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BOOK REVIEWS

Qualitative Polarized-Light Microscopy. By P.C. Robinson & S. Bradbury. Oxford University Press. Distributed by Bios Scientific Publishers Ltd., St. Thomas House, Becket Street, Oxford OX1 1SJ, U.K. US$26.00 (softcover). ISBN 0-19-856410-4. (Royal Microscopical Society, Microscopy Handbook 09).

This thin, tightly written paperback is one of a series of twenty-five *Microscopy Handbooks* issued by the Royal Microscopical Society. Twenty-three have appeared to date, and three are already in revised editions. Most are of limited interest to mineralogists and geologists, but some are pertinent (see my review of no. 24 of the series, *The Preparation of Thin Sections of Rocks, Minerals, and Ceramics*: *Can. Mineral.* **31**, 1063).

Qualitative Polarized-Light Microscopy is written as an introduction for microscopists not familiar with the petrographic microscope. It is not designed for workers in our fraternity, and certainly is unsuitable as a textbook. For example: "Details of interference figures and the uses to which they can be put are beyond the scope of this handbook" (p. 25).

Five chapters conclude with exercises, many of which are novel and use such familiar materials as polaroid sun glasses, olive oil, potatoes, fishing line, polyester film (used to wrap food), plexiglass, and transparent tape. Particularly interesting is the use of a ping-pong ball to view interference figures (p. 24), and employing transparent tape to construct a "quartz" wedge (p. 85). Many of the exercises could be put to use productively by teachers of undergraduate optical mineralogy. As a geologist, I found concise and informative the final chapter, on differential interference contrast (Nomarski methods) in reflected and transmitted light. A concluding glossary is a good idea, but it could be expanded, and a few of the definitions are inadequate. The only typo that I caught is the curious spelling "pleiochroism" in three places.

In summary, this is a book to browse. Teachers should find several of the exercises stimulating and useful.

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Geochemical Thermodynamics (second edition). By Darrell Kirk Nordstrom and James L. Munoz. Blackwell Scientific Publications, Oxford University Press, 70 Wynford Drive, Don Mills, Ontario M3C 1J9, 1994. Cloth 493 pages, US$65.00 (ISBN 0-86542-274-5).

Thermodynamics has become an indispensable tool in the earth sciences during the past forty years; as a result, there has been a small avalanche of textbooks relating thermodynamics to earth sciences. These books fall, in general, into two classes. The first examines basic assumptions, development and models in thermodynamics, and, as space permits, applies the results to geological problems of interest to the authors. A recent example would be "Thermodynamics in Geochemistry" by Anderson and Crerar. The second class of book, of which "Geochemical Thermodynamics" is an outstanding example, accepts the foundations of thermodynamics and concentrates on applications, particularly methods of calculation. The first edition of this book was probably the single most useful reference for a geologist looking for methods of approaching practical problems, complete with warnings of pitfalls and useful bibliography. This second edition preserves the usefulness of the first while adding important new material on silicate melts, high-temperature behavior of electrolytes, retrieval of thermodynamic data from experiments, and their application to geothermobarometry and geochemical modeling.

The book commences with three brief chapters on fundamentals of thermodynamics. Few students will learn fundamental thermodynamics from these terse chapters, and the authors' "engineering" approach appears weakest here. The strength of the book starts in Chapter 4, with a cogent, concise review of the phase rule, chemography and Schreinemakers rules. Chapters 5-7 cover solutions including melts and solid solutions as well as electrolytes at both low and high temperatures. Virtually all theoretical approaches are covered and illustrated, but it would be necessary to dig into the bibliography in order to actually apply some of the formulae. Chapters 8-10 cover mineral equilibria, including the equilibrium constant as applied to solid–solid, solid–gas and solid–liquid (solution) reactions, chemical potential diagrams (including solubility and mineral stability diagrams) and oxidation–reduction reactions (including both low-temperature pε–pH diagrams, and calculations of fugacity at high temperatures). Chapters 11-12 treat measurements and estimates of thermodynamic data and extraction of self-consistent datasets. Chapter 13 introduces geochemical modeling, including available software. Appendices touch on activity relations for mixing of ions, reliable thermodynamic data for minerals (a surprisingly small set!) and sources of thermodynamic data. The coverage of each topic is terse and to the point, with well-selected, generally current bibliographic references. Each chapter concludes with a summary of the principal points, and a set of problems so that the reader can try out the techniques.

