

BOOK REVIEWS

fought, young Kamen (then recently emigrated to USA) was dismissed on orders of the State Department from his position at the Lawrence Radiation Laboratory in California despite his great scientific achievements and sent to work in a salvage shipyard where unseaworthy vessels were dismantled – all this to ensure that he passed no secrets to the enemy. This section has several articles, including those by A. Benson and J. Bassham (both of whom worked with the Nobel Laureate M. Calvin). It is interesting and relevant also to have a photograph of the 'Rat House' where Ruben and Kamen worked, but somewhat unnerving to note that it is the grass in the foreground where Ruben collapsed after inhaling phosgene during his pioneering work (he died two days later). There is also an article by M. D. Hatch. It is the work of all these investigators and their colleagues that led to the discovery of the C₃ and C₄ pathways of carbon dioxide reduction. Special mention may also be made of the contribution of S. G. Wildman, who, with J. Bonner (one of my professors) discovered the Fraction I protein, later identified as Rubisco and for which they built their own Tiselius-type moving-boundary electrophoresis apparatus in the basement of Division Chemistry (then headed by L. Pauling) and adjoining the Division of Biology.

The sections on 'Genetics' and 'Evolution' complete the core of the book. In the 'Genetics' section, there is an excellent chapter by late L. Bogorad of Harvard (I was privileged to work with him too for some time) who pioneered work on isolation of photosynthetic genes employing the recombinant DNA technique. Work by groups of Bogorad as well as R. Herrmann (though there is no article by him, his photograph does appear in one article) has been of the greatest importance – since it is only after genes were isolated, that the putative amino acid sequences of key proteins could be obtained and the final assault begun, i.e. work on the deduction of three-dimensional architecture of the photosystems, the RCs, and the remaining machinery comprising cytochrome-plastocyanin and the ATPase complexes.

Additional sections, one on 'Laboratories and National Perspectives', another on 'Retrospectives' with useful lists compiled by Govindjee on symposia and books on photosynthesis and finally on 'In Memoriam' comprising a list of in-

vestigators of photosynthesis with dates of birth and death, complete the book supplemented by extensive indices of authors, as subject matter, as also of all the pictures.

To conclude, Govindjee and his colleagues are to be congratulated for preparing this extraordinary book, indeed without a parallel. Of course, their task was somewhat lightened by the fact that Govindjee has long been associated not only as an Editor of *Photosynthesis Research*, but even as a Chief Editor. Nonetheless, this collection would have been impossible without the support of his colleagues (especially Gest), his own deep commitment to the spread of knowledge and intimate personal knowledge of all investigators. Emerson and Rabinowitch were icons of photosynthesis research, and their laboratory was a Mecca where a constant stream of luminaries undertook pilgrimage. Govindjee has thus known the pioneers in photosynthesis research from 1950s. And, it is because of his love for history that the stories of a whole generation of researchers and of their travails and successes have been preserved for posterity. But for him, we may have lost this valuable treasure trove of information and we, in India, are especially proud of this notable achievement.

I wish Govindjee's example (of work on this book) can be emulated by others in plant biology, especially plant growth, development and morphogenesis, where Linda Sage's *The Pigment of Imagination* is currently the only relevant book (though excellent, it portrays the history of development of only phytochrome and thus is limited in scope). Hopefully, Govindjee's effort will inspire others to record major advances of our science in the last century, before it is too late.

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Special Issue on Proceedings of International Symposium on 'Applied Geochemistry in the Evaluation and Management of Onshore and Offshore Geo-resources'. K. Surya Prakash Rao and V. Divakara Rao (eds). Indian Society of Applied Geochemists, 2006. Price: Rs 300.

The Indian Society of Applied Geochemists (ISAG) has brought out the Proceedings of International Symposium on 'Applied Geochemistry in the Evaluation and Management of Onshore and Offshore Geo-resources' held during 28–30 September 2005 at Atomic Minerals Directorate for Exploration and Research (AMD), Hyderabad, as a special issue of the *Journal of Applied Geochemistry* (JAG; 2006, **8**). The editors are to be complimented for their efforts in bringing out the volume within a short period. The volume contains thirty-eight papers – nine on evaluation of petroleum source rocks and sedimentary basin with greater emphasis on geochemical studies, five on Coal Bed Methane (CBM), thirteen on ferrous–non-ferrous minerals, three on geochemical studies of onshore areas, seven on groundwater and pollution and one on air pollution.

