ogy is in another. Yet the two subjects are obviously of great mutual interest. Quaternary geology, for example, might offer a solution to the classification and nomenclature dilemma that confronts soil science. The dilemma arises because no two spadefuls of soils are quite alike and there has been, and continues to be, a tendency to create a new name for every spadeful. Quaternary geology might offer a solution by providing a stratigraphic basis for Recent as well as older soil features. But to develop a workable and mutually useful classification will require the joint efforts of the specialized departments now isolated from each other.

Dating Methods

Varves, despite their importance to the development of thought about the Quaternary, here and abroad, do not receive enough mention in this book to be listed in the subject index. Dendrochronology and isotope dating receive up-to-date treatment. The discussion of dating by isotopes is encouraging. As some skeptics predicted, conflicting dates were to be expected when isotopic methods could be developed for checking one another (ten methods are described). This conflict has led to conservative interpretation of dates and less of a tendency to rewrite geologic history because of some new surprising laboratory tests. Some extravagant statements of the past might be reconsidered in the light of the cautious statement that " . . . much of what is said here will more than likely be out of date within a few years" (p. 737). Although many consumers continue to misuse the product, isotope dating of Quaternary events is achieving a disciplined basis.

Not discussed in the book, but still not to be overlooked, are such methods as fluorine, thermoluminescence, hydration of obsidian, development of iron and manganese stain (desert varnish), patination, depth or degree of leaching under various environments, and rates of speciation. All these methods, like rates of erosion and sedimentation, have major shortcomings, but they have their uses too. For example, the fluorine method, which has proved useful for determining the contemporaneity of associated bone, contributed greatly to settling the controversy about the Piltdown skull [W. L. Straus, Jr., *Science* **119**, 265 (1954)].

Finally, mention should be made of the usefulness of volcanic ash beds, which are discussed in one of the miscellaneous papers, not only for correlation but also for dating.

Quaternary in Europe

Most of the foregoing observations about the Quaternary geology of the United States apply also to the Quaternary of Europe. My comments on volume 1 of Rankama's *The Quaternary*, therefore, will be restricted to a summary of the contents.

This book describes the Quaternary geology in the Baltic countries in four papers dealing with Denmark (90 pp.), Norway (48 pp.), Sweden (59 pp.), and Finland (73 pp.). In an introduction, R. F. Flint discusses some principles and problems relating to Quaternary stratigraphy. An author and subject index is included. Although the book is illustrated, maps showing locations of places referred to in the texts are inadequate. To make full use of this book, the non-Scandinavian reader will need an atlas.

The paper on Denmark, by Sigurd Hansen, describes the pre-Quaternary substratum and the extent of the Quaternary deposits, their lithology, weathering (including periglacial effects), structural changes, stratigraphy and chronology, geomorphology, sea level changes, earthquakes, economic geology, and archeology.

In discussing Norway, Björn Andersen describes the distribution of Quaternary deposits, the glacial history and stratigraphy, shore lines and their displacement, the different kinds of sediments, geomorphology, earthquakes, and archeology.

In Jan Lundqvist's paper, a summary of the Quaternary evolution of Sweden precedes discussion of the dating methods (pollen and varve), ice movements, deglaciation, changes in sea level, earthquakes, development of the climate, and biological development.

J. J. Donner, in the paper on Finland, outlines the pre-Quaternary setting, including the pre-glacial (or interglacial) weathering of the bedrock recorded by locally preserved patches of paleosols; this precedes discussion of glacial erosion and ice movements, the glacial deposits, eolian deposits, periglacial phenomena, post-glacial weathering, varve chronology, shoreline displacements, shell beds, late glacial and post-glacial stratigraphy, fossil mammals, certain animals surviving from the glacial age, and archeology.

Assuming that volume 2 of *The Quaternary* is as satisfactory as volume 1, both of these books and *The Quaternary of the United States* will be wanted by everyone interested in Quaternary geology, and they can be recommended for reading by those who are interested in the other geological systems; what is happening today happened during the Quaternary, and what happened then happened before.

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Applied Meteorology

Radiative Heat Exchange in the Atmosphere. K. Ya. Kondrat'yev. Translated from the second Russian edition by O. Tedder. C. D. Walshaw, Translation Ed. Pergamon, New York, 1965. x + 411 pp. Illus. $15.

In the U.S.S.R. the major preoccupation in the field of applied meteorology is with the marginal thermal conditions in the vast Siberian territories.

The radiative balance of the earth's surface is susceptible to measurement and to theoretical analysis, and there are simple measures (exploitation of slopes, greenhouses, and smudge pots, for example) that can be of real economic value. These considerations are recognized in the U.S.S.R. by an unusual concentration of research talent in the field of atmospheric radiation, and particularly in those aspects connected with surface climatology.

One of the best known research groups is that of the physics department of Leningrad University under the direction of Professor (now Rector) K. Ya. Kondrat'yev. During the past 18 years this extraordinarily prolific worker has not only produced many original contributions, but has written a series of valuable books (I know of six, but am not sure of the exact total) on all aspects of the subject. Now, at last, one of these books is available to Western scientists who, until recently, have had to be content with reviews of special topics.

