detection of adulteration of horseradish with parsnip roots. Several chapters are devoted to background information on infrared instrumentation, theory of molecular vibrations, and rather general aspects of the interpretation of infrared spectra. There is extensive discussion of characteristic group frequencies and recipes for the identification of unknown compounds. Other chapters deal with applications in particular areas such as research on pharmaceuticals, polymers, essential oils and cosmetics, and coal. There is also an interesting chapter on the use of infrared spectroscopy by governmental regulatory agencies. Finally, there are a number of chapters covering specialized experimental techniques. These include microsampling techniques, attenuated total reflection, infrared plant stream analyzers, and the use of computers in spectroscopy.

The chapters on particular applications and specialized techniques are generally well written and often quite enlightening. They provide concise but comprehensive surveys and include extensive bibliographies which should be quite helpful to anyone contemplating the use of infrared techniques in these areas. Unfortunately, the chapters on background material leave much to be desired. There is considerable repetition by different authors, and even by the same author in different chapters. The organization is generally poor, and some sweeping generalizations and simplifications are made which could be quite misleading to a person attempting to learn the theory of vibrational spectra. The discussion of such a basic point as the Beer-Lambert law is thoroughly muddled, and units are incorrectly handled in several cases. The discussion of selection rules is rather confusing, particularly in that no clear distinction is made between symmetry-selection rules and harmonic-oscillator rules. There are a number of misleading statements, such as the generalization on page 7 that ionic compounds such as NaCl do not absorb infrared radiation.

This book should prove useful to many chemists in industry and government who have specialized problems which may be amenable to infrared techniques. However, it cannot be recommended as an introduction to the field of vibrational spectroscopy.

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Early Papers on Chemotaxonomy

It is a pleasure to review James B. McNair's recently published book, even though there is nothing new in it. **Studies in Plant Chemistry, Including Chemical Taxonomy, Ontogeny, Phylogeny, Etc.** (the author, 818 South Ardmore Avenue, Los Angeles, Calif., 1965. 399 pp. Illus. $12) is a reprinting of 26 papers, the first of which appeared in 1916—when I was a schoolboy—and the last of which appeared in 1945—the year in which I wrote my first paper on chemotaxonomy.

I have read most of these papers with close attention, especially those dealing with the history of chemotaxonomy, for McNair is a pioneer. He was using masses of chemical data and applying them to taxonomic problems when few botanists were showing any interest in this field. He tried to show, for example, that tropical plants differ from temperate ones in the natures of their oils, fats, and waxes (paper 3); that the types of alkaloids produced are dependent upon climate and taxonomic relationships (paper 14); and that molecular weights and the numbers of fatty acids from seeds increase with advance in evolutionary position (paper 18).

To illustrate the scale upon which McNair worked we may refer briefly to paper 9, "Some properties of plant waxes in relation to climate of habitat" (1931). For this brief paper he assembled data on on fewer than 232 waxes. He concluded, among other things, that "wax hydrocarbons, acids, and alcohols from the tropics have lower melting points, greater molecular weights, and larger empirical formulae than those of the temperate zone." Nearly 30 years later I was told by Barber (then of Tasmania) of the importance of the melting points of their leaf-waxes to the survival of *Eucalyptus* species in that southern island.

In many cases McNair tried to do the impossible: to reach major conclusions from the then inadequate data. How different would have been his task today. We may not agree with his conclusions, but we must read his papers if we are to know the history of chemotaxonomy, and it has been difficult to get hold of them conveniently. McNair has done a great service by having them reprinted in a single handy volume—a book that should be in every botanical library. One bit of criticism: there is no index.

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Civilization in the Diyala Plains

The increasing use of extra-archeological evidence, techniques, and viewpoints is an indicator of the maturing and refining of traditional archeological research. **Land Behind Baghdad** (University of Chicago Press, Chicago, 1965. 231 pp. Illus. $8.50), by Robert McC. Adams, is a superb example of what imaginative cooperation between dirt archeologists, natural scientists, and historians can produce.

With its origins going back to a routine archeological reconnaissance by Thorkild Jacobsen in 1936–37, the Diyala Basin Archeological Project of 1957–58 completed the survey of over 867 sites in the Diyala region of east central Iraq. The coordinating of data from archeological field reconnaissances, ancient textual records, aerial photographs, and geomorphological studies provides the base on which Adams traces "successive phases of advance and decline over six millennia of man's slowly changing relation to the land." The little-used technique of viewing the overall developments of a complex ancient civilization through a multidisciplinary study of one particular region within the sphere of influence of the civilization is given encouraging support by this study.

The book opens with a detailed description of the contemporary setting with its major natural variables—climate, flora and fauna, water resources—and a study of recent human settlement patterns. The second part of the book outlines the changing patterns of ancient occupation, from the formation of walled towns (4000–2100 B.C.) through the period of Islamic revival and decline (A.D. 637–1900). Probable causes for the changing configurations in settlement patterns and irrigation systems are then analyzed.

