

Annual Review of Astronomy and Astrophysics 1998. G. Burbidge, A. Sandage and F. H. Shu (eds). Annual Reviews Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. vol. 38. 692 pp. Price: Individuals US \$ 75; Institutions US \$ 150.

The *Annual Review of Astronomy and Astrophysics* (ARAA) has been providing over the years highly authoritative and often very readable reviews on a variety of topics in astronomy and astrophysics. Each volume contains about a dozen articles, amounting to several hundred pages in all, written by experts in the area. The choice of topics is very wide ranging, from planetary science to cosmology, and instrumental, observational as well as theoretical topics are covered. Articles in the early volume of the series often had a pedagogic flavour and leisurely pace, while many articles in the later volumes tend to be more packed with information and require considerable familiarity with the subject on the part of the reader. But this only reflects the change in speed with which the subject develops at the present time, the great advances which have been made in many areas, and the need to bring out relationships between concepts and wavelength regimes which previously would have been thought to be quite independent of each other. The articles in ARAA continue to remain as valuable as ever, and always act as the best source of advanced introduction to some area that one needs to acquaint oneself with in the course of research.

The 1998 version of ARAA contains the usual catholic mix of articles spanning the whole area. There are two on planets outside the Solar System (detection of extrasolar giant planets by G. W. Marcy and R. P. Butler, and astronomical searches for earth-like planets and signs of life by N. Woolf and J. R. Angel). After many years of fruitless work, a number of extrasolar planets have finally been found, first (perhaps somewhat incongruously) around pulsars through timing analysis and later through direct detection at infrared wavelengths. A whole planetary system around a star has now been found (though after the publication of the review article), and even astronomers who usually set their sight on more active objects should be glad at the chance to acquaint themselves with

these significant developments, which should intensify the search for extra-terrestrial life.

On a subject nearer home, there is an article on radio emission from solar flares by T. S. Bastian, A. O. Benz and D. E. Gary. In the stellar realm, there are three articles, on Herbig AE/BE stars by C. Waelkens and L. B. F. M. Waters, one on carbon stars by G. Wallerstein and G. R. Knapp and a review on the first results from the Hipparcos space experiment by J. Kovalevsky. Hipparcos was launched in 1989 to determine accurately the positions on the sky, proper motions and parallaxes of a large number of stars. The Hipparcos catalogue has over a hundred thousand stars with positions determined to an accuracy better than 1 milliarcsecond, while the Tycho catalogue, based on data from the same mission, contains over a million stars with positions determined to a median precision of 7 milliarcseconds. This immense data base is used to determine a non-rotating stellar reference frame against which motions can be measured, and in the study of stellar properties and the distribution of stars in our Galaxy. The article excellently reviews the work done by the mission and the basic scientific results that have been obtained, and should prove to be valuable reading for astronomers working in different areas.

Chemical evolution of star-forming regions has been reviewed by E. F. van Dishoeck and G. A. Blake, who consider chemical processes that occur during all stages of the formation of stars, from the collapse of molecular clouds to the formation of planetesimals in protoplanetary accretion disks. There are a number of articles in the volume on the Universe outside our own Galaxy. M. I. Mateo has reviewed dwarf galaxies of the Local Group, while R. C. Kennicutt goes further to consider star formation in galaxies along the Hubble sequence. Kennicutt always lectures and writes wonderfully on the subject and, true to this tradition, the present article very readably and usefully considers observations of the global star formation properties as one passes from elliptical galaxies to late type spirals along the Hubble sequence, and their implication for the evolution of galaxies. The article includes a discussion of the physical regulation of the star formation rate in galaxies and future prospects in the field.

Getting to cosmological scales, there is a review of the Lyman alpha forest in the spectra of quasi-stellar objects by M. Rauch. Red-shifted Lyman- α absorption lines found in the spectra of distant quasars are believed to be produced by intervening matter at cosmological distances from the quasar. The observations of these lines therefore provide a very sensitive probe of the distribution and nature of gaseous matter in the Universe. The article discusses observational techniques and observed properties of the Lyman- α systems and then considers various models of the absorbing clouds. D. Branch discusses work done in the last decade on the determination of Hubble's constant using type Ia supernovae. These objects all have nearly the same absolute luminosity, and therefore their observed brightness provides a measure of their distance and they can be used in measurement of the Hubble constant. The author recommends a consensus value of $60 \pm 10 \text{ km s}^{-1} \text{ Mpc}^{-1}$ for this important parameter, whose real value has been eluding astronomers for so long. Simulations of structure formation in the Universe have been reviewed by E. Bertschinger. He considers the progress made over the last two decades in developing numerical methods and statistical tools for analysing observational data as well as the results of computer simulations of structure formation.

Radio galaxies and radio quasars often contain radio jets, on small spatial scales close to the nucleus, to very large scales extending to more than a million light years. Observations of these jets with excruciating detail are now available, but we are still far from having a theory of these jets which will explain their origin, structure and propagation. This is because the physics is very complex, involving gravity and magnetohydrodynamics in highly complex situations. A. Ferrari has reviewed the main results which have been obtained so far in modelling jets with analytical as well as numerical methods.

