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yield better estimates of year-to-year changes in production than do those that do not make use of such information. Here, the best method is that based on a multiple regression analysis in which the indicated acreage is related to the planted acreage in the preceding year; this analysis, which includes an estimate of condition made in June, explains 78 percent of the year-to-year variation in production compared with only 32 percent associated with the best method that does not make use of information on condition. For "other" spring wheat, the several analyses yield similar results and little is gained from making use of the June information on condition.

For all hay and for rye, the analyses that make use of information on condition are less reliable as indicators of production than is the best analysis that does not make use of this information. For hay, this results because the best analysis is based on a projected rather than an average yield.

The multiple regression analysis based on average yield, condition, and the change in indicated acreage from the harvested acreage in the preceding year was the most reliable of the several studies based on condition. It explained 38 percent of the year-to-year variation in production, compared with 27 percent for the best noncondition analysis that did *not* make use of a projected yield. A similar situation holds for rye. Here the best analysis that made use of information on condition was the multiple regression based on December condition and the seeded acreage related to harvested acreage in the preceding year. This explained 49 percent of the variation in production, compared with 5 percent for the best noncondition analysis not based on a projected yield. Apparently, information on condition of rye in April is less reliable as an indicator of production than is the information that is available in the preceding December.

Book Reviews

Economic and Technical Analysis of Fertilizer Innovations and Resource Use. Edited by E. L. Baum, Earl O. Heady, John T. Pesek, and Clifford G. Hildreth. The Iowa State College Press, Ames, Iowa. 393 pages. 1957. \$4.50

THE NEXUS between research in farm management, or agricultural production economics, and research in the physical sciences has long been recognized. But the Tennessee Valley Authority and its cooperators have an outstanding record of promoting actual teamwork approaches to interdisciplinary problems. This volume, and a previous one, "Methodological Procedures in the Economic Analysis of Fertilizer Use Data" (Iowa State College Press, 1956), are indispensable references for economists, agronomists, and soil scientists who are concerned with research on fertilizers. The scope of the present work is much broader than the field of soil fertility. The book will be useful in the planning of any agronomic-economic project.

Here are 29 papers presented by agronomists, economists, and statisticians at a seminar held in

Knoxville, Tenn., in 1956 under the auspices of TVA. They are grouped under the following headings:

1. Physical and economic aspects of water solubility in fertilizers.
2. An examination of liquid fertilizers and related marketing problems.
3. Methodological procedures in the study of agronomic and economic efficiency in rate of application, nutrient ratios, and farm use of fertilizer.
4. Farm planning procedures for optimum resource use.
5. Agricultural policy implications of technological change.

The early sections are devoted to specific new problems in fertilizer manufacture and use. Later sections are devoted to progressively more general problems in resource use and agricultural policy. The last two sections deal with fertilizer research only incidentally.

More attention is given in this volume to the planning of experiments than to the fitting of response functions and analytical techniques. These subjects were treated in detail in the preceding symposium. Several chapters, however, deal with the use of linear programming in connection with a variety of research problems—the manufacture of fertilizer, optimum fertilizer applications on the farm, and resource allocations in full-time and part-time farming, among others.

To aid in the planning of experiments, several papers presented deal with experimental design, selection of independent variables, and devices that will make experiments more meaningful to farmers.

Considerable attention is given to the design of experiments that will be more economical of resources than the usual factorial experiment. A corn-fertility experiment in North Carolina is reported, in which an adaptation of a design developed by G. E. P. Box and associates is used to estimate response surfaces. Fewer treatment combinations are used than would be needed with a complete factorial design.

Most production relationships from experimental data are highly specialized. This means that a vast number of relationships would have to be developed in order to analyze effectively the production possibilities of American agriculture. A paper by Clifford Hildreth shows how the number of functional relationships needed could be reduced substantially if each relationship were made more comprehensive. This might be done by putting more variables into each relationship and by including more variables in the statistical analysis. Hildreth suggests inclusion of such

variables as initial fertility, rainfall, temperature, and wind. He suggests that construction of an index of weather "goodness" might be useful handling weather as a variable in an experiment.

