stage of our ignorance, the chaos should be given its due.

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Physiology and Evolution

Avian Breeding Cycles. R. K. MURTON and N. J. WESTWOOD. Clarendon (Oxford University Press), New York, 1977. xiv, 594 pp., illus. + plates. $48.

Studies of reproduction in birds have made important contributions to endocrinology, ethology, population biology, and evolutionary ecology. It is now evident that the bewildering variety of annual cycles, mating systems, developmental patterns, and reproductive rates are modifications of a common set of physiological processes. Diversity as the elaboration of a fundamental, pervasive physiological structure is the theme of *Avian Breeding Cycles*. Its ambitious coverage ranges from the anatomy of the avian endocrine system to the endocrine bases of behavior, circadian rhythms and photoperiodism, the phenology of breeding cycles, the energetics of reproduction, and evolutionary and ecological perspectives on the variety of avian breeding patterns. For me, the strength of the book lies in its detailed summaries of key studies in avian endocrinology and photoperiodism. The authors' ecological and evolutionary perspective on these topics will attract the attention of many theoretical and field biologists not accustomed to a close view of their subjects' innards. *Avian Breeding Cycles* is an important book that will be welcomed by readers in a wide variety of disciplines and at many levels. It is clearly written, for the most part, and well illustrated. Seventy pages of references indicate the authors' thoroughness, but the scanty, three-page subject index is disappointing. And although the text is well edited, several glaring errors in the text figures may betoken others less readily detectable.

Beyond these minor criticisms, I was struck by two general shortcomings, one inherent to the book, the other, apparently, to the discipline. In their discussion of evolutionary aspects of reproduction, my own specialty, Murton and Westwood summarize more than they synthesize and accept too much at face value. Their views follow closely upon those of the late David Lack and his coworkers at Oxford. So although *Avian Breeding Cycles* is an excellent reference guide to a large body of literature, it is not an adequate appraisal and does not appear to me to plow new ground. I am not competent to judge adequately whether this criticism might apply to the coverage of endocrinology and photoperiodism.

Because *Avian Breeding Cycles* attempts both to describe the common bases of function and to explain its diversity among species, I had hoped to find a clear statement of the degree to which physiology constrains evolution. Biology desperately needs to define the relationship between the specification, development, and regulation of organism function and its modification by natural selection. *Avian Breeding Cycles* lets us peer under some of the feathers and at times brings the parts and the whole into view simultaneously. But we are still left wondering, Do regulatory mechanisms give evolution a free hand to adjust the controls or do they set constraints more stringent than those resulting from the allocation of limited time and resources? Nevertheless, this summary of the literature constitutes a major step toward answering this question. Murton and Westwood paint a vivid and exciting picture of maturing disciplines on the verge of a major synthesis.

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