REVIEWS

The Dictionary of Scientific Biography. Published by Charles Scribner's Sons, N.Y. (1970—). $ 35 per volume.

What was common among Chu Shih-Chieh, Eduard Cech and David Hilbert ? They were all mathematicians. What was common among Thomas Cooper, Benjamin Brodie and Profulla Rây ? They were all chemists ? What was common among James Croll, Ferdinand Broili and James Hutton ? They were all geologists. What is common among all these people ? They are all part of international community which has, over the centuries, reflected upon the nature of our physical world and contributed by their efforts and talents to the growth and development of scientific knowledge. The devotees of science are fast increasing in number and variety. The bulk of their works lie scattered in technical journals, textbooks and in treatises. Details on their personal lives and influences may be found in biographical sketches, critical studies and in private correspondences. Would it not be useful to have a single source from where to get relevant informations on the life and works of the innumerable investigators who have left their mark on the scientific enterprise ?

The Dictionary of Scientific Biography (*DSB*) is the affirmative answer to this question. For it is an attempt to bring between the covers of a set of tomes the life and impact of all those who have contributed in some perceptible measure to the scientific adventure, ancient and modern. It is an impressive undertaking, commendable as a concept and gigantic in scope. Clearly it is too vast an enterprise to be handled by one or two pandits. Hence the editorial board for the project—which was launched in the mid-sixties under the direction of Professor Charles C. Gillispie—has tapped the erudition and expertise of scholars from all over the world. An illustrious panel of consultants from several centres of research and study from many nations has added prestige to the project which is under the auspices of the American Council of Learned Societies.

The idea of such a biographical dictionary is not entirely new. The earliest work of the kind was probably Konrad Kesner's *Bibliotheca Universalis* which was published in Zurich between 1545 and 1549. A biographical dictionary devoted to a single profession —if profession it can be called—appeared in the seventeenth century when the Bollandists brought out the *Acta Sanctorum* which was a compilation of the lives and doings of all saints and martyrs. Pierre Bayle's *Dictionnaire historique et critique* (1696) resulted from the researches and labours of a single individual, and is a classic in itself. And during the nineteenth century national biographies began to appear. Today most nations have biographical compendiums of their eminent sons and daughters.

But the *DSB* is the first internationally authored work of this kind. Its contributors are generally those who have devoted their interests and talents to history of science as a professional discipline. The articles are therefore based on considerable scholarly research. At the same time, in an effort to bring the work within reach of a wide audience the scientific discussions are kept at a reasonable minimum without unduly sacrificing a meaningful analysis of the role played by the subject in the evolution of science. It is easy to express oneself in unadulterated technical jargon or to slip into over-diluted popularisation, but to strike a golden mean between the two extremes is a rather difficult task. But most contributors to the *DSB* have succeeded very well. There are certain instances, especially those related to mathematicians —the article on Cauchy would be a good example—, where a certain amount of technical mathematical background is indispensable for an understanding of the article.

Although certain elements of uniformity may be detected in the various presentations the styles of the articles form a large spectrum : from the very fascinating and readable to the more directly factual and informational. Thus the articles on Airy and Ampère are far more interesting than some others. But the purpose in each case is to give the reader an insight into the scientific contributions of the subject considered, the influences he suffered and exerted, and some interesting biographical details.

A work resulting from the combined scholarship of such a variety of authors is bound to be wholesome and reliable, but it may also be expected to embody the personal leanings and views of its authors which may not all converge on certain issues. Even with the most determined effort at objectivity a historian may find it hard to eliminate personal bias totally unless he is merely listing dates and facts. Thus the article on Robert Boyle notes that the quantitative relationship between the volume and pressure of a gas is "rightly called Boyle's law." (Vol. II, p. 277). We will have to wait for the article on Richard Townley to see whether its author agrees with this assessment. The article on Aristarchus states that Copernicus "deliberately supressed a statement acknowledging his awareness of Aristarchus' theory" because of his "disappointment at being anticipated by Aristarchus." (Vol. I, p. 248). However, in the article on Copernicus (Vol. III, p. 402) we find a different interpretation for this. There we are informed that "Corpernicus had no desire to inform or remind anybody that the fervently religious head of an influential philosophical school had 'thought that the Greeks ought to bring charges of impiety against Aristarchus.' "

The panel of consultants does not include any scholar from India although Indian science has certainly not been neglected. Because of the lack of adequate historical data on the lives of classical Indian scientists the biographical format has not been adopted in cases like Aryabhatta and Brahmagupta. In such instances no more than a list of their important works is given, along with a reasonably

complete bibliography. Professor David Pingree of the University of Chicago, whose knowledge and erudition in the field is well recognized, has given brief accounts of classical Indian men of science, and the editors promise "a series of essays (from Pingree's pen) giving accounts of the several schools and traditions to which they belonged." This situation reflects the need for greater exploration (of the scholarly and scientific variety) into original sources for increasing the amount of biodata currently available on classical Indian scientists. Alas, much too often myths are mingled with matters of fact in many instances of past Indian scientists.