The appearance of the book is generally very good. A few formulae have been boxed, but there is no obvious pattern. A few figures reproduced from other publications are at a scale that makes it difficult to see the data points, and on some, I found the choice of fonts esthetically unpleasing. I found the "cartoons" neither funny nor informative. However, these are trivial drawbacks. In my opinion, this is the best single source of information on applications of thermodynamics to the earth sciences, with a reasonable balance between low-temperature and high-temperature applications. This is not a book from which to learn thermodynamics, but it is very definitely a book from which to practise thermodynamics. It would be particularly appropriate as a text for postgraduate students with a grounding in thermodynamics, and it will remain a standard reference for professionals using thermodynamics.

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Modern and Ancient Coal-Forming Environments. Edited by James C. Cobb and C. Blaine Cecil. Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. Special Paper 286, 1993, 198 pages, US$52.50 (soft cover). (ISBN 0-8137-2286-1).

The origin of Late Carboniferous, equatorial coals of Europe and North America has been debated for at least a century and a half. Because many coal geoscientists were most familiar with the peats in their own backyards, the search for appropriate modern analogues has often centered around the temperate to subtropical peats of the Mississippi Delta and eastern U.S. coastal plain. However, as long ago as 1913, David White pointed out that the most suitable modern analogues lie in unfamiliar, equatorial southeast Asia, where the world's largest tropical peatlands are located. The choice of an appropriate analogue is not merely a question of latitude, for many peats in ever-wet equatorial zones are nourished from rain rather than from groundwater, resulting in doming, nutrient deficiency and unusual vegetational zonation. Furthermore, the elevated temperatures of the tropics result in exceptionally high rates of productivity and decay of organic matter. Domed peats, raised above the level of groundwater influence and river or tidal flooding, can also provide an explanation for the remarkably low ash and sulfur contents of some economic coals. Until recently, however, tropical domed peats had received little study from a geological point of view.

In the late 1980s, geoscientists of the U.S. Geological Survey, the Kentucky Geological Survey, other U.S. institutions and the Indonesian Directorate of Mineral Resources worked together to obtain detailed information on Indonesian domed peats and associated organic-matter-rich and tidal sediments. GSA Special Paper 286 contains seven papers that resulted from this project or from related work. The papers document the geographic and historical setting of a set of domed peats (Cecil *et al.*), their geometry (Supardi *et al.*), their inorganic geochemistry, including analyses of ash, sulfur, major elements and pH (Neuzil *et al.*), their organic, mineral and biogenic constituents based on petrographic study (Grady *et al.*, Ruppert *et al.*), aspects of their sulfur distribution (Kane & Neuzil), and the detrital peats of the Mahakam River Delta (Gastaldo *et al.*). Backed up by radiocarbon dating, these studies provide a wealth of detailed information about the development of the peatlands during the past 5000 years (following stabilization of Holocene sea level), and certainly form the most comprehensive account to date of these important domed peats. The papers also show clearly that sea-level change and climate, rather than the dynamics of local rivers and deltas, were the fundamental controls on peat formation. Because the project was designed unabashedly to provide an analogue for some Carboniferous coals, the range of information presented is restricted to geological and compositional aspects of particular interest to coal geologists. The papers are detailed but readable accounts, and are well supported by maps, cross-sections and data tables (although field or aerial photos of the peatlands would have been helpful).

In a companion section, studies by Eble & Grady and Willard & Calder (the latter a study of the Springhill Coalfield of Nova Scotia) concern the application of domed-peat models to some Pennsylvanian coals, using petrographic, geochemical and palynological information. Although these workers suggest that domed peats were indeed progenitors of some coals and parts of coals, their studies highlight problems in drawing such an analogy: relating the organic components of peats to those of thermally matured, bituminous coals (especially the inertinite maceral group) is a difficult matter. All three papers draw heavily on palynological evidence in inferring the nature of the Pennsylvanian vegetation but, unfortunately, botanical comparison with the modern Indonesian peatlands is restricted by the absence from the volume of a detailed botanical and palynological study. The final paper by Archer & Kvale concerns the recent identification of tidal rhythmites in Late Carboniferous coal basins, and implies that a tide-dominated coastal setting (Indonesia) may be of broader applicability to these coals than prevailing deltaic models would suggest.

