time to time in a characteristic English aspect. For example, lamenting the lack of exercise space on *Discovery* (a square-rigger!) he says, "When not working a station, I went down to the stokehold every evening to stoke and trim coal in the bunkers for an hour," which, even allowing for the reward of a bucket of hot, fresh bath water, impresses a somewhat sedentary seafarer like me.

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How To Depict

Scientific Illustration. Theory and Practice. CHARLES S. PAPP. Brown, Dubuque, Iowa, 1968. xiv + 318 pp., illus. $11.75.

Graphic Communication. WILLIAM J. BOWMAN. Wiley, New York, 1968. xii + 210 pp., illus. $9.95. Wiley Series on Human Communication.

Practical Geometry for Technical Drawing. S. J. WOOLVEN. Cambridge University Press, New York, 1967. viii + 256 pp., illus. $3.95.

All three of these books are well worth the attention of any scientific illustrator or potential illustrator, whether he is an artist or a scientist who wishes to illustrate his own papers. Each of the three deals with a different aspect of illustrating, and they complement each other remarkably well.

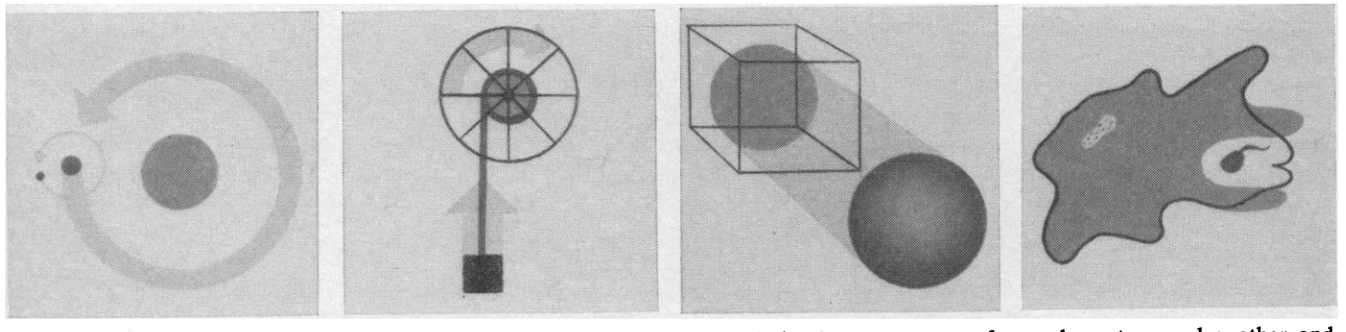
Charles Papp's book deals specifically with the problems and techniques of scientific illustration. The author, a highly talented scientific illustrator, is as detailed and precise in his writing as in his drawing. The major portion of the book is devoted to analyses of and instructions regarding the drawing techniques applicable to different subjects. Among the matters treated are the degree of accuracy and detail required in different types of publications, be they scientific, semipopular, or popular, and the best ways of achieving the desired results. Happily for the beginner, each major technique is described step by step and common pitfalls are considered, along with the amount of reduction that is desirable and the most appropriate printing method.

The special problems associated with each subject field are discussed. Archeological and paleontological rendering are included as well as the more familiar subjects of zoological and botanical illustration. Papp's illustrations are all outstanding, and a number of them are exquisite.

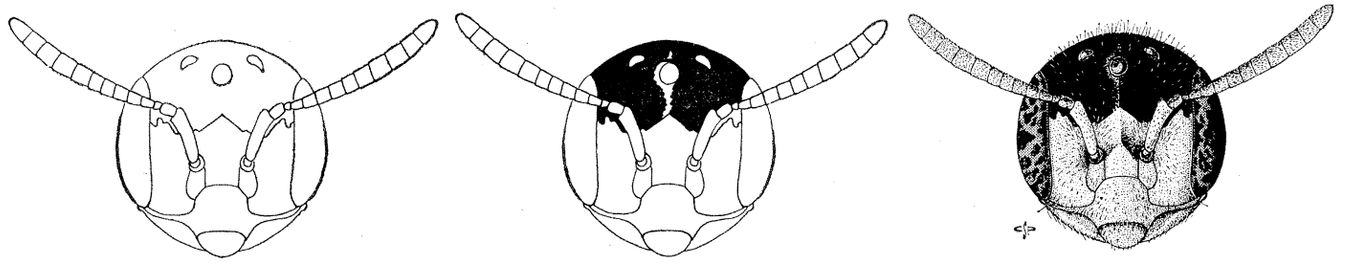
Descriptions of proper drawing instruments and their uses and of suitable papers and drawing surfaces are helpfully included. So is an informative section that introduces the reader to the kinds of drawing equipment and aids that are available, helpful, or necessary to the scientific illustrator. An extra bonus comes in the form of numerous and helpful hints drawn from Papp's experience with scientists and editors of scientific journals on how to satisfy both. The planning of formats, the reduction of artwork, composition, and proportions are all explained clearly.

The author rather forcefully brings out one point which is too infrequently made and with which this reviewer agrees wholeheartedly. This is the need of a good background in science for anyone making a career of scientific illustration. Training in a scientific subject gives the illustrator not only a knowledge of subject material but also familiarity with the scientist's point of view and needs.