Contrast this with classical Greek science. This field has been so thoroughly explored that three different sections, authored by three different scholars, are devoted to Aristotle ; and they cover in all over sixty columns. Archimedes, occupying over thirty-six columns, is the subject of another impressively long article. Even granting the enormous influence of these intellectual giants this circumstance is also a reflection of the magnitude of scholarly investigations that have been devoted to them. On the other hand, Dasabala, whose name does not even include an approximate year of birth, is followed by no more than the title of his two works ; and, as if to fill the fractional column devoted to him, chapter headings of the two books are also spelt out.

The lengths of the articles do not always reflect the scientific importance of the subjects treated. Thus the botanist Robert Brown (of Brownian motion) is accorded ten columns while Boerhaave receives less than eight.

Besides scientists proper (physicists, chemists, biologists, earth scientists, astronomers and mathematicians) some influential philosophers and science historians have also been included in the *DSB*. Thus one can find in these volumes articles on Bishop Berkeley and on Auguste Comte ; and so is the renowned medical historian Charles Creighton to be found here. In like manner future volumes will possibly include Paul Tannery and Emile Meyerson.

So far six volumes of the dictionary have come out of the press, covering scientists from Pierre Abailard to Joseph Hyrtl. Future volumes will appear in due course. Living scientists are not included.

In the years to come the *DSB* will undoubtedly serve the cause of science history. Besides the wealth of information and insights that it embodies it is also a well designed bridge between the world of the professional science historian and that of the average educated person who may be interested in aspects of scientists or science history. It is bound to inspire many to pursue such an interest, and the detailed bibliography appended to each article will certainly be helpful to many. The *DSB* should be considered an indispensable item in any public or institutional library.

V. V. RAMAN

A History of the Kerala School of Hindu Astronomy by K. V. Sarma, published by the Vishveshvaranand Institute of Sanskrit and Indological Studies, Panjab University, Hoshiarpur, 1972, xiv+205 pages. Price Rs. 20-00.

The view that the study of astronomy and mathematics in India stagnated after Bhāskara II has long ceased to be taken seriously. The post-Bhāskara II period witnessed remarkable efforts in producing excellent commentaries on astronomical and mathematical works by masters of previous centuries, an unmistakable evidence of a lively and continued interest in a difficult area of exact science. Yet the period did not remain entirely preoccupied with the production of secondary literature and occasionally witnessed men of considerable mathematical ability and insight into astronomy, making original contributions to Hindu astronomy. Already in the 18th Century, the existence in South India of a powerful tradition in astronomy had been noticed by European astronomers such as Le Gentil, Warren and others who compiled works on Hindu astronomy on the basis of oral information. In 1835, C. M. Whish reported on four manuscripts from Kerala, e.g. the *Tantrasaṃgraha*, the *Yuktibhāṣa*, the *Karaṇapaddhati* and the *Sadratnamālā* and worked out the rationale of the Hindu quadrature of the circle on the basis of rules given in these works. These studies had long ago suggested a thorough and systematic survey of astronomical and mathematical manuscript materials deposited with the libraries of Kerala and other places in South India. It is gratifying that Dr. K. V. Sarma has carried out this important survey long overdue and presented his results in the form of a book under review.

The work has been divided into six chapters, the first four being devoted to an estimation of Kerala astronomy and astronomers and the last two to a bibliography of Kerala *Jyotiṣa* literature and a bibliography on Kerala-based *Jyotiṣa* literature. These two bibliographies comprise more than half of the book and obviously constitute the most important chapters in as much as these present the results of the author's survey of manuscript materials and some secondary studies on them. The entries have been made alphabetically in which the names of authors and the titles of manuscripts appear, the manuscript references, e.g. the place of deposit, number, etc. being noted only against the manuscript title. There are however small omissions like the '*Aganitagrahacāra*' of Mādhava (p. 85) has not been entered under Mādhava (p. 151).

