down in the dissolution rate of the glass due to the lowering of dissolved silica levels, but eventually "will favor a rapid dissolution of the glass because the reaction affinity will remain high" since the reaction leads to the formation of magnesian silicates which are mor stable than the glass itself. However, we do not see evidence for such rapid dissolution in the case of microtektites, which have exhibited a very small extent of corrosion (see below) over periods of exposure of the order of a million years and, as a rule, are not observed to have distinct magnesian silicate deposits on their surfaces. It is interesting to note, although a full discussion of the subject is beyond the scope of this paper, that studies of nuclear waste glasses show that different glas⅛s compositions differ widely in the stability of their surfaces with respect to attack by aqueous media, and that the mechanism cited by Crovisier and Honnorez may apply, within the time scales relevant to nuclear waste immobilization, only to limited ranges of glass composition.

They then remark that tektites are higher in silica content (68–82%) than nuclear waste glasses and argue that therefore tektites are not suitable analogs for nuclear waste glasses. In fact, however, there is a class oficrotektites, called the bottle-green microtektites, whose composition extends to much lower values of silica content, specifically to and below the 50% figure cited by Crovisier and Honnorez [*Glass*, 1972]. Having in mind the point made by Crovisier and Honnorez, namely, that nuclear waste glasses are of low silica content, we concentrated effort on these microtektites. *Glass* [1982] found that the average depth of corrosion of microtektites in the deep-sea environment increased gradually from around 2 +/- 2 μm at 72% SiO_2 to around 14 +/- 5 μm at 54% SiO_2. (These figures are eye estimates from his plots.) The low silica values, near 50%, were found only in the fields with an age near a million years or younger. These glasses were then studied in the laboratory [*Barkatt et al.*, 1986] and were found to exhibit the property of survival in seawater (leach rates decreased by more than a factor of 30 from the leach rate in deionized water).

The remaining question is whether the glasses used for nuclear wastes behave like the low-silica microtektites in the presence of magnesium in the leach solution. The problem has been studied by Barkatt's group at Catholic University; they find that the waste glasses behave like microtektites, i.e., they are protected by magnesium, and not like the basaltic glasses reported by Crovisier and Honnorez.

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Reply

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We completely agree with the answer of the authors when they write, "although a full discussion of the subject is beyond the scope of this paper,. . .studies of nuclear waste glasses show that different glass compositions differ widely in the stability of their surfaces with respect to attack by aqueous media, and. . .the mechanism cited by Crovisier and Honnorez may apply. . . . "

The main purpose of our reply to the item by W. W. Maggs (*Eos*, January 26, 1988) was to state that, "On the whole, we believe that it is not possible to conclude that the presence or absence of magnesium or any other element (and could have added "any other factor") alone will lead to an increase or a decrease of the glass corrosion rate without considering the whole nuclear waste repository system." We are glad to note that in the end the authors agree with us with the saying, "One swallow does not make a summer."

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Books

Multiprocessing in Meteorological Models

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G. -R. Hoffman and D. F. Snelling (Eds.), Springer-Verlag, New York, 438 pp., 1988.

Reviewed by John P. Boyd

This book is the record of two workshops on parallel processing. The first was held in December 1984; its papers are the first 236 pages of this volume. The second workshop convened 2 years later. It is unusual to combine two conferences that were held so far apart into a single volume. It is also surprising that these papers were published in hardcover rather than the usual paperback. Nevertheless, these publishing decisions were wise. The book is a good archive that will be useful to meteorologists for years to come.

Parallel processing is clearly the long-term future of scientific computing. It is likely that small calculations will always be done on conventional serial machines; a multiprocessing pocket calculator is just plain silly. Unfortunately, conventional serial computers are rapidly approaching theoretical limits set by the speed of light. For general circulation models, dividing the calculation between many processors is the only way to transcend the limits on the power of a single processor.

Unfortunately, Lincoln Steffen's famous line about the Russian Revolution—"I've seen the future and it works"—would have to be paraphrased for parallel processing to "I've seen the future, and it's confused." The problem is that too many divide-and-conquer strategies are possible. No architecture is optimum for all problems; no algorithms are optimum for all architectures. Does the future lie with hypercubes with a thousand processors, or with bus machines with a common memory shared by a doen CPU's, or with some alternative not yet imagined?

