

Within conversations, the patterning of gaze is intimately linked to the tempo of speech and gesture, producing an interactional pattern of incredible complexity. Glances are used by speakers to signal breaks in interaction, encourage feedback, and permit entry by another speaker. Listeners signal their attention through gazing, accompanied by appropriate facial expressions to indicate more specific meaning. In a dyad, each person is simultaneously pursuing his own social goals as well as responding to those of the other, according to Argyle and Kendon's conceptual model of social behavior as a motor skill. Throughout, gaze plays a crucial regulating role. Unexpected gaze patterns, such as inattention or staring, can disrupt the flow of discourse as surely as an ill-chosen word, and often do so with much greater rapidity and effect.

Although there is a certain regularity within any culture in the encoding and decoding of affect and intention via the eyes, individual differences do exist. Aberrant use of the eyes has been noted in various mental disorders, notably autism, schizophrenia, and depression. In these cases, a general aversion to social encounter seems to be reflected in gaze aversion patterns. A need to cut down on sensory overload may also be operative, particularly in the case of autistic and schizophrenic individuals. In the more normal range, extraversion and affiliative needs have been found to correlate with greater use of gaze. Females overall seem to exhibit higher levels of gaze, a finding that gives rise to speculations on innate sex differences (six-month-old girls look more than boys of the same age) and on cultural conditioning (affiliative needs and interest in persons presumably are stressed more in the socialization of females).

Overall, then, Argyle and Cook conclude that gaze operates in the synchronization of conversation, the reception and sending of information, and the regulation of the emotional tone of an encounter. Intimacy and dominance are signaled by gaze, acting in concert with innumerable other verbal and nonverbal signals. Argyle and Cook have not tied up the loose ends of the field, of which there are many, but they have done a service by collecting and presenting in a readable manner evidence revealing the importance and complexity of the role of the eyes in interpersonal encounters.

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Interfaces

Grain Boundary Structure and Properties. G. A. CHADWICK and D. A. SMITH, Eds. Academic Press, New York, 1976. xviii, 388 pp., illus. \$34.75. Materials Science and Technology.

Grain boundaries have challenged the imaginations of metallographers, ceramists, mineralogists, and others who have observed the interfaces of grains or crystallites under the microscope. These interfaces, particularly the ones observed for an etched metallic specimen with an optical microscope, are so definite that it was felt that something must be present at the boundary, and the earliest conception of a grain boundary was as a thin, amorphous cement that held the grains together. Although there were no direct observations of any grain boundary structures, that conception was used to explain a variety of properties. In high-temperature metallurgy, for example, the concept of an equicohesive temperature was used to describe the creep behavior of certain metals as the temperature was raised: At low temperatures the grain boundaries were stronger than the grains and creep occurred by slip within the grains. At high temperatures the grain boundaries were weaker and creep occurred by slip at the boundaries. At the equicohesive temperature the grains and the grain boundaries were equally strong and both mechanisms operated. Grain boundary precipitates were observed and blamed for such phenomena as the sensitization of austenitic stainless steels to corrosion and the brittle fracture of certain steels. Although the search for an amorphous cement was fruitless, there was the abiding feeling that a grain boundary was *something*.

The feeling that a grain boundary had the qualities of a membrane was reinforced by the pioneer work of Cyril Smith and others on the energies of solid interfaces at equilibrium. The conceptual shift from specific interfacial tension was made immediately, and the simple calculations for relative interfacial energies were made on the assumption that the shape of a grain was determined by the balance of tension forces acting on a grain boundary intersection. This approach is still valuable, but it did leave an impression that grain boundaries were envelopes encompassing each grain. Only in the case of diffusion did it appear that they were something else. It was shown early that atomic migration was faster along grain boundaries than

through the lattice, at least at low temperatures, and this implied that there was considerably more room at the interfaces. Furthermore, studies of sintering indicated that boundaries might act as vacancy conduits and as vacancy sinks. The diffusion mechanisms implied that boundaries were disordered regions that were active in transporting absorbing vacancies.

Our experimental techniques and theoretical methods are now much more powerful, and we should be able to determine what a grain boundary is. The book under review provides a very good picture of the principal recent work in the field. There is a paper by Loberg and Norden on the use of field ion microscopy and high-resolution electron microscopy and on the theoretical interpretation of the data obtained by these techniques in terms of the coincidence site lattice theory, the structural unit model, and the plane matching theory. This paper has more the look of instructions to a computer than of a treatise in English, and indeed the very next paper is a computer simulation of grain boundaries. Both these papers leave the reader with the thought that a grain boundary is not simply a collection of dangling lattice sites, but rather a defect structure that may have some degree of regularity. Indeed, the coincidence site lattice model defines a parameter, Σ , which is the reciprocal density of the common lattice points in two neighboring grains, to describe the character of a grain boundary. The topographical concepts dominate the book, with discussions of models based on free volume (Aaron and Bolling) and models devised for special high-angle grain boundaries (Pumphrey). The atomic arrangements at grain boundaries are being actively investigated, and the most important product of this effort may well be a method of characterizing a grain boundary in terms of structural elements.

Some of the most interesting work, however, is on the chemical properties of grain boundaries (Hondros; Stein, Johnson, and White). Auger electron spectroscopy has provided a powerful tool for examining the segregation of impurities at grain boundaries, particularly oxygen in iron, antimony in tempered steels, and phosphorus in stainless steel. There is also a very interesting account of the role of calcium in the production of the high-density aluminum oxide; the densification effect had previously been ascribed to magnesium oxide. The discussions of the chemical effects at grain boundaries and the role of Auger spectroscopy are worthwhile, and the casual

reader should go straight to these chapters and then look at the rest as time permits.