According to Glenn L. Johnson, designers of agronomic experiments have done a good job of duplicating farm conditions in the use of those variable inputs that a farmer can apply under controlled conditions. They have not done so well with respect to those variables that can be controlled only experimentally. As a result, a farmer tends to look on experimental results as unreal and as not applicable to him. Johnson suggests that it might be desirable to allow for more variability in experimental results, as the amount of expected variation is one of the important facts in which farmers are interested. Increased variability in experimental results should not be objectionable so long as it does not interfere with the estimation of the functions of production.

TVA test demonstration work progressed long ago from the field demonstration stage to the whole-farm demonstration. This book contains excellent treatment of farm-planning procedures, of the need for analysis of the managerial function, and of determining the data needed to reach management decisions. Special problems of low-income farming are discussed. The relationship of the whole process of economic growth to farm production and welfare and the need for studying the growth phenomenon are presented in a trenchant article by T. W. Schultz.

Most research workers in agricultural economics, agronomy, and soil science will find much in this book that is useful.

Orlin J. Scoville

Iowa's Water Resources—Sources, Uses, and Laws. Edited by John F. Timmons, John C. O'Byrne, and Richard K. Frevert. Iowa State College Press, Ames, Iowa. 225 pages. 1956. \$3

THIRTY-SIX PAPERS given at a Water Resources seminar at Iowa State College in 1956 are made available in this volume. The seminar was sponsored by the Division of Agriculture, Iowa State College, and the Agricultural Law Center, State University of Iowa. The six parts of the book are made up of 37 chapters. Part I is a discussion of water supply in Iowa, part II deals with the economics of water use and con-

trol, part III is concerned with the multiple demands for water, part IV is devoted to water laws, part V covers the functions of governmental agencies regarding use and regulation of water, and part VI explores some of the possibilities for solution of Iowa's water problems.

The need for the seminar was premised on the conviction that Iowa, along with other humid-area States, has too little appreciation of the need for

adequate water supplies in agricultural, industrial, domestic, and other uses. The editors and the authors of some of the papers stress in profound terms the obvious fact that water is essential to man's existence. The papers indicate for the most part that the authors are experts in the subject matter they treat. The water facts they present are essential to an understanding of the water situation in Iowa.

An excellent chapter by H. Garland Hershey, State geologist, deals with quantity, distribution, and future needs of groundwater. Mr. Hershey suggests a groundwater inventory as a proper and necessary step to get an answer to how much groundwater will be needed and for what purpose. The inventory, he suggests, should show the quantity of water used and for what purposes, quantities and qualities available, and where obtainable.

Earl O. Heady and John F. Timmons, Iowa State College, attempt to provide an economic framework for planning efficient use of water resources. Although this chapter contains many useful ideas, it fails to give any practical economic guidelines for water-resource planning. If their criterion of maximization of economic welfare could be developed to the point of practical application and measurement in concrete terms and something more than ideal, it might have some value to those concerned with water-rights law and the planning of water-resource projects.

L. M. Adams, attorney in the United States Department of Agriculture, contributes a succinct and well-documented explanation of water rights in the United States under riparian and appropriative doctrines. Under riparian doctrine, Mr. Adams discusses the nature and extent of riparian rights and who may exercise them; diversion and return of water; detention of water; pollution of water; and loss of right. His discussion of these topics as they apply under the appropriative doctrine is amplified with (1) an explanation of the purposes for which appropriation may be made, and (2) a discussion of the transfer of these rights.

Wendell Pendleton, chairman of the Water Rights and Drainage Law Study Committee created by the 56th General Assembly of Iowa (1955), summarizes some of the committee's preliminary findings. The committee concluded that

the present water law in Iowa is both indefinite and inadequate. More basic information is needed on water supply, and although Iowa has a fairly strong program for collecting water data, the program should be accelerated. The committee agreed that the State of Iowa should adopt a water policy that would do everything practicable to conserve water for wise utilization, and that the goal should be maximum beneficial use of water in streams with a minimum of invasion of private property rights.¹

In the final chapter on water legislation, John O'Byrne declares it imperative to begin the formulation of a coordinated statement of policy or philosophy with respect to water use and control. A job to be done immediately, he says, is to articulate present water policy from legislative acts. He recommends a forthright legislative declaration of water policy, calling for State ownership of all waters not specifically subject to riparian use; State powers to regulate, control, and limit use, and prevent use of water sources; and the holding in trust of additional rights of use such as those relating to recreation, fish and wildlife, navigation, and maintenance of flow. He also recommends establishment of a permanent State resources organization of technicians who are qualified to plan the development of water resources on a long-range basis. After making these rather far-reaching and sweeping proposals, he returns to a more realistic note, in the opinion of this reviewer, by saying that our present stage of knowledge of Iowa's water problems dictates progress that is slow and careful. He concludes with a more modest hope that Iowa can adopt a long-range water law that will be subject to regular revision, and can establish an administrative body trained to administer an Iowa Water Code.