The book will be of considerable interest to professionals and students working in peat and coal, and I for one will be drawing frequently upon the information that it contains. The studies of modern peats are well complemented by those of ancient coals, which draw directly upon the Indonesian analogues. The title is, perhaps, a little misleading, as the papers deal only with a single peat-forming setting; there is, for example, no discussion of tropical peats elsewhere in the world, of peats in intermontane basins, of high-latitude blanket bogs or of the Gondwanan Permo-Carboniferous coals that formed in high-latitude settings. In addition, the emphasis of the volume might lead unwary readers to assume that most ancient coals formed from domed peats, although this is certainly not the case. Although the volume has no explicit economic application, mining geologists may find the book thought-provoking because of its excellent documentation of the geometry and technical properties of modern peats. Parts of the book form suitable background reading for graduates and advanced undergraduate students in sedimentary, mining or energy-related courses. In this regard, several authors provide tables and explanations that will help the general reader negotiate the minefield of coal-maceral terminology. Readers with more general interests may be disappointed to find only a brief treatment of the crucial botanical background and Quaternary geological history of the region. At US$52, the volume is certainly accessible to professionals and libraries.

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Geostatistical Simulations. M. Armstrong and P.A. Dowd, editors. Kluwer Academic Publishers, P.O. Box 989, 3300 AZ, Dordrecht, The Netherlands, 1994, 255 pages. US$89.00 (ISBN 0-7923-2732-2).

As noted by the Editors in the Preface, geostatistical simulation is more than twenty years old. Although the Turning Bands method (TBM) was presented in Matheron's seminal paper of 1973, it initially attracted less attention than kriging. In part, this was because the application of kriging required less mathematics than simulation, and in part because kriging was directly related to the problem of ore-reserve estimation commonly encountered in mining. Most of the early applications of simulation were limited to mine planning. This volume is a collection of thirteen papers presented at a conference held at Fontainebleau, 27-28 May 1993. The papers were presented in seven sessions, and the volume includes a discussion for each session. It is interesting that the TBM is included in only three of the papers, and only one of these focuses on an application of TBM, the other two merely use TBM for comparison.

In general, geostatistical (stochastic) simulation is based on a random function model. The data (if any) are assumed to be a nonrandom sample from one realization of the random function. The objective then is to generate additional realizations of the random function or, more precisely, nonrandom samples from these realizations. The original random function is not uniquely determined, but rather is characterized by first- and second-order properties such as the mean and covariance. Usually, the marginal distribution is assumed known, perhaps after a transformation. The simulation, *i.e.*, the simulated realization, is supposed to preserve certain characteristics, such as the moments and the covariance. In the case of conditioning, each simulated realization is to match the data values at the data locations. Preservation of the characteristics of the random function may either be in a theoretical sense or in an empirical sense. Since simulation is computationally intensive, there are both practical and theoretical problems to be considered.

The papers in the volume are a mixture of theoretical developments or comparisons of different algorithms, and applications of a specific simulation algorithm to a particular problem, such as reservoir characterization. Gotway & Rutherford compare five different algorithms with seven "exhaustive" data sets. Dowd & Sarac show how L–U decomposition can be extended to larger grids. Simulated Annealing is an optimization technique that has been utilized to generate realizations of a random function by forcing the sample variograms to fit the original theoretical model, and it has become particularly popular in the petroleum industry. Hegstad, Omre, Tjelmeland & Tyler apply annealing to reservoir description. Freulon considers the problem where the conditioning data have been corrupted or transformed nonlinearly, and the Gibbs Sampler is used. Ravenscroft considers the practical problems associated with using a simulation in a mining application. Bremond & Jeulin use lattice gas models to simulate growth and aggregation processes. Gomez-Hernandez & Cassiraga consider both practical and theoretical questions relating to sequential simulation. The common way to condition the simulated realization to the data is by kriging but, as is well known, kriging smooths the data, and hence the variance is decreased. Fouquet discusses the problems associated with this and considers the use of a multi-gaussian model to condition the data without the disadvantages of kriging. The sequential gaussian method considers a particular ordering of the points where a simulated value is desired, and then the conditional distribution is used to generate values at these points in the specified order. One disadvantage of the method is that it is impractical for a very large number of points and, in particular, only allows simulation on a discrete set. Lantuejoul combines spectral methods together with the Central Limit Theorem to simulate isotropic, stationary multi-gaussian random functions. A program using IMSL functions and subroutines is included as an appendix. Jaquet & Jeannin consider the application of TBM to the problem of modeling a karst medium using data from the Holloch, which is the largest known network of caves in western Europe. When modeling an oil or gas reservoir, the connectivity of the permeable phase is very important. Since this is not usually a defining condition for the simulation algorithm, many of the algorithms do not ensure the connectivity. Allard considers the use of a Truncated Gaussian model for simulating geological lithofacies. Galli, Beucher, Le Loc'h & Doliguez consider the advantages and disadvantages of the Truncated Gaussian model. Georgsen, Egeland, Knarud & Omre elaborate on the method described in a presentation at the conference held at Troia in 1992. The application pertains to facies architecture in fluvial reservoirs.