Three appendices provide the data upon which the studies are based. Appendix A describes the methods of "topographic archeology" employed. Appendix B describes the ceramic-dating criteria used for determining the

periods of occupation of the sites. Appendix C is a descriptive register of the 867 sites plotted in the surveys. References and notes are admirably copious and detailed.

It is unfortunate in such a large book that the notes to the tables in the text are reduced to such minuscule proportions. The same must be said about the otherwise finely produced maps and figures which illustrate the settlement and irrigation patterns. The numerals indicating the sites are unnecessarily tiny and difficult to read. It would have been more helpful to the reader if all the known site names were included in the index. As it is they are listed in the site register only numerically. But these are minor details which detract not from the overall excellence of this pioneering study.

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Soviet Geography

This book by Roy E. H. Mellor, **Geography of the U.S.S.R.** (St. Martin's Press, New York, 1965. 418 pp.; text edition, $8.50; trade edition, $12), should be a most welcome addition to the relatively small number of textbooks currently available in English on Soviet geographic conditions. The book, which examines the U.S.S.R. on a topical basis, may be divided into sections on the physical environment, the people and governmental administration, and the economic system.

The first part of the opening chapter deals briefly with the physical relief and geologic structure of the Soviet Union as a whole. This discussion precedes a rather detailed description of the landforms, including the geomorphology, of the major physical regions —the European plain, the west Siberian lowland, the central Siberian uplands, northeastern Siberia, southeastern Siberia, and the mountain systems. The Arctic islands and the country's rivers, lakes, and seas are treated in the last few pages of the chapter. In the second chapter the author considers the characteristics of the climate, soils, and vegetation. To facilitate description, the country is divided into nine climatic regions and ten soil-vegetation regions. The remainder of the book progresses from a discussion of the growth of the Russian state to the geographical exploration; population distribution and ethnic composition; town, village, and territorial administration; and finally a treatment of the individual topics of agriculture, fuel and minerals, industry, and transportation. A few notes and a number of references for further study of specific topics appear at the end of each chapter.

The book's 59 maps and 24 tables are well planned, free of unnecessary detail, and are effectively integrated into the text. The 34 pages near the back of the text contain an appendix, glossary, bibliography, and illustrations. The appendix lists the 1959 population of Soviet towns of 50,000 or more as well as the former names of many of the towns. The short glossary is helpful, but its value could have been greatly enhanced if all of the italicized terms that appeared in the book had been listed. The five-page bibliography includes a list of general and regional textbooks, atlases, periodicals, and statistical handbooks from both English and Russian sources. These references are mainly (there are a few repetitions) supplementary to those given at the end of each chapter. The 32 photographs are printed on glossy paper and are of high quality. Unfortunately, they are not keyed into the text nor are they cited in the textual materials. Only two photographs are dated.

Geography of the U.S.S.R. has a few faults, but they are minor in view of the book's quality and usefulness. The text conveys a remarkable amount of information in a style that is easily read and understood. No doubt it will become an important reference and textbook.

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Mathematics and Logic

In **Symbolic Logic and the Real Number System: An Introduction to the Foundations of Number Systems** (Harper and Row, New York, 1965. 237 pp. Illus. $7.50), A. H. Lightstone has two primary objectives: to set forth "the impact of symbolic logic on mathematics" and "to develop the real number system on the basis of ordinary arithmetic." This exposition should lead the reader to a real feeling for the concepts of logic rather than merely an ability to manipulate; for example, the use of a contrast between $p = q$ and p iff q could well tend to clarify a hazy area. Material on sets, functions, relations, operations, and so on leads to a discussion of mathematical systems. The ordered-pair approach used is sometimes burdensome, particularly in the notation for examples of mathematical systems; moreover, in the definition of isomorphism the all-important property is concealed in the notation. Illustrative examples are used effectively.

The development of the real number system proceeds from the Peano postulates through the systems of natural numbers, integers, rational numbers, and real numbers. Many parts of this (for example, the thought sequence leading to a definition of "less than") require considerable sophistication on the part of the reader. The real numbers are developed from the rationals by using sequences of decimal fractions, since the author believes that this is more natural than either the Dedekind cut or Cauchy sequence approach. The operations which this requires are simple enough as entities, but when they are combined the effect is not always clear. I question whether the intended simplicity is attained.

Some typographical errors may cause difficulty in reading, though most are evident. The proof (indirect) of Theorem 5.4.2 contains an example which appears to be an illustration; however, the contradiction obtained for the example turns out to be the theorem contradiction, no explanation of this unusual procedure being offered. A lemma (p. 125) includes uniqueness, but there is no mention of proof. Corollary 4.1.1 follows Theorem 4.1.14 rather than Theorem 4.1.1, hence back reference is not as easy as it could be.

Lightstone concludes his interesting exposition with a discussion of the properties of real numbers.

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Impact of Big Science

In April 1965, Purdue University sponsored a symposium on the general theme of "Science and Public Policy: Evolving Institutions." The principal papers presented on that occasion are brought together in **Science**