given bed material and flow condition there exists a critical velocity below which scour does not occur.

6. With these facts in mind, the following important paradox in the mechanics of erosion can be stated: *The velocity of non-erosive flow affects erosion.* With the aid of the disturbances caused by beating rain, otherwise subcritical or non-erosive flows do move soil and—just as in erosive flows—their velocity affects the erosive rate. It is easily observed that many particles raised from their resting places for a brief moment at raindrop impact, travel down slope. The distance of travel is undoubtedly dependent upon the velocity of run-off.

7. There is some evidence, obtained from mechanical analyses of the sediment load from two tests which differed in run-off rate, that variations in run-off rate and consequently velocity, affected the amount of the largest particles but not the finest. Thus, it may be concluded that a condition exists in these shallow "sheet" flows that is closely analogous to that reported as existing in streams. Here, as in rivers, the quantity of fine soil carried in suspension does not appear to be influenced greatly by the rate of run-off. On the other hand, the amount of larger particles which move as bed load appears to increase with increasing flow velocity. If this be true, then insofar as the test conditions represent field conditions—and it is believed they do for an appreciable portion of most cultivated fields for most run-off periods—the erosive forces accompanying rainfall impact are solely responsible for the losses of the finer portion of the soil. And methods devised to reduce the velocity of overland flow, which do not protect the soil surface from rainfall impact or reduce the total quantity of run-off, will not effectively reduce the losses of this highly important finer portion of the soil which carries much of the fertility.

Finally, it appears that Mr. Ellison's reference (*5*) (*Sci. Mon.* 1940, **63**, 241) is nonexistent.[1]

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[1] Ed. Note: This reference was erroneously recorded. The article in question starts on p. 241 of vol. 68, 1949, of *The Scientific Monthly.*

Book Reviews

Anatomy of the Dicotyledons: Leaves, Stem, and Wood in Relation to Taxonomy, 2 vols. C. R. Metcalfe and L. Chalk. New York: Oxford Univ. Press, 1950. 1,500 pp. $25.00 the set.

During a period when it seems that altogether too many botanists are wasting their time and effort in adding to an already marked superfluity of elementary botany texts, it is indeed refreshing when others demonstrate that they have a far better understanding of the real needs of the botanical sciences. The present book is a basic and truly monumental contribution toward a comprehensive knowledge of the vegetative organs of the Dicotyledons on a taxonomic basis.

The work is founded upon Solereder's *Systematic Anatomy of the Dicotyledons* and has the same chief aim —namely, to emphasize the taxonomic and phylogenetic values of anatomical characters—but the oft-repeated complaints against Solereder's treatise have been circumvented. The larger part of the book and the introduction are the work of the senior author, the junior one being responsible mainly for the descriptions of secondary woods. They were assisted by many other specialists.

The introduction is superb; every aspect of each subject treated, the pros and cons as advanced by various workers, have been fully discussed with admirable perspicacity.

Treatment of the families follows Bentham and Hooker in general, with the addition of those whose erection since their time has been generally recognized. Each family is begun with a terse summary concerning (1) general features and (2) wood anatomy, following which the leaf, axis, and root are discussed, together with paragraphs on ecological anatomy, anomalous structure, economic uses, and taxonomic notes. Roots are too briefly described and are omitted entirely for many families; in the reviewer's experience, these organs deserve more attention than most botanists seem to realize.

Factual errors are remarkably few. The reviewer checked numerous statements concerning plants of which slides were available but found only one inaccuracy. The leaf of *Petalonyx thurberi* (p. 669), said to be centric, actually is isobilateral, and the vascular tissue of the midrib consists entirely of lignified, pitted cells. Most of the errors concern geographical distribution, but many of these plainly were copied from sources which in turn were mistaken. As one instance, the citation for the distribution of the Saururaceae (p. 1127), which is given as Malayan, is apparently taken from Hutchinson's *Families of Flowering Plants,* yet the latter illustrates *Anemopsis californica* as representative of the family. All authors concerned should have observed that the specific epithet hardly refers to a Malayan region. No typographical errors have been noted, but one wonders why "s" is substituted for the "z" in Schizandraceae.

One specific criticism concerning morphological-taxonomic relationships is pertinent: the inclusion of *Trapa* in the Onagraceae (p. 664 *et seq.*). All the morphological and embryogenic evidence, which should have been noticed by the authors, excludes that genus from the family.

The typography is most pleasing, with important terms or characters in bold-face type. The binding, however, reveals immediate evidence of rather cheap and careless workmanship.