As is illustrated by this collection of papers, simulation algorithms are generally adapted to the specific application, and hence it is not easy to make comparisons between them. There are theoretical as well as practical differences. A number of the authors have used standard software packages, some of which are commercial, whereas others have used their own, and these may not be readily available to the wider audience. For an additional discussion of various aspects of simulation and the associated problems, see an article by the reviewer in the *Geostatistics Newsletter* 7(1), 1994.

This volume represents the current state of activity in the use of geostatistical simulation, except possibly for petroleum. It is not a complete compendium of the different algorithms, hence it is not particularly appropriate for a newcomer. It is a valuable addition to the collection of those already active in the application of geostatistics. The applications cited are concentrated in the earth sciences and do not include the environmental sciences or ecology.

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Geofluids: Origin, Migration and Evolution of Fluids in Sedimentary Basins. J. Parnell, editor. Geological Society, Special Publication No. 78. Geological Society Publishing House, Unit 7, Brassmill Enterprise Centre, Brassmill Lane, Bath BA1 3JN, U.K. 1994, 372 p. US$108.00 (ISBN 1-897799-05-5) hardbound.

This volume developed out of the Geofluids '93 conference held in Torquay, England, the intent being to present a state-of-the-art review of research on geological fluids. In this endeavour, the organizers have succeeded admirably.

Following a perceptive introduction by Professor W.S. Fyfe on Earth's water inventory, the main text is divided into six sections. In the first, Large-Scale Fluid Flow, Van Balen & Cloetingh use a dynamic numerical model to expose the deviations from the simple subsidence pattern predicted by the stretching model for basin evolution. They show that plate reorganizations are the cause of changes in the level of intraplate stress. Deming proposes that the continental crust should be recognized as a two-component system, namely a solid framework constantly evolving through interactions with crustal fluids. Jessop & Majorowicz emphasize that geothermics now includes a close association with hydrogeology, but lament the lack of complete quantitative description of the present thermal state of any given sedimentary basin. Phillips *et al.* distinguish between metamorphic fluids (those released by devolatilization of mineral assemblages) and fluids that are simply active during metamorphism. They focus on the contrasting geofluids present in metamorphic terranes containing gold only, and base-metal-rich deposits.

In Deformation and Fluid Flow, relationships among deformation, faulting and fluid flow are examined. Sibson identifies various mechanisms for fluid redistribution, shows that they operate to varying extents in different tectonic regimes, and emphasizes that stress cycling effects may be widespread. Evidence for the mechanical involvement of fluids at all stages in an earthquake is substantiated by Muir Wood, who likens seismic strain cycling (of pulsed episodes) of fluid flow to the lungs' function in breathing. His demonstration of the magnitude and distribution of visible water-discharge for normal-fault earthquakes was one of "the talks" of Geofluids '93. Follow-up papers by Knipe & McCaig on microstructural and microchemical consequences of fluid flow in deforming rocks highlight recent progress in understanding various dynamic geological settings.

In Fluid Flow and Reservoir Evaluation, Bjorlykke demonstrates quantitatively that flow of pure water in sedimentary basins transports heat and solids in solution and is therefore likely a significant factor in diagenetic reactions. Sedimentary ores may form when hot fluids flow rapidly toward the surface to be cooled by mixing with seawater or cold groundwaters. Ringrose & Corbett deal with flow of immiscible fluids in permeable sandstones and conclude that many of the inferences on oil migration based on uniform-media approximations are probably invalid. Consequently, some impetus such as large-scale pressure gradients or high-permeability pathways (*e.g.*, episodically open fault-systems) appear necessary.

