zation in relation to morphogenesis. In addition, the present expanded volume contains information on plant embryogenesis, tissue differentiation, and flowering and a brief examination of selected morphogenetic studies on nonvascular plants. These topics are considered largely in terms of the developmental changes occurring at and above the cellular level. Although some attention is given to cytological and biochemical studies, the paucity of ultrastructural and biochemical data, particularly in the section on embryogenesis, will no doubt disappoint those whose attempts to understand plant morphogenesis have led them to study factors controlling changes in form at the subcellular level. Many readers will question the omission of references to the recent exciting studies on oriented cell divisions, mitotic spindles, and microtubules which already have contributed to our understanding of morphogenetic events.

Selected recent contributions from the literature on growth and form in plants are used to illustrate advances in specific topics. Unfortunately, they do not clarify materially such terms as "physico-chemical reaction systems," "physiological fields," and "growth centers," which are used frequently throughout the book to explain various morphogenetic phenomena.

It is not clear what audience the author had in mind when writing the book. The treatment is too detailed to permit its use as an introductory text in plant morphogenesis or for courses where developmental aspects of plants are briefly considered. A background in plant morphology and physiology is necessary if one is adequately to follow the author as he summarizes and integrates results of numerous investigators from Goethe (1790) to Waris (1967). The book is best suited for the advanced student and active worker in the field, who will find it useful for the comprehensive summation of experimental work performed on apical meristems.

More than half of the book is directly concerned with apical organization. The surgical experiments developed by Wardlaw and his colleagues and used so successfully during the past two decades to investigate the potentialities of the shoot apex are considered in great detail. These contributions have been extensively reviewed elsewhere, and readers will find much familiar material in this volume. Some will undoubtedly question the value of the present treatment, since much of the same material is covered in the authoritative chapters contributed by Wardlaw to the *Encyclopedia of Plant Physiology*. To others who, like myself, early followed closely the exciting developments in plant morphogenesis depicted in Wardlaw's writings, the book may be a poignant reminder of how little is known of whole-plant morphogenesis and how much remains to be accomplished.

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A Question in Astrophysics

Spectral Line Formation. JOHN T. JEFFERIES. Blaisdell (Ginn), Waltham, Mass., 1968. xxii + 298 pp., illus. $10.50.

Much of the total information we obtain from the solar atmosphere and almost all our data concerning stellar atmospheres come from the shapes and total intensities of the dark lines in their spectra. Accordingly, astrophysicists have devoted much effort to trying to understand the exact mechanisms involved in spectral line formation. The shape, or profile, of a spectral line is determined by a number of factors, including line broadening due, for example, to Doppler effects produced by thermal motions of atoms or by their mass motions (turbulence); "density" broadening due to encounters between radiating atoms and perturbing particles; natural broadening (radiation damping); and—for some elements such as manganese—hyperfine structure. Stellar rotation or magnetic fields also tend to broaden spectral lines. Precise calculation of the profile of any line becomes a formidable task. One must know certain atomic constants such as transition probabilities and collisional line-broadening parameters, how the number of atoms capable of absorbing the line varies with depth in the stellar atmosphere, and finally the "mechanism" of line formation. Are the absorption and emission of radiation determined entirely by the local temperature and density (assumption of local thermodynamic equilibrium = LTE) or are they fixed primarily by the radiation field (non-LTE)? Earlier work on stellar atmospheres employed the simple LTE approach—which fortunately turns out to be a better approximation than we might have deserved. Some of the earlier work on non-LTE effects yielded spurious results because of bad observational and experimental data. With an improved understanding of stellar atmospheres and better data this situation is being remedied.

Jefferies' admirable contribution to the literature on the theory of spectral line formation constitutes a volume which every serious student of astrophysics will want on his shelf within easy reach. Emphasis is placed more on basic physics than on applications. The book is particularly valuable in the context of line-formation problems where deviations from LTE must be taken into account; these include the most important and challenging tasks in spectral-line-formation theory. One of the most difficult of these is to determine the solar iron abundance. If solar and chondritic silicon : iron ratios are indeed identical and the transition probabilities are not wrong, there is something very fundamental about spectral line formation we do not understand. Deviations from LTE apparently cannot remove this discrepancy in silicon : iron ratio. Publication time lags being what they are, there is no reference to promising brand-new developments such as the technique of spectrum synthesis developed by B. J. O'Mara and John Ross whereby the exact shape of even complicated regions of the solar spectrum can be reproduced.

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Analytical Technique

The Practice of Gas Chromatography. LESLIE S. ETTRE and ALBERT ZLATIKIS, Eds. Interscience (Wiley), New York, 1967. xvi + 591 pp., illus. $14.95.

Despite a welter of theory on gas chromatography it is still difficult for an analyst, even if he has digested the theory, to make precise decisions on the design of his analyses, and much remains a matter of judgment. This book provides guidance for the necessary judgments without requiring the reader to absorb more than the bare minimum of theory.

Inevitably this leaves the reader at the mercy of the authors of the chapters. At times their guidance is not what this reviewer would have given; however, this occurs only where differ-