Science in the U.S.S.R.

The Communist Party and Soviet Science. STEPHEN FORTESCUE. Johns Hopkins University Press, Baltimore, MD, 1987. x, 234 pp. $28.50.

The Soviet Union has the largest research and development apparatus in the world, with more than one-third of the world's engineers and one-fifth of its physicists. In all, it possesses over 1.5 million scientific workers who are employed in institutes of the Academy of Sciences, industrial ministries, and universities. Until recently, Western scholars have had little success in analyzing the role of the Communist Party in the administration of those institutions or in understanding how party members and scientists interact over questions of ideology, personnel, management control functions, and the science-policy process in general. Stephen Fortescue's *The Communist Party and Soviet Science* fills this gap, offering an interesting, informative, and well-researched evaluation of the role of party institutions in Soviet science. Fortescue is not concerned with the role of the party in military R&D institutes but focuses on the natural and social sciences.

Drawing on a wide range of such sources as party documents, journals and newspapers including *Pravda, Izvestiia, Kommunist*, and *Partiinaia zhizn'*, Soviet scientific journals, memoirs, emigre writings, and a thorough search of the western academic literature, Fortescue attempts to determine the strength of the Soviet scientist relative to the party apparatus. His book covers much of the ground covered in previous forays into this area of interest, but no one heretofore succeeded in presenting such a comprehensive analysis. In consecutive chapters Fortescue considers the position of ideology in Soviet science and then the organization, function, and membership of "leading party organs" (the Politburo, the Central Committee and its Science Department), the regional and local party apparatus, and primary party organizations (PPOs) in the administration of science. He argues that the Academy of Science and the State Committee for Science and Technology have power that exceeds that of the Science Department (whose influence is limited to ideological matters) and rivals that of GOSPLAN—the State Planning Commission. Though he focuses almost exclusively upon institutions, he also indicates that the bulk of the science policy-making process takes place within the state apparatus. However, the regional party apparatus and PPOs have gained in importance and power in general science management since the Khrushchev years through their control of conference travel, publication, and personnel appointments.

Fortescue's approach reveals the pitfalls of using Soviet materials, as well as the payoff possible from persistent effort. He takes the reader through the membership and background of the officials who work in the Science Department of the Central Committee and the regional party apparatus. For example, he shows that the percentage of the Central Committee membership working in science is not far below the percentage of Party members working in science. Elsewhere, however, he admits that there is a dearth of information concerning the technical or natural sciences and can only claim that his conclusions "seem" or "appear" to hold. The drawbacks are evident when Fortescue considers the L'vov reform for the regional planning of science, treating extensively a reform that he admits is small-scale, or when he presents evidence on the relative influence of scientists on policy-making based on an analysis of their membership in party organizations. It is not clear that "attendance" at a meeting or writing an article shows involvement in the policy process.

Where Fortescue offers quantitative analysis of the personnel involved, he runs head on into the problem of the meagerness of sources. For the most part, he succeeds in presenting his data in an orderly and instructive fashion, showing us the extent of overlap between scientist and party official, how the central party apparatus is not really capable of knowledgeable administration of science policy, and how, therefore, most party control must be exercised at the regional and local level. Still he might have stated this more clearly. More charts to summarize the data would have been useful. This quantitative analysis is also the strength of Fortescue's approach, however. He uses his evidence circumspectly and generates some of the most revealing information to date about the career patterns and interests of individuals involved in the science policy process in the Soviet Union.

It must be pointed out that Fortescue's attempt to place his analysis within the framework of three different models of the Soviet polity—totalitarian, "vanguard party," and pluralist models—does not quite succeed. He considers these issues directly only at the beginning and the end of the book. As a result the exposition of the models appears to be out of place, if not superfluous. I share Fortescue's conclusion that the need for scientific-technical expertise in post-industrial society requires that Soviet party leaders rely on the advice of scientists and that an interest-group or pluralist model is the most applicable of the three he considers. But concern with this theoretical issue diverts him from consideration of more fundamental factors affecting the strengths and weaknesses of Soviet science. Such factors include the bureaucratic-functional and structural and other "traditional" impediments to innovation and rationalization of party control. In addition, when considering the role of the party apparatus in day-to-day science management, Fortescue limits himself to consideration of personnel appointments, management issues, and the so-called "science-production tie," rarely addressing the role of the party official and the scientist in research plan formation or the budget process.

