

The list of references is quite exhaustive. It presents at one place some of the publications of Indian geophysicists in the applications of geophysical methods.

This book is recommended not only to every student of geology, but also to the practising geophysicists in India for their general guidance and reference. The book highlights Indian field examples and the important results obtained therein with the help of geophysical methods over a span of thirty years. Shri M. B. Ramachandra Rao has rendered a great service to the community of Indian Earth Scientists by providing an introductory volume in an area which is comparatively new in our country and where books by Indian authors giving Indian examples are non-existent.

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THE MINERAL AND NUCLEAR FUELS OF THE INDIAN SUB-CONTINENT AND BURMA. By J. Coggin Brown and A. K. Dey, Oxford University Press, Delhi. pp. (i-xix) 517, 1975, Rs. 240/-

There has been stupendous progress in the Development of Mineral resources in India which has now gained a more respectable position amongst the many countries of the world as regards resources of petroleum and nuclear fuels, quite apart from those of several other important minerals for which India has long been famous. A large volume of literature on the scientific and economic aspects of these developments lies scattered in numerous reports, official records and some papers published in journals or periodicals of scientific societies. One has to wade through a multitude of such reports in order to obtain authentic information on the geological occurrence, reserves, production, processing and utilisation of these minerals. In the currently available text books on Indian Geology, the information given on the economically important minerals is very brief and elementary. 'India's Mineral Wealth' by Coggin Brown and Dey, published in 1955, has been long out of print. The book under review is the first one to deal exclusively with the mineral and nuclear fuels, and it may be hailed as a boon to students of Geology and Geologists and others interested in coal, petroleum and atomic energy minerals. The foregoing minerals are dealt with in three sections and each section in two parts: an introductory portion giving succinctly the general aspects such as origin, chemical constitution, utilization etc., and a descriptive portion giving in detail the geological conditions of individual fields or deposits in India, Pakistan, Bangladesh and Burma.

The first section on Coal, (including lignite and peat) comprises 15 chapters, of which 10 form the introductory part. The chapters on the origin, petrography, chemical constitution, and classification of coal are written lucidly and include the gist of a large volume of literature on these aspects. The processes of gasification and synthesis of petroleum are explained, pointing out the results of researches carried out in India and abroad. The figures of reserves of coal given, viz. 118,004 million tonnes, (of which 23,612 million tonnes are of coking grade suitable for metallurgical plants) in India are as on 1-7-64 i.e., more than a decade prior to the publication of the book. The annual production of coal in India in 1951 was 35 million tonnes; it increased to 70 million tonnes in 1965. After nationalisation

of the coking coal mines in 1971, and of the non-coking coal mines in 1973, the total annual production now has gone up to over 90 million tonnes.

The descriptive part relating to individual coal fields is covered in 5 chapters, the fields being grouped according to geological age: the Tertiary coal fields and lignite deposits, the Lower Gondwana Coal fields, and finally the peat deposits. Details regarding the geology and description of the various seams and the development and mining work carried out are given in a systematic order.

The second section on Petroleum forms almost half of the book. There are 8 chapters in the introductory part dealing with such aspects of general interest as chemical composition, origin and migration of petroleum, geochemical and geophysical prospecting, mechanics and conservation of reservoir energy, and lastly the role of the Geologist in petroleum exploration, development and production. Students of petroleum geology will find in all these chapters very useful information. The reviewer feels that in respect of geophysical prospecting, certain observations regarding gravity method are hardly apt. For instance, it is stated (p. 212) that 'gravity surveys in India have had disappointing results'. The authors cite two cases, in Sind and Assam, where the gravity anomalies did not correspond exactly with summit of the anticlinal structures noted in seismic surveys. Although the gravity method may not furnish indications precise enough for outlining a structure, it can draw attention to promising localities at comparatively low cost for starting the more expensive seismic investigations and drilling in virgin areas. As a matter of fact, the gravity highs found in the two cases cited (as also in Cambay and Anklesvar areas) did draw attention for carrying out seismic investigations with good effect. The inherent limitations of magnetic and gravity methods do not militate against their use in petroleum exploration as these methods are used essentially for reconnaissance. It is not a question of gravity *VS* seismic, but gravity cum seismic methods. In all modern exploration, the emphasis is on integration of data obtained by different geophysical methods for achieving more useful interpretation and successful results. The authors would have done well if this aspect had been emphasised.

Part II comprises descriptions of the individual oil and gas fields. The geological features of the several sedimentary basins, as also of each of the individual fields are explained in considerable detail, pointing out the correlation of various formations both in the Indian stratigraphic and International nomenclature.

The results of exploration carried out in India have been summarised, giving the various views which have been expressed regarding the petroleum prospects. Detailed accounts have been furnished of the several producing fields like Anklesvar, Kalol, Nawagam etc., in the Cambay basin, and Digboi, Nahorkatiya, Moran, Rudrasagar fields in Assam.

The annual production and reserves of petroleum in various countries of the World for 1968 are given in appendix 3, p. 462. India had an annual production of crude oil to the extent of only about 2 million barrels at the dawn of Independence; it increased to 44 million barrels in 1968 and 52,914 barrels in 1973. The production was over 60 million barrels during last year. The reserves noted in 1973 was 891 million barrels. However, with the discovery of a few more fields in Assam and also of the Bombay High the reserves presently would perhaps be much higher,

nearly double the quantity given for 1973. Progress in petroleum exploration and development in modern times is so rapid indeed that in the duration between the writing of a book and its publication much could happen, and figures of reserves and production get outdated. This is a handicap that will loom large particularly when the publication gets much delayed for one reason or the other. Nevertheless, the authors have done well in referring to some of the recent developments in the postscript to the preface. Another important event which might have been mentioned is the abnormal hike in crude oil price in 1974. It increased India's burden of foreign exchange to more than Rs. 1000 crores, compared to the former outgo of Rs. 150 crores per annum for import of oil.

The third section of the Book dealing with Nuclear Fuels consists of five chapters. The introductory chapter gives a brief historical account of the developments leading to the production of atomic energy. This is followed by description of Geiger Muller and Scintillation Counters for surveys to explore for radioactive minerals. Gamma ray Spectrometer which has come into greater use could also have been dealt with in some detail as this instrument provides high sensitivity spectral analysis of energy levels in natural radiation from the ground, and records the activity levels of uranium, thorium and potassium and also of total radioactivity separately.

Two chapters are devoted to detailed accounts of uranium and thorium minerals. The uranium ores in India are mostly of low grade, while those of thorium are rich and abundant. The world distribution of uranium and thorium and the geological features of the many occurrences of these radioactive minerals in India are given together with brief notes on mining and treatment of the ores. India ranks sixth amongst countries having workable resources of uranium, while she is first amongst the few countries having workable resources of thorium. If a suitable process is developed to utilise thorium as nuclear fuel, India's capability to produce atomic energy can be vastly increased. Experimental studies are in progress in the Bhabha Atomic Research Centre.

To sum up, the book forms a valuable compendium on the resources of coal, lignite, peat, petroleum, and of uranium and thorium ores. Most of the known facts about these minerals in India and her neighbouring countries have been ably marshalled. The book is amply illustrated with excellent text figures, maps, sections, charts and tables and a few photographs. The authors (particularly Dr. Dey, who after the demise of his senior collaborator as far back as 1962, bore the brunt of writing and completing this book) deserve to be congratulated. The printing and get up is very good. The price, Rs. 240/- however is very high and beyond the means of students who might otherwise have been happy to possess such a book. May we hope that cheaper editions will follow in due course?

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