The book deals with the transfer of long-wave, thermal radiation in all its

aspects: theory, measurement, and application to practical problems. The absorption and scattering of solar radiation was the subject of an earlier book, which is not available in English, but the two topics are combined in chapter 7, which is concerned with the net radiative balance, principally at ground level—that is, with the prime topic from an agricultural point of view.

Radiative Heat Exchange in the Atmosphere was written in 1956, when it was a remarkable pioneering achievement. The present edition is in excellent English and contains additional references up to 1961 (why was it not published then, for the manuscript was essentially complete at that time?).

The book has many admirable features. The references are a gold mine, for not only do they record an extensive Soviet literature, but they appear to include most of the work of value carried out in the United States and in Europe. The physical fundamentals are treated with an awareness unusual in meteorological literature—for example, the careful discussion of the breakdown of local thermodynamic equilibrium. The book has a logical structure and development, and the subject is treated as a whole. Finally, theory and measurement of the surface radiative balance are treated with great detail and will be invaluable for agricultural research workers. Thus, chapter 6, which is concerned with long-wave radiation at the surface, occupies one-quarter of the entire book.

But the general meteorologist, or the reader whose interests lie in other planetary atmospheres, will find the theoretical argument rather uneven. Part of this uneven development can undoubtedly be attributed to the existence of Kondrat'yev's other works, but a student will surely find it difficult to understand the integral equations when the differential equation of transfer is not discussed. Moreover there are occasional claims that a derivation is "obvious," when important assumptions are implicit, but not expressed. Equation 4.1 is an example; the reader must seek elsewhere for an explicit statement of the awkward assumption that the absorption coefficient is *not* a function of state. The average reader would profit from elaboration in such sections at the expense of, say, the lengthy theoretical justification of semiempirical formulas in chapter 6.

It is also possible to take issue with the author on some factual and some theoretical points, but this does not rob the book of its essential merits based on its pioneering quality and its sound physical insights. It will be a standard work of reference for many years to come and can be read with profit by all students of meteorology.

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Radioactivity Measurements: Experimental Data

Die Physikalischen Grundlagen der Kernstrahlungsmessungen. E. Fenyves and O. Haiman. Akademiai Kiado, Budapest, Hungary, 1965. 727 pp. Illus. $17.50.

This encyclopaedic textbook of more than 700 pages is a most comprehensive *Handbuch* covering the whole field of radioactivity measurements and their physical foundations up to about the end of 1963. The preface is dated December 1963, but the book was published in 1965. Therefore most of the very full lists of references are dated prior to 1960. Of some 1700 references to other books and to original papers, only 5 percent were published subsequent to 1957, and the references for the years 1960 through 1964 number, respectively, 19, 10, 1, and 1 (the last cites a book "in press"). These references are actually a bit difficult to locate, some of the chapters being short and some quite long, and one has to thumb through the pages forward, say, until the figure or section numbers change, to indicate a change in chapter, and then turn back to find the references. Some indication of the chapter numbers on each page, in default even of an author index, would be a tremendous asset to this very valuable book.

The emphasis in this book, as one would infer from its title, is on the measurement of nuclear radiation, and the historical introduction is from the point of view of the "development" and "perspective" of the "methods" underlying such measurement. This introduction is followed by a description of the interaction of radiation with matter; the transmission of radiation through absorbers; the principles involved in various media of detection (for example, gas multiplication, scintillation, Cerenkov radiation, and photographic emulsion); the construction and operation of detectors for the detection of single particles; the use of such methods of detection to determine the physical properties of particles emitted from nuclei; the determination of gross energy and particle emission from radioactive samples (for example, microcalorimetry, dosimetry, and the measurement of the gross activity of radioactive samples by dosimetry or by comparison with radioactivity standards); the construction and operation of particle "track detectors" (for example, cloud and bubble chambers); and the determination of the physical properties of particles, largely cosmic, from their behavior in such "track detectors," with, for example, graphs and tables of range-energy relations in nuclear emulsions.

The book concludes with three appendices that deal with the use of radiation detectors in the discoveries of the elementary particles; the statistical evaluation of radiation measurements; and, finally, the principles of elementary circuitry used in the detection, amplification, discrimination, and multi-channel analysis of pulses due to nuclear particles. This last appendix is concerned entirely with vacuum-tube circuitry and although transistors are mentioned in its introduction there seems to be no further reference to them, even in the subject index. This, however, probably reflects the date of the preface, namely 1963.

There are a few curious omissions of reference. For example, the reference for the U.S. National Bureau of Standards "$4\pi\gamma$" ionization chamber is given (in the caption) as H. Muth in *Atompraxis* instead of to several publications from the National Bureau of Standards, which could give more data, and a $4\pi\beta$ counter that looks very much like the NBS version is captioned only as "after Muth," whereas the reference (the same article in *Atompraxis* by H. Muth) again credits the National Bureau of Standards and again gives appropriate references to NBS papers.

This book is, however, most comprehensive, with a wealth of experimental data in the form of curves and tables; it should be an excellent refer-