Graphic Communication by William J. Bowman may be of more interest and use to the commercial artist than to the scientific illustrator, but it contains much valuable information that can readily be used by the latter. Many different types of subject matter and many



Examples of the illustration of motion. *From left to right*: The compound circular movements of one element around another and a third, subordinate element around the first; a pulley motion in which both circular and direct movements are indicated; a kind of exit movement, depicted without the use of an arrow; an amoeba changing the position of its right side forms to absorb a small organism (here again the movement pattern is made evident without the use of arrow forms). [From *Graphic Communication*]



Steps in the drawing of a bee. *Left*, a pencil outline is inked in; *center*, dark areas are covered with India ink, leaving highlights around the ocelli and the middle of the frons; *right*, the finished drawing. "Incidental patterns in the eyes are added. . . . Shading . . . brings out the 3-D effect. Highlighting the ocelli gives life. Details at the base of the antennae give a moderately concave appearance. . . . Hair lines on the black areas are scraped with a scapel. . . . Pubescence on the antennae is illustrated by scraping very fine lines close together. . . . To finish the eyes a prefabricated tone [is used]." [From *Scientific Illustration*]

kinds of design and artwork are used in illustrating ways of presenting information visually in simplified form. The book provides less basic step-by-step assistance than *Scientific Illustration,* but it does present many imaginative ideas for expressing data pictorially, and certainly many of these are applicable to the presentation of scientific data and experimental situations. Extremely useful also are different sorts of cutaway and sectional representations, both in detail and in simplified diagrams. The book is clearly written, well organized, and wide in scope.

Bowman is obviously a talented and knowledgeable graphic artist, and on the whole the profuse illustrations in his book are excellent in design and elegant in their illustration of points made in the text. In the foreword, Bowman states that "These design solutions are intended to serve as conceptual models, to be interpreted rather than imitated. With this spirit in mind they have been executed informally in pencil, rather than in formal media such as ink and air brush." The pencil renderings are slightly fuzzy and lack contrast, and I hope prospective buyers will take time to discover the worth of the book and not put it back on the shelf because of this shortcoming.

Practical Geometry for Technical Drawing by S. J. Woolven is a delight, at least to anyone who loves geometry or technical drawing. It should be very useful to any illustrator who needs occasionally to include accurate geometrical figures in his drawings. The book gives clear, logical, and detailed instructions for the construction of a wide variety of figures and includes both the hows and whys of each problem. The constructions are clearly illustrated, and I think the book should be a boon to students studying technical drawing. The levels of complexity covered by the author run from how simply to bisect an angle and construct accurate scales, to developments of compound objects. As well as being useful, this book is fun.

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Crosscurrents in Statistics

The Selected Papers of E. S. Pearson. Issued by the *Biometrika* trustees to celebrate his 30 years as editor. University of California Press, Berkeley, 1966. viii + 327 pp., illus. $6.75.

Joint Statistical Papers. J. Neyman and E. S. Pearson. University of California Press, Berkeley, 1967. viii + 299 pp., illus. $7.

A Selection of Early Statistical Papers of J. Neyman. University of California Press, Berkeley, 1967. x + 429 pp., illus. $14.75.

It is 40 years since J. Neyman and E. S. Pearson launched the series of papers which so profoundly influenced the development of theoretical research in statistics and of the teaching and application of statistical theory. At first, their work appeared to be complementing and extending that of R. A. Fisher, who was already established as an innovator of great genius in the theory of statistical inference [see Neyman, *Science* **156**, 1456–60 (1967)]. However, from 1935 until his death in 1962, Fisher consistently and often scathingly attacked the concepts of Neyman and Pearson and railed against the dominance of these concepts in theory and practice. Since the 1950's, moreover, the Bayesian approach to statistical inference has been making significant inroads into the British and American statistical communities, under the influence of scholars such as D. V. Lindley and L. J. Savage, and thus is regaining much of the important position it held throughout the 19th century. The new Bayesian school has in common with Neyman and Pearson an emphasis on models for decision-making, but the Bayesians find unacceptable the formulations of hypothesis testing and confidence regions which are basic to Neyman and Pearson. In such circumstances, the volumes under review form a welcome platform, amid conflicting intellectual crosscurrents, for the examination and assessment of the approaches and contributions of their distinguished authors.

The Pearson volume covers the longest span of time, with nine papers from the great productive decade 1928 to 1938 and 11 subsequent papers up to 1963. These papers range widely over topics important in applied statistics. They contain early examples of the use of experimental sampling to determine the effects of failures of assumptions on common tests of significance. Throughout his career, Pearson has expounded and defended the view that testing procedures should be viewed as decision rules and evaluated on the basis of long-run frequency properties, always within specific contexts such as the handling of outliers, the analysis of randomized experiments, or the analysis of various kinds of data having the form of a 2×2 contingency table. Pearson strongly emphasizes the role of theory in planning data collection and in treating the planning and the subsequent data analysis as a unit. A recurring metaphor in his writing is that of the statistician as a craftsman whose theoretical conceptions are tools which facilitate statistical design and analysis. Pearson is sensitive and undogmatic, but a persistent advocate of the Neyman-Pearson position.

The volume of joint papers consists of ten papers from the years 1928 to 1938 which set forth the main features of the Neyman-Pearson theory of hypothesis testing, whose theoretical development continues today over a wide spectrum, extending from very general mathematical theories to specific situations arising in day-by-day statistical practice. It is interesting that the initial paper sets the Bayesian approach on a par with the approach via sampling distributions, but gradually loses interest in the former owing to the apparent arbitrariness of (that is, the absence of a frequency basis for) prior distributions. Much of the early work involves the introduction and application of the likelihood ratio criterion for tests. But the idea of controlling long-run frequencies of errors is present from the start, along with the appealing concept of errors of two kinds, namely the error of accepting a false hypothesis and the error of rejecting a true hypothesis, which grafted a new dimension on the old puzzling (and still puzzling) concept of what Fisher called a significance test. An important breakthrough came in the