

pertinent to the subject complete a book that will assist in promoting the science of range management. It will be a valuable addition to the libraries of botanists, physiologists, ecologists, teachers, students, range administrators, and livestock producers.

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Principles of Plant Physiology. James Bonner and Arthur W. Galston. San Francisco: Freeman, 1952. 499 pp. \$5.50.

This book is a pioneer in what will undoubtedly become a widespread movement aimed at modernization of botanical texts too long steeped in the classical intuitive approach. Bonner and Galston have bravely stepped between the fire of the orthodox who cannot tolerate change and of the moderns who will carp at the lack of rigorous intellectual treatment and at the comic-book aspect of some of the illustrations.

Specifically, the authors have attempted a fusion of plant physiology with contemporary biochemistry, much of the latter unfortunately based more upon what is known about animals and bacteria than upon knowledge of plants. Their mode of approach is clearly outlined in the preface. Emphasis upon brevity, decisiveness, and basic principles was sought, and to ensure success in the search "detailed discussions of contradictory views [were] . . . avoided . . . in the hope that a clear conception of [e.g.] translocation will aid the student in organizing and remembering the facts relative to the subject." The authors admit that "such a treatment tends to become dogmatic," but by some curious turn of logic claim to have tried "diligently to avoid dogmatism." That the treatment is dogmatic by virtue of oversimplification can scarcely be doubted. That some degree of dogmatism cannot be avoided in a first enthusiastic attempt to wed the ingrained empiricism of plant physiology to the analytical approach of biochemistry is a certainty.

The physiological content of the text is by and large excellent, although one detects a natural tendency to emphasize those topics nearest the research interest of the authors' institution. Especially welcome are the elimination of lengthy, obscure tables and the substitution of graphs wherever it is possible to describe processes in quantitative terms. The graphs are well chosen and excellently rendered. Welcome also are the relegation of water relations of plants to a position commensurate with their comparative unimportance and the introduction of much modern material on growth.

Presentation of biochemical subject matter is difficult at the elementary level unless one can presume a thorough grounding in theoretical chemistry on the part of the student. The biochemical section of this text appears to be a watered-down version of the senior author's recent general treatment of the subject. Pedagogically, it is doubtful whether the begin-

ning student will acquire a very clear and convincing conception of plant physiological chemistry even with the advantage of numerous, perhaps overly facile, chemical formulas and equations and the whimsical, five-armed ghostly enzyme of Evan Gillespie. In general, the use of illustrations, however competently drawn, at the expense of critically written text would seem to exceed the needs of even a picture-conscious generation.

Because this is a pioneering text and because it is obviously written with vigor and enthusiasm, it should be on the shelf of every physiologist and of those physical scientists who, in unguarded moments, wonder why the life sciences have not yet adopted the language of mathematics.

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Contributions to Embryology, Vol. XXXIV, Nos. 222 to 230. Carnegie Institution Publ. 592. Washington, D. C.: Carnegie Institution of Washington, 1951. 196 pp. and 58 plates. \$9.50; \$8.75 paper.

Eight of the nine papers in this new volume of *Contributions to Embryology* deal with primate material (macaque, 3; human, 5) and are equally divided between studies of embryonic development and of the reproductive tract. The ninth, by LaVelle, "A Study of Hormonal Factors in the Early Sex Development of the Golden Hamster," compares the effects of castration of hamsters of both sexes on day 1 after birth and of administration of male sex hormone with the conditions found in normally developing animals. The material in all the papers is presented in the lucid style and with the abundant and well-executed illustrations that have characterized papers in previous volumes.

The most extensive of the four embryological studies describes age groups XIX through XXIII in the series "Developmental Horizons in Human Embryos," planned by Streeter for the survey of the Carnegie Collection. This paper, the fifth by Streeter, was prepared for publication by Heuser and Corner utilizing illustrations and notes assembled by the author prior to his death in 1948. These age groups cover the last ten days of the embryonic period and have an estimated ovulation age of 39 ± 1 to 47 ± 1 days. Tabulated data concerning the 112 embryos, photographs of ones selected from each horizon, and detailed descriptions and figures of the development of the eye, cochlea, kidney, and certain other organs are presented. A graphic plot of embryos in the collection in horizons XI through XXIII provides a growth curve for the period between 22 and 48 days of estimated ovulation age.

Of the three other embryological studies, that by Hines and Emerson, "Development of the Spinal Cord in the Fetal and Infant Macaque, I. Growth, as Increase in Size," analyzes measurements of cord length and of cross-sectional areas at selected levels of the cord in specimens from 66 days of gestation to 14 months postnatally; that by Sensenig, "The

Early Development of the Meninges of the Spinal Cord in Human Embryos," traces meningeal origin to paraxial somitic mesoderm with a contribution of some neural crest cells to the pia mater; and that by Faulconer presents "Observations on the Origin of the Müllerian Groove in Human Embryos."