Hanor builds upon his earlier reviews of the origins of saline brines in Fluid Chemistry: Metal Organic Interactions. Using a data-set extracted from published compositions of formation water, he contributes a new global perspective on subsurface water chemistry. Chemical potential of chloride, or alternatively, the aqueous concentration of anionic charge, is among the master variables that drive fluid–rock exchange and control bulk-fluid compositions. Working from a strong thermodynamic data-base, Giordano and Kharaka advance several provisional chemical models of diagenetic and ore-forming fluids, and establish the relative importance of specific organic ligands in these fluids. The nature and origin of trace elements in various hydrocarbons are thoroughly reviewed by Filby, who notes that most geochemical information is provided by discrete metal complexes, mainly geoporphyrins present in crude oils and bitumens. Nicholson finds that techniques used to examine geological processes in geothermal systems are likewise appropriate for gold exploration and hydrocarbon reservoir modeling.

Fluid Evolution: Migration and Precipitation of Hydrocarbons and Metals begins with a detailed review by Mann, focussed on methods used to study expulsion of petroleum from source rock. As for other migrating subsurface fluids, an integrated multidisciplinary approach is required for precise quantitative understanding. Simoneit follows up with a masterly account of hydrothermal generation of oil, a process that occurs in systems with high water–rock ratios and where the conventionally accepted lengthy scenario for petroleum generation in a sedimentary basin is short-circuited. Paragenetic relationships between hydrocarbons and inorganic minerals is explored by editor Parnell. He emphasizes the aspect of comigration of hydrocarbons and aqueous fluids, as evidenced by the presence of numerous authigenic minerals in many solid bitumens, and points to the importance of metal-rich organic matter as an exploration guide to metallic ore deposits. On a related subject, Fowler promotes the role of water-saturated geopressured shales adjacent to carbonate platforms in the formation of Mississippi-Valley-type deposits. Metcalfe *et al.* provide a valuable review of the state of knowledge concerning chemical evolution of the fluid phase during red-bed diagenesis.

The sixth and last section, Tracers of Fluid Evolution, consists of two papers, each describing the application of specialized analytical techniques to trace the pathways and consequences of fluid flow. Duddy *et al.* emphasize the enormous transfer of heat accomplished in sedimentary basins by moving fluids. By integrating data on vitrinite reflectance with fission-track data of apatite, they show how distinctive paleotemperature profiles result from the flow of hot fluid, whether transient or steady state, as distinct from simple conduction of basal heat flow. Updating their earlier review (1993), Ballentine & O'Nions show how the isotopic composition and distribution of rare gases can be used to evaluate the crustal, mantle and atmosphere-derived components of fluids. Surprising differences emerge as a result of case studies of fluid regimes in different types of sedimentary basins.

This landmark volume succeeds to a notable degree in its stated objective. The importance of fluids in geological systems can scarcely be overemphasized. This book will be of high interest to workers in many fields of geoscience.

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Health Effects of Mineral Dusts. George D. Guthrie, Jr. and Brooke T. Mossman, editors. Mineralogical Society of America, Reviews in Mineralogy, Volume 28, 1993, 584 pages (including glossary and index).

Over the past 20 years, issues that combine Health and the Environment have exploded, but only recently have many mineralogists and geologists become attuned to the fact that their expertise is important, indeed essential, in the formulation of public policy in these arenas. This lagtime has had some repercussions. For example, it might have been an entirely different story if members of the medical, and legal, professions, and the public, had had a greater appreciation for earth materials, and their distribution, when regulations were being constructed for asbestos.

Exceedingly dusty environments, such as occupational exposure to asbestos, leading to disease, is not an unexpected finding. The wake-up call for most geoscientists came when the regulations stipulated for the workplace spilled over into mandates for detecting and removing or confining asbestos in schools and public buildings. In spite of the range of detailed information provided to government officials and "interested parties", front-page news stories and editorials caused panic, with the resultant laws binding on all industry, homeowners and institutions.