It is likely that parallel processing—programming languages, architecture, and algorithms—will continue to rapidly evolve until at least the end of the century. Paradoxically, this very dynamism of the field makes this book more useful. It treats, at least briefly, almost all parallel architectures that now exist. Theoretical articles such as the 40-page, 1984 review by McBryan are complemented by many articles that discuss practical experience with the ECMWF model and others on multiprocessor Crays and Cybers. This book will be a good "fixed point" in a rapidly changing world. The scientist who needs to get a quick overview of a particular type of computer, or of the practical difficulties of applying parallel processing with a spectral or finite difference model, will be able to find enough in this book to at least become oriented.

The main criticism of this book is the usual gripe about conference proceedings: the articles are very diverse. Some are long and detailed; the 70-page article by Hoffman, Swarztrauber, and Sweet includes complete FORTRAN listings for simple programs they ran on three different machines. Others are brief abstracts of the authors' own current research. Because the field of parallel processing is itself so confused and diverse, this volume has even less focus and coherence than the average conference proceedings.

Nonetheless, every library should buy this book. Most numerical modelers will also want to read it, and many will invest in a personal copy.

What sets this apart from most other volumes on parallel processing is that books by computer scientists are focused on thousands of processors. This book, especially in the papers of the second workshop, has a stronger emphasis on machines with two to eight processors—the Cybers, Crays, Alliants, and ETA machines that are the workhorses of contemporary meteorology. It fills its intended purpose admirably.

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Aeolian Dust and Dust Deposits

PAGE 861

Kenneth Pye, Academic, Orlando, Fla., 334 pp., 1987.

Reviewed by Pierre Rognon

In Earth science history, numerous subjects, such as pollen and freshwater diatoms have been studied from first a geological point of view, then in relation to the present-day environment. This is the case for dust; loess deposit studies began as far back as 1880 and included many international publications on the subject, but scientific works concerning the eolian dust only started toward the middle of the 20th century. Nevertheless, investigators of eolian dust have made great strides, as it is pointed out in the interesting book by Kenneth Pye, which puts together the present studies on dust and its history since the Quaternary and Cenozoic epochs. In addition to loess, the studies also cover the contribution of dust to deep-ocean sediments, ice, and soils.

Today, the bulk of data concerning the eolian dust is larger than that concerning loess, and in Pye's book about 190 pages deal with eolian dust, while only about 70 pages deal with loess. The rapid development of dust studies is linked to major environmental and economical consequences, for example, wind erosion of soils, prediction of blowing dust hazard and reduced visibility, effects on human health, dispersion of toxic metals, desert varnish or duricrust development, effects on salt weathering, and dust addition to soils. These implications of dust deflation, transport, and deposition (chapter 7) often are new areas for further research, supported by some scientific projects.

Kenneth Pye has succeeded in writing a multidisciplinary book which provides numerous data on wind dynamics, meteorological conditions propitious to dust loading, oceanic and continental deposition, paleoclimates, and Quaternary history, etc., using very diverse references (about one thousand titles) and synthesizing much data and many different opinions. This very well written and profusely illustrated book is of great value for geologists, geomorphologists, soils scientists, meteorologists, engineers, and environmental managers. It brings an important contribution to the future international Global Change project.

The first question about the dust concerns the mechanisms of fine-particle formation. The answer is not easy because dust and loess deposits are mainly composed of particles in the 10- to 15-μ size range. The silt formation is much harder to explain than the clay or sand formation. Pye suggests nine possible mechanisms of silt particle formation. Some are linked to cold environments (glacial grinding, frost weathering) and have long been recognized in relation to research on periglacial loess. But today it is necessary to explain the huge bulk of dust coming from the hot deserts, and some studies have pointed out new mechanisms, such as eolian abrasion or salt weathering.

The physical laws of eolian transport were for a long time restricted to the blown sand and desert dunes (*Bagnold*, 1937–1941). The eolian dust entrainment involves a primary sorting from a bed composed of sand/silt or silt/clay mixtures and can be initiated under different conditions including both wind dynamics (fluid drag, aerodynamic lift, entrainment by ballistic impact) and the characteristics of the ground. Only field and wind tunnel observations combine all the parameters (for instance, grain size distribution, cohesion, or roughness of the source material) and are an important contribution toward understanding these intricate problems. The distances traveled by suspended dust particles have been principally obtained by computation while the dust is in a state of neutral equilibrium, i.e., when the temperature gradient above the surface is very close to zero. But recent samplings in the eastern Pacific and the Canary Islands point out that these calculations are not available to explain the fallout of >100-μ particles at one or a few hundreds of kilometers off the coast. New models should be used in unstable atmosphere, when the air temperature rapidly decreases with height.