The four papers on the reproductive system include one on corpora lutea of the human ovary (White, Hertig, Rock, Adams); two on cyclic changes in the endometrium of the macaque (Bartelmez, with the collaboration of Corner and Heuser; Bensley); and one on certain differences in the pattern of uterine enlargement in primigravidae and multigravidae during the latter half of pregnancy (Reynolds and Baker). The report by White *et al.* compares histological and histochemical observations on 28 corpora lutea from pregnancies of 60 hours (a 2-celled egg) to 4½ months with those made on 48 corpora representing every day from ovulation to menstruation in normal menstrual cycles and on 13 associated with abnormal ova. "K cells," a new cell type, arising in the theca interna and eventually appearing in the membrana granulosa receive particular emphasis since their ketosteroid content suggests that they, as well as the granular lutein cells, may be involved in the secretory function of the corpora.

Two aspects of the cyclic changes in the macaque's endometrium are presented by Bartelmez and Bensley. The former considers the changes in the endometrium as a whole; the latter, the fluctuations in the mitotic activity of its epithelium. Both compare the conditions found in the different phases of the menstrual cycle (follicular, pro gravid, regressive, menstrual, and repair). Bensley finds the highest mitotic rate at the follicular phase and the lowest at the late luteal phase, but some variation in the rate appears in different regions of the epithelium, such as the surface epithelium, the superficial glands, and the basal glands. Bartelmez describes in detail the structural pattern of the endometrium for each phase and interprets the conditions found in the follicular, pro gravid, and regressive phases as adaptations for insemination, care of the blastocyst, and nourishment of the trophoblast.

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A Study of Antimetabolites. D. W. Woolley. New York: Wiley; London: Chapman & Hall, 1952. 269 pp. \$5.00.

The establishment of a new principle in any branch of science occurs rarely. We can now safely assert, however, that the interference with metabolic activities by structural analogs is an established principle in biology. Its demonstration during the past 12 years has been more and more conclusive. (A number of investigators explained various phenomena on this basis as far back as 1920, it is interesting to note.)

This review of the antimetabolites by one of the foremost authorities in the field is most welcome and rewarding. Material covered includes a summary of

the factual knowledge; hypotheses; applications to chemotherapy, pharmacology, and biochemistry; "the designing of antimetabolites;" and a chapter on synthesis and other phases of methodology.

The "favored hypothesis" for this phenomenon is that the antimetabolite is able to form a complex with the enzyme with which the metabolite normally reacts, but this enzyme-antimetabolite complex cannot then be converted into the normal products of the reaction, whereas the enzyme-metabolite complex can. This hypothesis, as well as objections to it, is examined critically.

It is not generally recognized that antimetabolites occur widely in nature and that evidently "nature long ago has seized upon this phenomenon, possibly as an elegant way of controlling natural processes." Cases in point are the antagonisms between testosterone and estrone, adenosine and cytidine, and between certain amino acids. Sometimes these result in physiological checks and balances, sometimes in disease.

Isosterism is considered, and an attempt is made to reconcile it with the favored hypothesis. This is the phenomenon that is quite the opposite to biological antagonism—i.e., the fact that two drugs closely related in chemical structure may have the same rather than antagonistic effects. Another mystery discussed is the fact that *p*-aminobenzoic acid, toward which the sulfa drugs are antagonistic, is itself a chemotherapeutic agent against rickettsial diseases.

An interesting topic is the antihistaminics as antimetabolites. One or two of the examples used require some stretch of the imagination in order to see them as analogs of histamine, but since they have been found to be effective clinically, the effort is worth making.

The lack of an author index is a minor fault that does not appreciably lessen the usefulness of this scholarly and readable volume.

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Adhesion and Adhesives. N. A. de Bruyne and R. Houwink, Eds. Houston-Amsterdam: Elsevier, 1951. 517 pp. \$10.00.

The editors, assisted by a group of 14 specialists, have undertaken to cover in one volume a rather detailed survey of adhesives. Two main sections of the book deal, respectively, with the theoretical aspects of adhesion and with classes of materials generally useful as adhesives. A final chapter briefly describes adhesive testing.

The theoretical section summarizes efforts to relate phenomenological quantities—for example, those representing surface tension, interfacial energy as well as solubility and compatibility with molecular constants, as defined by dipole moment and group moment, dielectric constant, and the van der Waals' constants. Such efforts have so far led only to limited qualitative successes. The rheology of adhesives is