Of the first four chapters giving a general estimate of astronomy in ancient and medieval Kerala, the first one deals with some of its salient features, e.g. the adherence to the system of Āryabhaṭa, the development of the *kaṭapavādī* system of notation for expressing numbers, Haridatta's *Parahita* system and Parameśvara's *Dṛk* system. The second chapter entitled 'Anticipation of modern mathematical discoveries by Kerala astronomers' deals with longitude corrections due to planetary latitudes, Newtonian—Gauss interpolation formula upto second order, Taylor series for sine and cosine function, and π-series on the basis of rules quoted from

the works of Mādhava, Nīlakaṇṭha, Acyuta Pisāraṭi and others. In some cases, original texts and their English translations have been given. These topics which constitute the most important features of some of the works produced in medieval times should have received a fuller treatment with emphasis on historical development. The third chapter deals with major trends in *jyotiṣa* literature as developed in Kerala, e.g. the popularity of the classical texts such as the *Āryabhaṭīya*, *Mahā-* and *Laghu-bhāskarīya*, *Līlāvatī*, *Sūryasiddhānta*, *Laghumāuasa* and some of the astrological works of Varāhamihira and Śrīpati, and consequent production of commentaries on them ; new types of *Karaṇa* works aimed at giving improved results; and some special areas of astronomy forming the subject of several small tracts.

Special importance attaches to chapter IV giving particulars of over eighty authors of astronomical-mathematical texts as could be identified. Compiled from the manuscripts, these particulars needs must be sketchy, but in the circumstances useful. Only the necessity of including anonymous cases where nothing more is known than that the person was a disciple of such and such astronomer, is not understood.

The book bears evidence of a painstaking search, spread over many years, through manuscripts deposited at the Kerala University, Oriental Research Institute, and Mss. Library housing the Trivandrum collection, and at other places and through important manuscript catalogues. Dr. Sarma deserves every praise for his attempt to focuss attention to the astronomical efforts of the Kerala School during ancient and medieval times.

S. N. Sen
A. K. Bag

1. *Folk Medicine*. pp. xxxii+228 Price Rs. 60. 2. *Indian System of Medicine*. pp. vi+260 Price Rs. 60. 3. *Yogic and Tantric Medicine*. pp. xvi+176 Price Rs. 60. These three books, forming volumes III, IV and V of the "History of Science and Technology in India" series are written by Dr. O. P. Jaggi and published in 1973 by Atma Ram & Sons, Delhi.

While all the three 'medicines' have, as their general object, the maintenance of good health, the difference between them may be stated, more or less in the author's own words, somewhat as follows : 'The first and the second deal with means to bring back the sick man to health, though the systems of treatment are fundamentally different. The Yogic system deals with practices or physical processes which ensure healthy longevity. The Tantric practices are intended to make the human body 'immortal and undecayable' through the use of mystical or physical *amṛta*, the elixir'.

The first book deals with the oldest and most primitive form of notions for curing physical ailments. Though called *Folk Medicine* it can be hardly called

'medicine' in the sense in which we use the word normally. The most primitive people in India, as elsewhere, entertained superstitious ideas that diseases were caused by the "wrath of gods, evil spirits, magic witchcraft, etc.",and so "the treatment is based upon removal of the causative factor through the propitiation of gods, exorcism, counter-magic, use of charms and amulets, and, of course, administration of some herbal preparations".

There are clear references to this in the *Atharvaveda*, and the author has dealt with the various practices in vogue from that remote period down to the present time. The author quotes the following passage from the *Atharvaveda* (II, 9 3): "There are hundreds of medical practitioners and thousands of herbals, but that which could be achieved by a collective effort of them all, could be done singly by a charmed amulet".

The reference in the footnotes is evidently wrong, for there is nothing like it in the Whitney's translation of the *Atharvaveda*. There is, however, no doubt that there are many references in the *Atharvaveda* to the treatment of this type with full approbation.

The author has discussed in detail the beliefs and practices prevalent among the tribal peoples even now. But it is difficult to accept the view that 'more people in India believe in Folk Medicine than all the other systems of Medicine taken together" (Preface).

The second book, *Indian System of Medicine* deals with the wellknown Āyurvedic system prevalent today all over India. The author traces its origin and antiquity, describes the vast literature on the subject, and discusses in some detail the Medical Education, Personal Health, Public Health, Anatomy and Physiology, as well as cause, classification, diagnosis and prognosis of diseases and their treatment. Special interest attaches to the author's treatment of Surgery (including a description of surgical instruments), Toxicology, Medical Jurisprudence and Veterinary Medicine, because the practitioners of Āyurvedic system today are not generally known to be efficient in these subjects. The book concludes with a general review of the relation between medical system of India and that of Greece and the Arabian world.