D. K. Pande in his keynote paper has discussed the importance of geochemical studies for getting clues on the generation, migration and evaluation of oil and gas. He opines that great thrust has to be given for exploration and exploitation of CBM as it is going to be an alternate source of energy. In this regard, the role of ISAG is important in designing programmes for training professional geochemists in the search for CBM (p. 233). S. Pahari *et al.* have evaluated the petroleum source rocks of Mesozoic and Tertiary deposits of Cauvery basin, Sattapadi, Kudavasa and Karaikal (pp. 234–250). G. C. Datta *et al.* have presented the results of geochemical investigation of several aromatic biomarkers in Bombay 'High' and Bassein of western offshore to evaluate the lithology, palaeoenvironment and thermal activity of source rocks (pp. 251–265). Minati Das has given an account of the influence of clay minerals on hydrocarbon potential in the Jorajan, Assam basin (pp. 266–276). A case study of absorbed gas concentration survey in the Kutch–Saurashtra offshore is presented by D. K. Singh *et al.* Two prospects for hydrocarbon have been identified based on positive indication of threshold values

(pp. 277–287). D. Vyas *et al.* have given an account of geochemical and geological studies to predict the nature of sub-surface hydrocarbon for exploration in Cauvery and Krishna–Godavari basins (pp. 288–298). S. R. Mangotra *et al.* have discussed the results of geochemical studies of hydrocarbons in Ramnad–Palk Bay sub-basin, Cauvery basin which are aimed to understand the genesis, exploration and migration of gaseous hydrocarbon (pp. 299–319). Rakesh Sharma *et al.* have discussed results of twelve major and trace elements. Higher concentrations of Cu, Ni, Zn, Fe, Li and K are reported for the areas of Bokabil and Middle Bhuban of the Agartala dome structure, and a good correlation is found between lithostratigraphic and chemostratigraphic units (pp. 320–331). A. K. Bhatnagar *et al.* have given an account of geochemical characters vis-à-vis oil source south of Cambay basin (pp. 332–358).

CBM generated during coalification process gets entrapped within the pore space. This has been recognized as an alternate source of energy in the coal-bearing countries of the world. India, with vast resources of coal, has initiated exploration of CBM and commercial production of gas is yet to begin. S. C. Das Gupta's paper deals with the exploration and resource evaluation of CBM in India. Methane in the coal bed is dependent on thickness, degree of coalification, depth of occurrence and permeability. Direct measurement of methane in the GSI borehole has indicated gas content of 0.14 to 12.7 cubic metre/ton (pp. 359–365). Shankar N. Chaudhuri *et al.* describe the depositional environment of coal in the Ramkola–Tattapani coalfield vis-à-vis CBM. Although the rank character of coal is not encouraging from the CBM point of view, better rank is expected at deeper parts of the basin, as favourable petrographic compositions of coal seams are characterized by thick vitrite bands (pp. 336–375). Anil M. Pophare and Abhay M. Varade have studied petrographic and chemical properties with the methane adsorption isotherm of five coal seams of Sawang area, Bokaro coalfield, which indicate that vitrine maceral shows highest adsorption capacity of CBM in pores < 2 µm size. The coal seams show good adsorption of methane gas (pp. 376–393).

Two papers deal with the pollution/toxic aspects of arsenic, mercury and flyash association with the coalfields. One at

Raigarh coal field, Chhattisgarh by Amit Kumar Ray *et al.* (pp. 394–396) and the other by M. V. Subba Rao *et al.*, who have suggested the utilization of toxic flyash at VTPS, Vijayawada for road metal, in ceramic tiles, and brick-making instead, leaving them as waste product, thus avoiding environmental pollution (pp. 397–400).

A theoretical paper on 'Growing acceptance of applied geochemistry – Focus on marine resources like gas hydrates and hydrocarbon', a future energy resource was presented by Pranaya Sangvai as a keynote address. The role of ISAG in the exploration efforts is also discussed. Gas hydrates, a marine resource, are stabilized gas molecules surrounded by a cage of water molecules and the concentration contains great volume of methane. In this context, the potential of the hydrates in the Arabian Sea and Bay of Bengal was discussed (pp. 401–406). C. Jayaprakash *et al.* have discussed the results of temporal variations of major oxides, carbonate and trace elements around Kavaratti Island, Lakshadweep, collected from the five gravity core samples of length 1.69 to 1.93 m at a depth of 1747 to 2083 m. The carbonate content varies from 29.98 to 17.49% (pp. 407–416). P. Martin Deva Prasath *et al.* have given an account of distribution of heavy metals before and after the tsunami at Tharangampadi, southwest coast of India. Good accumulation of heavy metals is noted after the tsunami (pp. 417–422).