Elco L. Greenshields

¹The study committee submitted its completed report to the Governor of Iowa on December 1, 1956. The committee in its report proposed a redraft of Chapter 455A, Code of Iowa, 1954, to include, in addition to flood control, specific terms relating to the conservation, development, and use of water resources. The essential recommendations of the committee were enacted into Iowa water rights law by the 57th General Assembly on April 13, 1957. The law provides that permits will be required for increasing the usage to more than above normal of water from flowing streams and underground sources.

COLLEGE TEACHERS and personnel trainers have received in these selected readings a more than satisfactory response to their need for help in providing their students with sources of information in the field of agricultural cooperation. The body of literature has continued to grow until even professors who teach the course must be selective in their own readings. But when a professor dips into his last annual volume of *American Cooperation*, he finds the gems interspersed with other ideas that have been better expressed before, either in this or other publications, and he longs for a single collection of the best.

These selections were made by Dr. Abrahamsen and Dr. Scroggs, a couple of keen students, who have had broad teaching and research experience with farmer cooperatives. The review of the literature involved a tremendous reading task, and the orderly arrangement called for a broad grasp of the many aspects of farmer cooperation. The major framework for assembling the readings is a division into three parts: I. The Emergence of the Cooperative Institution; II. Cooperatives in the Modern Economy; III. Evaluation and Appraisal.

The Emergence, part I, is developed with (1) a historical and statistical account; (2) a variety of statements of objectives; (3) interpretations of the sociological, spiritual, philosophical, and economic nature of cooperatives; and (4) a statement of generally accepted principles of operation.

Cooperatives in the Modern Economy, part II, includes a review of (1) the development of policy toward cooperatives in general farm organizations, in Government, and in educational institutions; (2) legislative benchmarks; (3) relations with other cooperatives, with general farm organizations, with other businesses, and with the public; and (4) the use of horizontal and vertical integration as the core of present-day cooperative growth.

Evaluation and Appraisal, part III, considers the place of farmer cooperatives, of their business

performance, the growing use of cooperative research, and of the social and economic betterment they effect.

The 54 selections in the readings are by 49 authors, most of them nationally known leaders in farmer cooperation. We find such names as E. G. Nourse, Harold Hedges, Murray Lincoln, M. M. Coady, O. B. Jesness, Marvin Schaars, Lyman Hulbert, Marvin Briggs, Frank Robotka, George D. Aiken, Raymond Miller, and Joe Knapp. Most of the articles were taken from *American Cooperation*, but the editors made several selections from earlier contributions as well as other contemporaneous sources, including one unpublished statement. At the end of each of the 16 chapters is a carefully selected list of other available articles for students who wish to dig deeper.

The historical review and the chapter on business performance do not gloss over the organization struggles, business failures, economic losses, and thwarted hopes of the past—those associated with the Grange promotion of the 1870's; the Equity, the Alliance, and the Populist drives of the 1880's and 1890's; the activity of the Farmer Union during the first decade of this century; and the Sapiro and Federal Farm Board efforts of the 1920's and early 1930's. It is pointed out, however, that progress made and lessons learned through those trials constitute the foundation for the relatively strong position of farmer cooperatives in many fields today.

The future place of cooperatives is to be a fairly modest but very effective one of trail blazing; setting of standards for price, quality, and service; and individual and community satisfaction from common efforts. This is the consensus expressed in most of the selections. The publication can well constitute a milepost in cooperative education in the United States, and its publication by the Oxford University Press assures an impact on British Commonwealth nations.

James L. Robinson

Adaptive Behavior in Marketing. Proceedings of the Winter Conference of the American Marketing Association, December 1956. Edited by Robert D. Buzzell. American Marketing Association, 27 East Monroe Street, Chicago. 242 pages. 1957. \$2.