All in all, however, Fortescue's book succeeds in its stated purpose, convincingly demonstrating that the importance of scientific-technical advice for the Soviet state is such that experts have achieved a position of power, influence, and responsibility within the Soviet system.

PAUL JOSEPHSON
Program in Science, Technology, and Society, Massachusetts Institute of Technology, Cambridge, MA 02139

Deep-Crustal Evolution

The Nature of the Lower Continental Crust. J. B. DAWSON, D. A. CARSWELL, J. HALL, and K. H. WEDEPOHL, Eds. Blackwell Scientific, Palo Alto, CA, 1986. viii, 394 pp., illus. $78. Geological Society Special Publication no. 24. From a meeting, London, Oct. 1984.

The lower continental crust is defined as having seismic velocities ranging from about 6.4 to 7.3 kilometers per second and densities of about 2.1 to 3.1 grams per cubic centimeter. A relatively low radiogenic heat flow is also assumed. The genesis of the boundaries of the lower crust, namely the Conrad discontinuity on top and the deeper Mohorovičić (Moho) discontinuity below, remains enigmatic, a circumstance that is further complicated by the putative nonexistence of a Conrad discontinuity in North America. This timely and well-edited collection of 30 papers brings together new observations, constraints, and models concerning the evolution of the lower continental crust.

Deep seismic reflection profiles obtained in recent years suggest a lower continental crust that is crudely laminated, often overlain by a more transparent middle crust. Other profiles show no distinct layering of the lower crust, however. A consensus is emerging that listric normal faults and listric

thrust faults somehow merge into the layered lower crust. This modern view contrasts with more traditional seismic interpretations that offer evidence for very substantial subvertical faults cutting across the lower crust.

The lower crust is also a region of low electrical resistivity, which is explained by the presence of increased amounts of water and perhaps also free carbon (graphite), or else by the presence of low-resistivity shear zones.

An important petrological assumption is that the lower crust is formed under metamorphic granulite facies conditions. Thus, petrographers visualize the lower crust as a combination of mafic rocks and quartzofeldspathic granulites that contain orthopyroxenes and garnets. Outcropping sections of tectonically uplifted lower crust are mafic in some regions and silicic in others. In all outcrop sections there is an upward change to amphibolite and then to greenschist facies. Thus, the common denominator of the lower crust is metamorphic grade rather than composition. Of course, lower crust outcrops may represent a special type of lower crust that can tectonically rise to the surface. Therefore, petrographers and geochemists also rely on xenoliths that are brought to the surface by igneous processes.

The primary formation of lower continental crust probably occurs in places of lithospheric convergence. In that situation lower crust would be formed by residual cumulates which would be geochemically complementary to the more silicic shallow intrusions.

Tectonic reworking of preexisting continental crust by either compressional or extensional processes is postulated by many workers in the area: hence the increased effort to better understand the nature and distribution of brittle and ductile layers within the lower continental crust. Ductility in the lower crust is greatly enhanced by the presence of volatiles such as water, carbon dioxide, and perhaps methane. Whether these volatiles are mantle-derived or got there by continental underthrusting associated with A-subduction, or else by the subduction of oceanic lithosphere (B-subduction), remains an open question. The presence of water in the lower crust leads some, including contributors to this book, to postulate high-pore pressure zones that would act as a guide for the soles of listric normal or listric thrust faults.