The hope of the senior author that taxonomists will recognize the value of anatomical characters in the delimitation of all taxonomic groups from families down to species seems to be somewhat optimistic, if the extent to which readily available cytomorphological, not to mention embryonomic, data have been ignored in the past by all

save a few systematic botanists is any criterion. In any event, for plant morphologists this is unquestionably the most useful reference work ever compiled.

But anatomy alone will not solve all taxonomic problems in the Angiosperms: the aid afforded by the other morphological fields must also be taken into consideration. When the data of anatomy, of microsporogenesis, and megagametogenesis, plus those of embryonomy and cytology, are all brought together, we may get the answer to the ancient and harrowing question: "What is a species?"

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Structure of Molecules and the Chemical Bond. Y. K. Syrkin and M. E. Dyatkina; translated and revised by M. A. Partridge and D. O. Jordan. New York: Interscience; London: Butterworths Scientific Publs., 1950. 509 pp. $8.75.

The first chapter of this book includes an introduction to wave-mechanical ideas and the hydrogen-atom wave functions, and the second develops the periodic table. The next five chapters develop the theory of the chemical bond, taking up in order the covalent bond, saturation and direction of bonds, resonance of valence structures, resonance of covalent and ionic structures, and the molecular-orbital method. Then comes a chapter on diatomic spectra, dealing chiefly with the subject of potential energy curves. The next few chapters take up particular properties: vibrational frequencies and interatomic distances, dipole moments, bond energies, and intermolecular attraction. The three chapters following deal with certain types of compounds: crystals, complexes, and the boron hydrides. The last three chapters are rather more mathematical, dealing with the calculation of resonance energy in aromatic molecules and giving a number of derivations whose results are quoted earlier.

The book deals with the correlation and interpretation of observed structural data, and with the interpretation of chemical behavior in structural terms. Methods of determining molecular structure are not discussed. The mathematical level, except for the final chapters, is not demanding but is adequate; in fact, we feel it strikes just the right pitch, especially in the first and third chapters, which treat basic wave mechanics and Heitler-London theory, respectively.

This task of presenting the quantum theory of chemical bonding without using much mathematics is one of the most difficult that any teacher faces. There are several good books on the subject. Does this book offer anything new and useful? We think it does. First, the presentations of several basic ideas, though not new or flawless, are well done. Second, the book gives a wealth of experimental data, much more than is usual, to illustrate the topics discussed; enough data are given for the reader to see for himself just how well the rules are obeyed.

The way in which these data are given, however, and this wealth of illustration, give rise to our chief criticism. The data are presented uncritically and without adequate references, and no indication is given of their reliability. Similarly, structural interpretation and speculation on various cases are given uncritically and are, we feel, carried too far; the chapter on the boron hydrides is an example of this. The concepts of modern valence theory are very useful, but their application to chemical problems is an art, and a delicate art at that, rather than a routine logical procedure; one must be able to judge which theoretical conclusions are absolutely sure, and which are speculative. The student should develop this ability to place his bets wisely. We fear that this book will not help him to cultivate this ability as much as it could.

The text seems uneven. We liked the treatment of van der Waals forces but disliked that of the hydrogen bond; we thought the treatment of vibrational frequencies too superficial and empirical, and were surprised to find no discussion of such correlations as Badger's rule; we felt the discussion of metallic structures was far too brief. Some of this unevenness may arise from the revision of the book during translation; but on the whole we feel that the translators are to be commended. Some of the better sections, notably the chapter on molecular orbital theory, are among those that were rewritten.

We can recommend the book as a useful addition to the textbooks on this subject; if the critical viewpoint can be externally supplied, this book should be valuable and stimulating. But we should not advise a student to read it without concurrent discussions with someone learned in the art of which it treats.

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A History of Experimental Psychology. 2nd ed. Edwin G. Boring. New York: Appleton-Century-Crofts, 1950. 777 pp. $6.00.

Boring has revised his history of experimental psychology. Important news for psychology this—the revision of a classic. During the twenty-odd years since the publication of the first edition, nearly every contemporary psychologist has been stimulated by it. In revision, the classic will achieve even greater importance.

The second edition is a true revision. In Professor Boring's own estimate (a fair one), ". . . the new edition is about one-third larger than the old, is one-half new writing and uses for its other half about two-thirds of the old edition." The treatment of the emergence of science (22 pp.) now throws into relief the problem of the great man versus the *Zeitgeist* in the interpretation of history, and Boring returns again and again to this problem. The emergence of psychology within science, particularly within physiology (127 pp.), is treated without much change from the first edition. The discussion of the emergence of psychology within philosophy (116 pp.) includes a new chapter on the Scottish faculty school and the French materialists, as well as a new section on Kant. The founding of experimental psychology by Fechner, Helmholtz, and Wundt (73 pp.) is little changed. The establishment of modern psychology in Germany (106