The author has given evidence of critical judgment which is not unoften missing in treatises of this kind. He has for example, referred to the traditions of the devine origin of Āyurveda system, but has justly described them as mere stories such as were current among other ancient peoples like the Greeks and Egyptians. It would perhaps have been better if he had omitted the illustrations of the popular tradition by means of images of Brahmā, Aśvin twins, Dhanvantari, Indra, etc, as these are likely to be taken as evidences of the historical character of the tradition. The true critical spirit is not, however, shown in his dissertation on the historical origin of the systematic treatment by medicine on pp. 4-6. It is difficult to understand his conception of the spread of Indian civilisation, particularly its "Himalayan

Origin" and "the introduction in the doab of a more advanced culture—complex of the mid-Himalayas" (p. 5). His acceptance, as authority, of the observation of Dwarakanath about the seminar presided over by Punarvasu Ātreya, the disciple of a disciple of God Indra, is hardly in keeping with the critical spirit shown in dismissing the mythical origin of Āyurveda as story.

While the author has discussed the influence of Āyurvedic system on that of Greece and Arabian world and referred to the opinion of foreigners (pp. 207-37), he might have added its prevalence in Cambodia, particularly as the Sanskrit inscriptions from this region with known dates, refer to details of Āyurvedic medicine and hospitals of which we have no information from Indian sources. This is all the more regrettable because the author has traced the origin of the concept of hospitals to the Persians and its introduction into India by the Muslim conquerors in the 13th and 14th centuries A.D. (pp. 217-18). There are, however, at least nine Sanskrit inscriptions of king Jayavarman VII (1181-C. 1218 A.D.) (each in 48 to 50 verses and 98 lines of writing) which give details of hospitals—specially the requirements of food, medicine medicinal plants etc. This king is said to have established no less than 102 hospitals. As the entire civilisation in Cambodia and neighbouring countries was derived from Indian colonists and there was constant communication between India and these regions, it may be easily presumed that the idea of the hospital was carried to South-east Asia along with the Āyurvedic system to which, and particularly to Suśruta, reference is made in the inscriptions of Cambodia. There can be little doubt therefore that the hospitals existed in India long before the Muslim invasions in the 13th century A.D.

The third book, the *Yogic and Tantric Medicine*, as mentioned above, deals, not with medicine proper, but with Yogic and Tantric principles and practices which ensure, respectively, sound physique, and immorality. Part one describes, with illustrations, many Yogic *āsanas* (postures) and *kriyā* (practices) and their therapeutic efficacy as well as Yogic anatomy and physiology.

Special chapters are devoted to *prānāyāma* and its medical significance, *samādhi* and its physiological significance and comparison with the Chinese Taoist Yoga showing similarity in practices, procedures and concepts.

Part Two begins with an account of the evolution of Tantrism, both Hindu and Buddhist, which lays stress on the importance of human body. This is described as follows:

"According to tantrism, there is nothing in the universe which is not present in human body. There is a perfect parallelism between the physical processes of the universe and the biological processes in the body of man. The sun, the moon, the stars, the important mountains, islands and rivers of the outer world are represented within the human body. The time-element of the universe, in all its phases of day and night: fortnight, month, and year have often been explained with reference to the course of *prāṇa* and *apāna*.

"Different *cakras* and *nāḍis* represent different *tattva*. But the *tattvas* represented by them lie latent, until they are made potent through proper yogic culture and control." (p. 122).

The author describes how this mysticism was carried to its logical conclusion by the *Nātha Siddhas*, while the *Rasa Siddhas*, akin to them, turned their attention to alchemy. "The *Rasa* (sic) or *pārada* (mercury)", according to them, is believed to be vested with mysterious capacity of tansforming a base metal into gold and thus by constant rejuvenation, and invigoration, through a process of transubstantiation, the *rasa* can make every creature immortal. It has been said that *rasa* is called *pārada* because it leads one to the other shore of the world. It is the quintessence of Lord Śiva. The *rasa* is again said to be the seed of Hara (i.e. Śiva) while *abhra* (mica) is the ovum of Gauri. The substance that is produced through the combination of the two elements makes creatures immortal". (p. 125).

The author gives a long list of the Tantric texts with a short account of each and thus sums up their contents. "They describe mercury and its preparations, procedures about turning other metals into gold, mineral compounds, salts and alkalies, procedures and instruments meant for keeping the body healthy and undecayable, etc." (p. 138).

This part ends with a detailed account of Alchemy and refers to some alchemists, including the famous scholar Nāgārjuna, the great popularity of Tāntric medicine, and a comparison of Indian alchemy with that of China, Arabian world and European countries.

These three volumes are valuable additions to the history of Science and Technology in India. The author is to be congratulated upon making available to general readers short accounts of an important aspect of ancient Indian culture.

The printing and get-up of the volumes are quite good. Unfortunately, there are number of printing mistakes. But still more serious defect is the method of transliteration followed by the author in a very haphazard manner. He gives diacritical marks to indicate long vowels *ā*, and ū, but not ī or ṛ, and the consonants are left without any diacritical marks. There are many errors even in this restricted [redacted]. This is a serious flaw in the otherwise well-written books.

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