DISCUSSION at the 1956 winter conference of the American Marketing Association was centered around the central theme, "Adaptive Behavior in Marketing," dealing in turn with current developments in retail trade, wholesale trade, the facilitating agencies of marketing, and the price and competitive aspects of the distributive trades.

Perhaps the various ideas in the papers brought together in this volume are all reasonably well known to some few within the marketing group. However, as marketing is a relatively new field to agricultural economists, it seems to me at least that in reviewing this material many of us will come across several new ideas or new ways of looking at several current trends in the marketing field.

The discussions were not of course confined to the marketing of food and agricultural products. But the opening paper under retail trade does

deal with supermarkets, while automation in wholesale food distribution centers is discussed in the first paper in the wholesale trade section. Several of the papers also deal directly with the question of vertical integration and its relation to our agricultural system. Richard Kohls, from Purdue University, for example, discusses the by-passing of terminal marketing facilities in agricultural marketing; Richard Heflebower, from Northwestern University, considers the question as to whether mass distribution is best looked upon as a phase of bilateral oligopoly or simply as another phase of classical competition; and Robert S. Hancock from the University of Illinois considers the same subject under the title, "Implications of Quasi-Agreements and Competitive Behavior."

Several papers dealing with the future supply of marketing teachers are also of interest.

O. V. Wells

A Dictionary of Statistical Terms. By Maurice G. Kendall and William R. Buckland. Hafner Publishing Company, New York. 493 pp. 1957. \$4.50.

REVIEWING A DICTIONARY is a difficult assignment because one does not ordinarily read it from cover to cover. Statistical workers who have time to read this one will find it profitable and instructive.

Work on this volume was started in 1951 at the request of the International Statistical Institute. Five years were spent on its preparation. The authors state, "We have been conscious of the fact that, had we possessed the stamina and leisure to spend another 10 years on it, a more complete and scholarly work might have . . . resulted; but it would have been 10 years behind the demand." Despite their comment, this is an amazingly complete book and their definition of the field of statistics is wide. For example, definitions of the following are included: *Aggregative model*, *almost certain*, *analogue computer*, *attack rate* (from medical statistics), *axonometric chart*—to mention a few that I would not have expected.

The authors say, "The function of a dictionary, in our view, is to provide an explanation of terms in current use, whether they are intrinsically desirable or not. . . . We thought it our duty to keep a tight rein on our inclination to omit expressions which are confusing or redundant, and have contented ourselves with a statement of opinion about those which we felt should be allowed to lapse into disuse." The term *best estimator* is one that I have found confusing. Their definition is unusually clear:

The estimation of population parameters from information provided by the sample raises the question whether there is a "best" estimator. The answer depends mainly on the criteria that are laid down as to the "goodness" of an estimator. If there is a criterion which distinguishes one of two estimators as better than the other and if there

exists an estimator which is better than any other, it is said to be the best.

Various criteria have been suggested, for example those of sufficiency, minimum variance, or closeness. It is not always true that a best estimator exists.

Many authors define *unbiased*, *consistent*, and *efficient* in a way that is almost meaningless to the nonmathematician; Kendall and Buckland give definitions that undoubtedly are less precise from a mathematical standpoint but that are clear to the ordinary reader.

One of the great values of a book of this kind is to cite alternative meanings for a given term. Three meanings are given for *Monte-Carlo method*, one of which "is not to be recommended." Cross references to more precise terms are given also. For instance, in connection with an *efficient estimator* the authors state, "An estimator which tends to full efficiency for large samples is called Asymptotically Efficient." Frequently the adjective is omitted in statistical literature. Many tests, theorems, criteria, transformations, distributions, and so forth are identified by the individual who developed them. This is an exceedingly useful aspect of the dictionary.