The map showing the distribution of areas with a high dust storm activity (p. 63) points out the first place of the subtropical desert regions, which are the major sources of present-day dust emissions. But the Sahara is absent among the numerous maps of annual frequency of present-day dust storms in the Middle East, Soviet Union, China, southwest Asia, Australia, and the United States. That is not an omission: No data are available today on the scale of the largest desert of our planet. In the same way, measurements on dust concentrations in the air have been made both over land and the oceans, but only near the ground and often far from the dust sources. Few data are available at high altitudes (sampling by plane) or in the desert itself. The short duration of most of these samplings prevents study of the seasonal variability. There is almost no data for the rates of dust deposition, but a few sediment traps directly measure the amount of material settling to the seafloor in the Pacific. Pye's book shows how difficult it is to obtain precise values of global dust fallouts.

Chapter 5 takes stock of the question about the dust-transporting wind systems. The mechanisms seem to be well known at small or regional scale (dust devils, haboobs, shamal, etc.), but in west Africa they vary according to the regions, seasons, levels of atmosphere, etc. Synoptic situations are very useful to understand some long-range transports of dust (by jet streams, for instance), but more and more, the satellite images and trajectographies should be used (e.g., Coudé-Gaussen et al., *Journal of Geophysical Research*, 1987).

The review of all data concerning grain size, mineralogy, and chemistry of the natural dust is very interesting. It is difficult now to give a general survey from sparse and episodic data, obtained by different methods of collection and measurement. New techniques, such as oxygen isotope ratios of quartz and magnetic differentiation, will be used to identify the source of long-range dust.

The study of former dust is easier in ocean sediments than in continental sediments because oceanic records are complete and have a relatively good stratigraphy, and very numerous cores have been made available over the last 20 years. The dust input is more important than pointed out in previous works (in some areas, up to 80% of the total accumulated sediment). Seven maps clearly show the distribution of quartz or clay minerals in Atlantic or Pacific modern sediments, and the changes in dust supply have been studied from oceanic cores to reconstruct climate fluctuations over the neighboring continents during the late Cenozoic and the Pleistocene. On the mainland, most of the loess in western Europe or in North America was deposited during the later part of the last glacial stage, and only a few sequences of loess deposition show as many as 17 episodes during the last 1.7 million years in central Europe. In China, loess sedimentation probably began about 2.4 millions years ago. The presence of paleosols indicates that loess accumulation was episodic and few deposits have been identified during interglacial times. In fact, there is very little diagnostic evidence of the sedimentary features of loess deposits, and about their mode of formation and source environment, probably because few studies have been done on silt particles by scanning electron microscopy (SEM) examination or on the original microstructures by optical and SEM microscopes. On the other hand, they supply very precious paleoclimatic data by the pollen, faunal, or pedological evidences included in them. Moreover, all the models for the present-day eolian deposits are available in the tropical oceans and around the hot deserts, as all the major loess occurrences are localized in the cold zone. On a map (p. 201), only the well-known example of Israel is shown among the subtropical desert loess, not the loess from Tunisia, which is identified in numerous papers of G. Coudé. Pye explains the quasi lack of hot desert loess by the fact that here dust is dispersed over a wide geographic area as a consequence of environmental gradients (p. 265). The argument is perhaps valid for the present time, but not for the glacial times, and I rather think the principal reason is the very limited development of the research works on former dust deposits around the Saharan (Libya, Niger, Nigeria, Mali, Cameroon, etc.) or Australian deserts. In the regions near these deserts the dust deposits can be fine sandy loess (p. 265) because fine sand can be transported by suspension during vigorous storm winds. Moreover, all the loesslike deposits are yet unknown around the hot deserts, and this gap in the present-day inventory (on Figure 9–1) is quite provisional.

In conclusion, Pye's book does not only bring a huge mass of current data of present and former dusts, but also a useful evaluation on the acquired knowledge and on the future of research.

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