I believe that the root cause of such expensive disease "prevention" is a lack of basic understanding about the materials and processes unique to our planet, and common sense. We are now doing a better job of educating the populace, but "education" has a long time-scale. There is a pressing need to increase dialogue now, especially among professionals. Remembering that much of what any individual considers "hazardous" depends on perception and personal risk-tolerance, we geoscientists may need some "continuing education" on the "hazards" of mineral materials.

This volume, emanating from a Mineralogical Society of America (MSA) short course held on Nantucket Island, Massachusetts, preceding the GSA meeting in November, 1993, should help us appreciate and utilize the data presently available from both the geo- and bioscience perspectives. It is not the first, nor probably the last, publication on this particular interdisciplinary topic. Since 1972, when the International Agency for Research on Cancer (IARC), part of the World Health Organization, held a conference in Lyon, with proceedings published as "Biological Effects of Asbestos", many volumes have appeared, including reports commissioned by concerned governments here and abroad. Not surprisingly, in light of the importance of mining and exports of chrysotile to the Canadian economy, the Mineralogical Association of Canada mounted a short course in 1978 on "Mineralogical Techniques of Asbestos Determinations" (*Short-Course Handbook* **4**). The present edited volume documents that, although much has been accomplished in 25 years of active research toward the definition of systems and of some of the interactions of minerals as foreign bodies in living systems, the mechanisms remain elusive. New approaches and techniques hold promise, and there is no doubt of the global interest, and significance, of such efforts.

The contributors are mainly geologists and mineral scientists, with some laboratory researchers in the health sciences fields of pathology, toxicology and epidemiology. Nineteen chapters briefly mentioned below (authors in brackets) have two basic thrusts: to define, as completely as possible, the potentially offensive minerals and the medical and biological systems that may be involved in any disease states, and to address possible mechanisms of "mineral-induced pathogenesis" or, ultimately, as for all "cancer-causing agents", to identify the factors that lead to toxicity (cell death) or proliferation of altered cells.

The Introduction (Guthrie & Mossman) outlines the interdisciplinary thrust of the volume and the history of the disease response related to mineral dusts that has culminated in the present efforts in experimental research.

As befits the mineralogical source, initiation and prospective audience of the volume, the first chapter describes the dusty environment in which we live (Klein). The following three chapters discuss the possible components of hazardous mineral dusts. The most prominent minerals are the asbestiform amphiboles, serpentines and other 1:1 layer silicates. Each group is defined structurally and morphologically, with special reference to the surface chemistry and kinetics of dissolution (Veblen and Wylie). Other minerals found as dusts similarly described are: clays and zeolites, with their particularly interesting exchange characteristics (Bish & Guthrie), and the silica, iron and titanium oxide minerals (Heaney & Banfield).

The fact that these minerals occur as dusts implies fine grain-size particles and provides special challenges in preparation of samples for study (Chipera *et al.*), their characterization (Guthrie), and the need to understand their surface chemistry as a contribution to their relative reactivity (Hochella).

These mineralogical chapters precede descriptive outlines of the research that has addressed possible etiologies of disease induction. The primary hypothesis, promulgated by Stanton and coworkers, invokes physical factors, shape and size of fibers, rather than the composition of the mineral materials (Nolan & Langer). The specific effects of mineral surfaces, amount and properties, especially of the several silica species (Giese & van Ose) and the total lung burden (Churg), also have been implicated in dust-related disease.

Since biological systems exist in a variety of hostile environments, bombarded by all manner of potential disease-causing species, a variety of defence mechanisms have evolved. Those that have been identified to combat the inhalation of particles in humans (Lehnert) are background for assessing epidemiologic and pathologic investigations. Discrete reports on exposure and disease associated with asbestos (Kane), or other mineral dusts (Ross *et al.*) provide some human-response data. Similar effects have been generated in animal model (*in vivo*) systems and have been used to identify (Driscoll) and to assay (Davis) the toxicity of a range of different mineral fibers. Experiments utilizing cell cultures (*in vitro*) offer the possibility of examining relative differences in reactions among mineral samples directly on the target lung tissues, and the possibility of identifying molecular mechanisms that may be the initiators, or in the pathway, of disease induction (Mossman). A compilation of animal model and cell investigations with quartz particulates (Saffiotti *et al.*) reviews the present hypotheses on carcinogenic mechanisms, including direct interaction of mineral materials with DNA.