And now we return to the original question: What is a grain boundary? Well, it is quite literally nothing, arranged not quite at random and having powerful chemical affinities. Much of the detail will be found in the book.

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Laser Technology

Gasdynamic Lasers. An Introduction. JOHN D. ANDERSON, JR. Academic Press, New York, 1976. xii, 180 pp., illus. \$17.50. Quantum Electronics.

Many laser physicists are probably less familiar with gasdynamic lasers than with most other varieties. This is largely because the distinctive pumping technique ensures that experimental work is effectively restricted to a few major laboratories with large wind tunnel facilities and a pool of expertise in aerodynamics. Moreover, at least some of the research is done behind closed doors. One would nevertheless be foolish to neglect this branch of laser physics, not only because gasdynamic lasers have formidable power capabilities, but also because the gas-kinetic information obtained from the related research has a direct bearing on more conventionally pumped gas (particularly CO₂) lasers.

Anderson's book succeeds admirably as an introduction to the world of gasdynamic lasers. The text is readable, the style informal, and the treatment sufficiently concise to enable the reader to grasp the basic principles of gasdynamic laser operation after only a brief perusal. In particular, Anderson, by including some rather elementary material in the early chapters, has clearly taken to heart the saying attributed to Enrico Fermi: "Never underestimate the joy people derive from hearing something they already know." Indeed, the momentum attained in the sections in chapter 2 on population inversion and small signal gain carries the reader through the treatment of the vibrational rate equations for the CO₂-N₂ system in chapter 3 with remarkably little difficulty.

In his attempt to present an up-to-date review of the gasdynamic laser field, however, Anderson is less successful.

The book certainly includes a substantial amount of information on research up to 1974, but the coverage reflects the author's own interest in the theory of the gasdynamic process. Although there is a chapter comparing theory and experiment and another on the present research situation, one searches in vain for a table comparing the values achieved at various laboratories for such basic parameters as mean power and energy per unit mass. Perhaps it is the closed doors that are causing the problem.

Despite these shortcomings, the reviewer enjoyed the book and commends it to others who wish to be better informed about this important branch of laser technology.

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Seed Anatomy

The Seeds of Dicotyledons. E. J. H. CORNER. Cambridge University Press, New York, 1976. Two volumes. Vol. 1. xii, 312 pp. \$39.50. Vol. 2. Illustrations. viii, 552 pp. \$65.

Seed anatomy has been a neglected subject, despite its inherent importance in the study of taxonomy, phylogeny, dispersal mechanisms, and dormancy characteristics. The appearance of this major contribution is therefore a welcome event. There is no need for anyone with an ambition to work in this intriguing field to feel inhibited, however. Although the book presents a wealth of new information (volume 2 consists wholly of illustrations derived from original research), only a small fraction of dicotyledonous genera and species have been covered by Corner—or by earlier workers. Those interested in seed anatomy will also have to acquire a copy of Netolitzky's 1926 monograph, *Anatomie der Angiospermen Samen*, which Corner rightly respects highly, cites liberally, and does not supplant.

Corner's choices of genera and species are, predictably, biased. Any worker would show a bias, if only in response to the availability of material. Surely every organismal botanist is familiar with Corner's "durian theory," which proposes that ancestral angiosperms had black seeds with red arils and such features as pachycauly (thick stems with large pith and cortex). Few botanists have accepted this colorful theory, to the best of my knowledge, but the reader of *The Seeds*

of *Dicotyledons* will want to keep Corner's ideas in mind as he peruses the book. The reader will readily be able to separate theory from data, and one cannot fault Corner's accuracy or scholarship in the description of seeds. However, arillate seeds (which are admittedly interesting for a variety of reasons) bulk large in Corner's presentation, as do seeds with vestigial arils, arillike structures, or unusual venation.

Corner is alert to the phylogenetic and taxonomic implications of his data. The phylogenetic analysis is extensive, but it is based almost exclusively on seed anatomy. Attempts to build a natural system of classification are faced with the far more difficult task of integrating all types of data. For example, Corner finds it difficult to place Anacardiaceae on the basis of seed anatomy, but the totality of evidence seems to me clearly to show that the Anacardiaceae are sapindalean. Those interested in phylogeny will have their thinking briskly challenged by some of Corner's ideas. For example, according to Corner, seeds of the admittedly enigmatic Rafflesiaceae show a relationship "to those of Piperaceae, Saururaceae, and Podostemaceae, which may be thought a curious alliance, but if all can be derived from a Magnolialean beginning, the inter-relationship is not impossible. It suggests a pachycaul line that has failed in vegetational dominance but discovered some of the most remarkable ways of existence." Corner's speculations will be stimulating to some, and they are certain to create some controversy.

The terminology in these volumes is clear and simple, and is explained by suitable diagrams. The illustrations are all drawings, admirable for their clarity. Corner's main concern is with the seed coat; endosperm, embryo, and fruit histology receive more abbreviated treatment. The arrangement of families in both text and illustrations is alphabetical—an eminently sensible scheme that should be more widely adopted in botanical monographs. The reader will encounter a few recondite segregate families (Balanitaceae, Legnotidaceae, Nandinaceae, Sauvagesiaceae), and some families are omitted altogether, presumably because liquid-preserved material was not available. Although the price is too high for most individuals, institutions where plant anatomy is represented will certainly want to acquire *The Seeds of Dicotyledons*.

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