This book reviews much of what we know about the lower continental crust, but it does little to place the lower crust into a broad tectonic context. I would have liked to find specific discussions that related tectonics of the upper crust to the lower continental crust. Also, not much is said about the genesis of the Moho. Even though not as yet formally stated, it now appears that the Moho is formed and reset following thermal events that raise the lithosphere-asthenosphere boundary to the base of the crust. In extensional regimes the Moho is reset underneath a stretched crust, while in compressional settings a new Moho is formed after absorption of substantial lithospheric roots by a new asthenosphere. Thus, the evolution of the continental crust probably involves a resetting of the Moho following stretching or compression, and perhaps this subject ought to be addressed in future conferences on the lower continental crust.

A. W. BALLY
Department of Geology and Geophysics, Rice University, Houston, TX 77251

Fossil Synapsids

The Ecology and Biology of Mammal-like Reptiles. NICHOLAS HOTTON III, PAUL D. MACLEAN, JAN J. ROTH, and E. CAROL ROTH, Eds. Smithsonian Institution Press, Washington, DC, 1986. x, 326 pp., illus. $35; paper, $19.95. From a conference, Poolesville, MD, and Washington, DC, June 1981.

A conference held in 1981 has finally come to fruition with the publication of this exciting collection of 21 essays covering all manner of aspects of the fossil synapsid, or mammal-like, reptiles. Paleontologists and students of the physiology, ecology, and behavior of living vertebrates have combined to produce discussions of such topics as the phylogenetic relationships, paleoecology, biogeography, temperature physiology, and anatomy of these animals.

The mammal-like reptiles are a highly diverse and very long-lived group, appearing in the Pennsylvanian and surviving until around the end of the Triassic, a span of some 120 million years. They have never achieved the fame of the dinosaurs, being on the whole less bizarre, which is a pity because they have one supreme advantage over the dinosaurs for the evolutionary biologist. The earliest forms are about the most primitive reptiles known, whereas the latest members of the group are almost indistinguishable from mammals. And the group as a whole spans the enormous morphological, and presumably physiological, distance from stem reptile to mammal. If any fossil group is going to reveal the nature of the evolutionary transition from one great taxon to another, it is this one, a view that directly informs many of these essays. On the view that modern reptiles constitute vicariant ancestors of mammals, the mammals are assumed to have evolved features like endothermy from ectothermy, large, complex brain from small brain, and more sophisticated physiology and behavior of reproduction; therefore the mammal-like reptiles ought to illustrate intermediate stages in these transitions. How far this actually happens varies. For those functional systems which involve skeletal elements, much can be learned from the fossils. Crompton and Hylander on the acquisition of the mammalian jaw hinge and Allin updating his ingenious theory of the origin of the mammalian ear ossicles, for example, can propose functional hypotheses directly testable by reference to actual fossil morphology. At the other extreme, Duvall on the use of pheromones by mammal-like reptiles and Guillette and Hotton on the origin of mammalian reproductive characteristics search the fossils in vain for truly revealing comparative morphology and are reduced simply to speculating about what must have been so. Interesting and thought-provoking as such exercises are, their scientific value may be thought dubious in these days of hardened attitudes among paleontologists about what constitutes a proper, testable hypothesis.

Within the last few years paleontologists have also grown to appreciate that if the evolution of characters is to be explained in functional terms, then the first step must be the creation of a proper, testable hypothesis about just what the sequence of character states is that needs explaining. A cladistic analysis of relationships takes precedence over paleobiological theorizing. Thus the cladogram of the therapsids presented by Hopson and Barghusen is the most fundamental contribution to the volume. There will continue to be arguments about a number of their particular taxonomic conclusions, and it is noteworthy how few characters there are in support of several of the important groupings. But their study does give a solid baseline for future work.

As an overview of the nature of these particular fossils and of the ways in which such a fossil record can be made to generate questions of more general interest concerning evolutionary matters, this book is successful and deserves a much wider readership than synapsid specialists. There will be skepticism on the grounds that many of the conclusions reached by various authors exceed the evidence. But the mammal-like reptiles did exist, did live in particular habitats, and did evolve mammalian characters. Therefore it is perfectly rational to seek to understand them in terms of the functional and ecological meaning of the inferred changes they underwent. That the best an-