A special feature of ARAA has been the inclusion of an autobiographical account by a great astronomer in every volume of the series. The present volume includes an article by the Dutch astronomer H. C. van de Hulst, who has made pioneering contributions to a number of areas of astronomy including interstellar matter, light scattering and

radio astronomy. With all these fine articles, this volume of ARAA, like all previous volumes, is highly recommended. It should be a valuable long-term possession for any astronomer. The Indian astronomer may find the price daunting, and it is to be hoped that the publishers may some day be able to make the series available in India at a special price.

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Annual Review of Physical Chemistry 1998. H. L. Strauss, G. T. Babcock and S. R. Leone (eds). Annual Reviews Inc., 4139, El Camino Way, Palo Alto, California 94303-0139 USA. Vol. 49. 678 pp. Price: Individuals US \$ 69; Institutions US \$ 138.

Having reviewed the *Annual Review of Physical Chemistry* (ARPC) 1997 this time last year, I agreed readily to review the ARPC 1998 and I could not help comparing the two.

ARPC 1998 is somewhat thinner (!) (678 pages when compared to 822 pages the previous year) but does justice to the recent developments in the area of Physical Chemistry (and Chemical Physics). It starts with the traditional prefatory chapter, this time by A. D. Buckingham, known (if not personally, at least by name) to most people working in the area of Chemical Physics or Physical Chemistry, as he has been one of the editors of *Chemical Physics Letters* for many years. If every bit of Chemistry can be related to either intra- or intermolecular forces, then Buckingham has done it all.

Most of chemistry can be classified into structure and dynamics. Traditionally, the former was probed by spectroscopy and the latter by kinetics. In recent years, time-resolved spectroscopic techniques have enabled the study of ultrafast processes that include structural changes. The meaning of the word 'fast' (and 'ultrafast') has changed over the years. Bond breaking is definitely ultra-

fast (~ fs) and rearrangement of solvent molecules around a solute is fast (~ ps). But protein folding is 'slow' in comparison.

When I was an undergraduate student (in the sixties) I only learnt about gases, liquids and solids and occasionally about glasses. But today one learns about (atomic and molecular) clusters as the fifth state of matter. We learnt about colloids as special entities. Today, you are considered old-fashioned if you do not talk about nanomaterials.

Understandably, ARPC 1998 covers the recent developments in all the above-mentioned areas. While Toennies and Vilesov discuss the spectroscopy of atoms and molecules in liquid helium (an unusual solvent), Myers examines molecular electronic spectral broadening in liquids and glasses and de Boeij *et al.* present an overview of 'ultrafast' solvation dynamics explored by femto-second photon echo spectroscopies. By reviewing the developments in high resolution spectroscopy in gas phase, Pratt concludes that even large molecules have well-defined shapes. Obsession of physical chemists with doing 'single molecule' spectroscopy without isolating 'single' molecules becomes clear from the review of Xie and Trautman. This subject was dealt with in ARPC 1997 also. While Callender *et al.* give an account of the 'fast' events in protein folding, Collier *et al.* provide a review of nanocrystal superlattices.

Theoretical/computational chemistry has come a long way from the study of electronic structure of H_2 and dynamics of (H , H_2) collisions. Semiempirical and single determinant LCAO-MO-SCF calculations are no longer considered adequate. While full CI calculations continue to remain a dream for most systems, MCSCF wave functions are adequate for most purposes. Schmidt and Gordon write about the construction and interpretation of MCSCF wave functions. The need to go beyond Born-Oppenheimer approximation is emphasized by Butler. Normally one talks about proton transfer and electron transfer. But Cukier and Nocera point out the developments in understanding proton-coupled electron transfer that takes place in a number of systems. Fullerenes and their derivatives continue to draw the attention of chemists. Therefore, it is not surprising that the computational approach to their

study is outlined by Andreoni. More and more computer simulations with explicit inclusion of solvent interactions are being carried out these days. Recent progress in the thermodynamic decomposition of free energies and in modelling electrostatic effects is reviewed by Levy and Gallicchio.

While Bartell looks at large molecular clusters as models of condensed matter, Giancarlo and Flynn take a peek at the peaks and point out the utility of scanning tunneling and atomic force microscopy in probing self-assembled physisorbed monolayers. Knoll points out the knowledge gained on interfaces and thin films using bound electromagnetic waves.

People often try to justify doing basic research by pointing out the potential applications and the benefits that accrue to the society. What is perhaps missing is the realization that anything you see around has its explanation coming from our basic understanding of the forces operative at the atomic and molecular levels in nature. Legend has it that Raman was driven by the curiosity of sea water being blue and the sky being blue before discovering the Raman effect. His nephew Chandrasekhar was gazing at the stars before announcing to the world the Chandrasekhar limit. The 'shuttle glow' phenomenon is demystified in terms of emission from the excited electronic states of NO_2 formed by surface-aided recombination of NO and O , by Murad. One learns from Steinfeld and Wormhoudt that there are a lot of underlying physical chemistry issues involved in timely detection of explosives - quite a useful article, at a time when the whole world has to constantly deal with terrorist acts.

A friend of mine (John E. Dove, who now rests in peace) used to say that one could either carry out research or keep up with what others are doing but not both. For those of us trying to do both in our limited domain of research, volumes like ARPC are indispensable. I am glad I got the opportunity to update myself by reviewing ARPC 1998.

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