Finally, an historical perspective and present mandates to assess and monitor exposure to fibers by specific agencies, the Occupational Safety and Health Agency (OSHA) for the workplace, and the Environmental Protectional Agency (EPA) for the environment, are presented (Vu). Hazardous asbestos fibers, defined as particles with an aspect ratio >3:1 and length >5 μm, have a permitted exposure level of 0.2 fibers/mL that is applied to all industries (OSHA 1986). The latter is provided not as "safe" levels but feasible using current technology. Under the Clean Air Act of 1971, the EPA continues to regulate the emission of all hazardous pollutants (Toxic Release Inventory). The Asbestos Hazard Emergency Response Act (1986) enacted to protect school children requires a facility survey preceding any demolition or renovation. In the U.S., there is a ban and phase-out of asbestos in commerce due to be complete by 1996.

As a summary and compilation of work in progress, and a predictor of future directions, the volume is most successful, although probably more detailed than most geologists and mineralogists require. Substitutes for asbestos, the previously dubbed "miracle fiber", so prominent as insulation materials, as well as the proliferation of fiber products for communication, sports, and medical applications, assure that the EPA and other agencies will continue to be busy monitoring all the environmental media: air, water, and land. The biological effects of these, and many other mineral materials, together with the fact that "dusts" will be with us always, leaves no doubt that additional research, and lengthy review-type volumes, will continue to appear. In addition, publication of a volume with such an interdisciplinary focus demonstrates that at least some of the mineralogical and geological community is apprised of one vexing biological–medical problem-area, and will not be shy in seeking future interchange and opportunities for research in Health and the Environment.

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Humbolt's Travels in Siberia (1837–1842) – The Gemstones. By G. Rose, translated by J. Sinkankas, edited by G. Sinkankas. Geoscience Press, 12629 N. Tatum Blvd., Suite 201, Phoenix, Arizona 85032, U.S.A. 1994, 80 pages, hardcover. US$25.00 (ISBN 0-945005-17-2)

In 1829, the celebrated German naturalist Alexander von Humboldt, accompanied by Gustav Rose, associate professor of mineralogy at the University of Berlin, and by Christian Gottfried Ehrenberg, a pioneer in microbiology and micropaleontology, conducted a 10-month scientific excursion into the Siberian reaches of the Russian Empire at the invitation and the cost of Czar Nicholas I. The excursion had been urged upon the Czar by the German-born Count Cancrin, not least to help establish the nature and extent of the area's mineral resources. In 1837, after long preparations, Gustav Rose, the expedition's secretary, published the official account of the group's travels, and it is from this original that those passages that relate to gemstones have been culled.

In his introduction to this brief booklet of extracts, Captain Sinkankas, who is himself noted for uncompromisingly comprehensible writing, comments favorably on Rose's appreciation of gemstones, his eye for detail, and simplicity of style. Indeed, Rose builds none of the ornamental and self-indulgent ziggurats of clause piled upon clause, which are a hallmark of German academic writing then as now. We learn instead, as the expedition passes through the amber-producing areas of Prussia, that annual production of amber was in the range of 150 tonnes and was divided into five categories of quality, the lowest of which made up nearly 65% in value, the highest only 0.8% of the whole. We learn that local residents were permitted only a single bleak bathing beach, where little amber washed ashore, and that if caught on other beach areas, they were subject to arrest and detention by the "strand riders" patrolling on behalf of the lessor of the amber rights. We learn that before setting out into the metalliferous regions of the Altai in July, every member of von Humboldt's party was equipped with an anti-mosquito cap, which previous experience in the Urals had shown to be indispensible. We are given a drawing, based on a lead model, of the singularly miscut Orlov diamond; we visit lapidary workshops, pegmatites, rhodonite and malachite quarries and alluvial gold workings.

The drawback is that this is primarily a booklet of excerpts, and antiquarian ones at that. Anyone who is specifically interested in gems from a historical standpoint will find information as to occurrences, discoveries, methods of working in the terra (nearly) incognita of the early 19th century Russian frontier. For the rest, the excerpts, even though connected by explanatory passages by Captain Sinkankas, give the whole a disconcertingly disjunctive character; somewhat like a book of lists or enumerations. But that is the drawback of the extract form. For those interested in the specific subject, there is information of interest; for the rest, it's a bit of a jump from fact to fact, with very little in between, rather dissatisfying, if perhaps unavoidable.

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