As in any general book, an expert finds minor errors and incompleteness in some items. A casual examination reveals two such examples: (1) the *coefficient of part-correlation* is defined as a synonym of the *multiple-partial correlation coefficient* and the latter is attributed to Cowden (1952) based on a suggestion of Hotelling (1926). However, the term *part correlation* was intro-

duced by Ezekiel in 1930 and is defined by him in a different way. (2) The definition of the terms *endogenous* and *exogenous variates* are conventional; they are based on whether the variables are an inherent part of a system of equations or "impinge on the system from outside." We are coming to believe that it is important to use a more technical definition, namely, that an *endogenous variate* is one that is believed to be correlated with the unexplained residuals in a structural equation and an *exogenous variate* is independent of these residuals. This definition is particularly valuable in helping the analyst to decide whether certain variates which he would prefer to treat as exogenous can so be treated in a statistical fit. In view of the statistical reputations of the authors and the colleagues who assisted them, it can be anticipated that such errors are few.

An interesting feature is the inclusion of glossaries in French, German, Italian, and Spanish. But definitions as such, are in English. An occasional American colloquialism has been permitted, as in the following:

Line-up

The American equivalent of the English meaning of the French word "que." (See Queueing Problem.)

This book is a valuable reference work to any one even remotely connected with statistics and, the reader who has time to browse through it will discover many hitherto unknown aspects of the field.

Richard J. Foote

Agriculture and Industry—Relative Income. By J. R. Bellerby in association with G. R. Allen, A. J. Boreham, D. K. Britton, G. Gutch, H. A. Rhee, F. D. W. Raylor, and F. D. Thompson. St. Martin's Press, London, and Macmillan & Co., New York. 369 pages. 1956. \$6.75.

THE MAJOR PURPOSE of this book is to provide statistics on the relative incomes of persons engaged in agriculture and persons engaged in other occupations. The author has examined and reworked a considerable body of statistical data covering the United Kingdom, Canada, United States, France, the Netherlands, and Eire. In addition, he has brought together the information available for other nations as a basis

for judging the probable relative income position of agriculture in those countries.

The income ratio with which Mr. Bellerby is concerned excludes from both sides of the income comparison—farm and nonfarm—the return to property. Briefly, the income ratio involves the return per equivalent adult male from farming compared with equivalent full-time earnings in the rest of the economy. It should come as no sur-

prise that his investigations show lower incomes for persons engaged in agriculture than for persons engaged in other pursuits. The author ranks countries according to their farm-nonfarm income ratios in 1938 as follows:

1. Ratio probably over 75 percent—Australia, New Zealand, France, China.
2. 60-75 percent—United Kingdom, Denmark, Germany, India, Burma, Hungary.
3. Between 45 and 60 percent—Sweden, Canada, Finland, Italy, Chile, Japan.
4. 35-45 percent—United States, Netherlands, Eire, Peru, Norway, Bulgaria, Portugal.
5. Under 35 percent—Egypt, Mexico, Philippines, Thailand, Turkey.

A look at these findings shows that there is no single guideline determining the income position in agriculture relative to industry. Nor are variations explained by the several stages of economic development involved for the individual countries. According to the author, the high income ratios of Australia and New Zealand reflect a condition where agriculture is the predominate occupation and where it has grown as rapidly as the rest of the economy. For China, both agriculture and industry were on a primitive level. The relatively low ratios for the United States and most of western Europe reflect a situation where industry has grown faster than agriculture.

Next Mr. Bellerby turns to an explanation of reasons for low-income ratios for agriculture. Here there appears to be nothing new. He quotes the farm surplus problem and pressure on farm

prices and incomes flowing from low income-elasticity, low price-elasticity for farm products, and flexibility in expanding the supply of farm products. He states, "Agriculture is not capable of achieving a significant degree of contraction immediately or, indeed, for a considerable period of years, in the face of a shrinking market and falling prices."

He appraises next the meaning of differences in income levels as between farm and nonfarm people. Several factors are listed—differences in the cost of living on farms and in the city, the advantages of working on the land and being your own boss, security on the farms during depressions, as well as occupational, social, and personal immobilities. The difficulties of evaluating income differentials between farm and nonfarm people have been discussed elsewhere, recently in the report of the Secretary of Agriculture on "Possible Methods of Improving the Parity Formula," Senate Document 18, 85th Congress.

Perhaps the most significant point is that Mr. Bellerby's statistical investigation shows that for many countries, including Australia, New Zealand, France, the United States, and Canada, there has been little long-term change in income ratio. This indicates that although farmers' incomes are generally lower than those of other workers, the long-term tendency is for both to increase at much the same rate.

Nathan M. Koffsky