V. Venkateswara Rao has presented a keynote paper on the Indian scenario of ferrous and non-ferrous minerals. He has described the different metallogenetic provinces and hoped that the nation-wide geochemical mapping may lead to more discoveries (pp. 423–429). Anil M. Pophare *et al.* have discussed orogenic modeling of tungsten mineralization at Kuhl–Khobana–Agargaon belt, Nagpur district, Maharashtra. The genesis of mineralization is attributed to metal-bearing hydrothermal fluids, which might be generated due to intrusion of tungsten-bearing granitoids into Sakoli meta-pelites, while CO₂ played a major role in mobilization of tungsten (pp. 430–440). V. Balaram, in his paper on exploration for Platinum Group Elements (PGE) in peninsular India, has discussed the status, problems and scope of an economically viable deposit. In this context, the importance of detailed geological, petrological and geochemical studies are emphasized (pp. 441–457). Prabhakar Sangurmath has

given an account of results of a geochemical study of the alteration zones of Buddini gold deposits in Hutti–Maski greenstone belt, India and conditions required for the mobilization and migration by diffusion into the host rock (pp. 458–470). Abhijeet Mukherjee and G. Prabhakar have discussed the evidence of aqueous, low-salinity CO₂–H₂O fluid in the gold deposit of late Archaean greenstone (pp. 471–474). K. T. Vidyadharan and K. Paliappan have suggested a few target areas for PGE mineralization from the study of mafic–ultramafic and related rocks in the southern Indian shield (pp. 475–500). S. N. Siddiquie *et al.* have presented the results of remote sensing, Helimag survey and stream sediment carried out in Kalyandurg and known kimberlitic areas of Anumpalle, Dibbasanipalle, Venkatapalli and Pamidi, Anantapur district, Andhra Pradesh (AP). The survey has helped in demarcating the known kimberlite bodies (pp. 501–509). C. R. M. Rao in his paper on 'National geochemical programme', has stressed the importance of adoption of uniform analytical methodology by all the organizations for proper correlation. The instruments should have higher detection limits of trace and ultra trace-elements from the crustal values (pp. 510–521). Burra Subrahmanyam has suggested a conceptual model for the search of kimberlites in AP from the study of different station intervals of gravity data with emphasis on structural elements that control the emplacement of kimberlites, viz. mantle upwarp, crustal faults, junctions of trends/faults and granite body (batholith?) (pp. 522–526). G. S. Ravi *et al.* have given an account of X-ray fluorescence spectrometric technique for evaluating monazite and zircon in onshore and offshore areas (pp. 527–535). Madian Jamil Safi *et al.* suggested a method for beneficiation of phosphate ore from the eastern mine 'A' in Syria. The method helps to reduce the chlorine content, while the CaO/P₂O₅ ratio helps in selecting the suitable process based on the composition of phosphate ore to be treated (pp. 536–545). G. Parthasarthy reports on the moganite (a novel silica polymorph). The detailed mineralogical study of amygdaloidal minerals of the Killari borehole in Deccan basalt reveals that the moganite is stable up to laumontite zone. These studies also indicate two distinct geological formations in the borehole cross-section (pp. 546–557). R. Dhana Raju has discussed the geo-

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chemistry of peninsular gneiss and closepet granite in Rayachoti area, AP and their implication on the concept of age-zonation of peninsular gneiss with Dharwar craton and Dharwar batholith (pp. 558–577). V. I. Malkovsky and A. A. Pek have discussed the results of injection into deep underground aquifer for disposal of liquid radioactive waste on the industrial scale (pp. 578–588).

V. Sambasiva Rao *et al.* have given an account of quality of groundwater in AP. The survey indicated high electrical conductivity, nitrate and fluoride. Telangana region has highest incidence of fluoride (25%), followed by Rayalseema (9%) and the coastal region (8%). Prakasam district has the highest incidence of fluoride (37%; pp. 589–603). A case study on potable water in and around Damarcherla, Nalgonda district, AP infected by fluoride is presented by R. V. Singh *et al.* (pp. 604–617). A. G. S. Reddy and P. N. Rao have studied the genesis of fluoride in and

around waters of Wailpalli watershed in Nalgonda district, AP. The analysis of groundwater indicates a potential health hazard with 2.79 mg/l fluoride content and the high incidence is due to structural disturbance and intense weathering and high evapotranspiration together with leaching of fluoride in high concentration in the country rock and soil of the area (pp. 618–630).

K. V. Ramani and D. Prasad have discussed the status of air quality and management in Hyderabad, AP. The studies revealed an increase in respiratory ailments and higher concentration of iron and copper in RSPM compared to other heavy metals due to an increase of vehicles from 1992 to 1999 (pp. 631–637). Vi Nu Hoai Nguyen *et al.* have suggested a method using TiO_2 as the photocatalyst and formic acid for the treatment of selenium, which is an important pollutant at low concentrations and becomes toxic at high concentrations (pp. 638–649). P. K.

Das *et al.* have discussed the effect of Bharalu river-water pollution in the groundwater of Guwahati city. The results indicate a gradual decline in the quality of groundwater near the drainage channel of the Bharalu river. To make the city clean and green, the river bed course should be made free from all kinds of untreated-waste dumping and sanitary sewer leakage (pp. 650–655). J. Chapla and J. A. Kamalakar have studied the surface ozone concentration in Hyderabad, which is likely to increase with population of growth and consumption of fossil fuels in the coming years (pp. 656–660).

In conclusion, the volume is free from editorial and typographic errors and the wealth of information presented is of great value to all the earth scientists.

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