Numerous agricultural professionals have been labeled "educator," "administrator," or even "humanitarian." However, only a handful of men and women have impacted the agricultural scene—locally, nationally, and internationally—as much as Barrel S. Metcalfe. He served as a respected and influential member of the faculty/administration at the University of Arizona for almost a quarter of a century. He is recognized worldwide for his significant impact on resident instruction, his capabilities in agricultural administration, and his significant contributions to the profession of agronomy.

Dr. Metcalfe was born in 1913 at Arkansaw, WI. He grew up on a 32-ha (80-acre) farm and was active in 4H and FFA activities. He worked his way through college, earning a teacher's certificate from the University of Wisconsin-River Falls in 1931. After college he taught grade school in Pepin County, WI, for 5 yr. He received the B.S. degree from the University of Wisconsin-Madison in 1941 and earned a M.S. degree in 1942 at Kansas State University.

He was inducted into the U.S. Army in 1942 and served until 1946, being active in the invasions of Okinawa and Leyte. After this service commitment was completed, he was employed at Iowa State University where he progressed from instructor to professor of agronomy during a 10-yr tenure. He took time out to complete his Ph.D. degree at Iowa State in 1950. His research was focused on several aspects of grass and legume seed production. In 1956, he began serving as assistant director of student affairs at Iowa State while continuing as professor of agronomy.

His tenure at the University of Arizona started in 1958, when he was employed as associate dean and director of resident instruction, assistant director of the Arizona Agricultural Experiment Station, and professor of agronomy. He served in these capacities until 1982, when he retired. While maintaining his position as director of resident instruction, he served also as acting dean of the College of Agriculture and acting director of the Cooperative Extension service in 1978 and 1979, and as dean and acting director during the period 1979 to 1980. Few individuals could fulfill the duties of these three full-time positions, which he held concurrently during the 3-yr period of 1978 to 1980.

Dr. Metcalfe’s noteworthy contributions to agricultural education and administration are numerous. In his 24 yr as associate dean and director of resident instruction and his 3 yr as dean of the College of Agriculture at the University of Arizona, college enrollment grew from 535 to 2700, the School of Renewable Natural Resources was added, and the nation’s only racetrack management program was developed. Additional activities included: (i) modernizing the agricultural curricula, (ii) introducing teacher evaluation, (iii) developing an outstanding teacher recognition program, (iv) developing a strong recruitment program in which initially he visited every high school in the state, and (v) participating in resident instruction activities on state, national, and international levels. He played a major role in the creation of the Student Activities Subdivision of the Resident Instruction Division of ASA. At the 1950 ASA Annual Meetings, he proposed to the Board of Directors that the agronomy student group meet with the Society, rather than at the International Livestock and Grain Show in Chicago (3). After much discussion and considerable opposition, the Board approved this arrangement.
The importance of his contributions to agronomic education through his books and papers is significant. Undoubtedly, Dr. Metcalfe has influenced greatly and contributed substantially to the education of literally thousands of students. This has been achieved principally by his coauthorship of the widely used textbooks *Forages* 1951, 1962, 1973, 1977, 1985 (1); and *Crop Production Principles and Practices* 1957, 1972, 1980 (5). Both books have Spanish editions. In addition, he is the author of more than 40 scientific and educational articles.

The humanitarian side of Darrel Metcalfe motivated him to lead his university into new areas of international involvement. This included personal interest and activity in projects in Brazil, Italy, Egypt, Somalia, Kenya, Yemen, and Oman. He was appointed by the U.S. Secretary of State to a 3-yr assignment on the Organization for Economic Cooperative Development. He served as a U.S. Delegate and planned a conference on “Improvement of Higher Education in Agriculture” in Paris in 1963 and presented papers to the conference in 1964 and 1965. The 1964 paper, entitled “Agriculture in the United States; The Past is Prologue,” has been widely quoted. From 1962 to 1973 he was involved in Agency for International Development (AID) programs in Brazil and with the Council for Brazilian Rural Development. He authored the original contract for the University of Arizona/Brazil AID program and visited several countries in South America, including his first visit to Brazil as Chief of an AID Survey Mission. Even after formally retiring from the University of Arizona at age 69, he remained active on the international scene, as a member of a National Academy of Science panel to review a project in Cairo, Egypt, and as a member of the Board of Directors for a project in Sanaa, North Yemen. Also, he represented the Institute for International Education in Somalia, Kenya. He was hired directly by the Oman government in 1982 to help develop a College of Agriculture at Qaboos University in Oman, an assignment he completed in 1986.

Dr. Metcalfe has rendered outstanding service to a number of organizations and societies, including the American Society of Agronomy. In ASA, he served as chair of the Agronomic Education Division and on numerous committees. He received the Agronomic Service and Agronomic Education Awards from ASA and was elected an ASA and CSSA Fellow. His papers presented at ASA meetings have stimulated much interest and discussion but have not been without controversy. A paper entitled “Can Teachers be Evaluated” presented at the ASA Meetings in 1954 at St. Paul, MN, was very controversial at a time when instructional evaluation was not common and the gap between researcher and teacher salaries often was wide (2). This paper likely was responsible for many institutions initiating teacher evaluation programs, accompanied by rewards for outstanding instruction. His invitational paper “The Image We Create” presented at the Society meetings in 1961 brought much criticism and stirred controversy (4). This paper was presented at a time when the profession’s view of the public image of agriculture was that it was excellent and without blemish. This early paper raised some concerns about agriculture’s image that are still valid and relevant today.

Dr. Metcalfe was active in the National Association of Colleges and Teachers of Agriculture (NACTA), serving as President from 1970 to 1971. He received the E.B. Knight NACTA Journal Award and the Distinguished Educator Award from that organization. One of his major contributions related to NACTA activities involved encouraging better relations between land-grant colleges of agriculture and non-land-grant universities with agriculture programs.

In addition to the honors mentioned previously, other prestigious awards he has received include: (i) Honorary Bobcat Award, given to only two faculty members each year at the University of Arizona; (ii) Honorary Alumnus Award, given to only one other College of Agriculture faculty member in the 100-yr history of the college and; (iii) Acacia Medallion of Merit, awarded for his contributions in the fields of agriculture and the humanities. He was the first person in agriculture to be so honored.

Darrel Metcalfe still lives in Tuscon with his wife, Lucille. He continues to work on several agricultural, community, and church projects. Long after he ceases to be active, Dr. Metcalfe’s legacy will live on through his publications and other written records of innovative ideas and accomplishments. Perhaps more importantly, the legacy he leaves will be one of a burning interest in agricultural education and, additionally, a vital concern for the welfare of all persons in our global society.

REFERENCES

Dr. van Bavel, a native of Breda, the Netherlands, earned his undergraduate degree in horticulture from Wageningen University in 1945. He immigrated to the USA where in 1946 and 1949 he earned his M.S. and Ph.D. degrees in soil physics under the direction of Dr. Don Kirkham at Iowa State University. His research there on improving methods for measuring soil water content and availability led to the development of the commercial neutron meter and later the gamma transmission method for measuring soil water content and soil density (3).

He became associate professor of soil physics at North Carolina State University in 1949. During the next 8 yr, he laid the statistical foundation for evaluating irrigation requirements through an analysis of daily precipitation and evaporation data (8) and studied applied hydrology in mountainous areas. He demonstrated that evapotranspiration is a significant factor in estimating stream flow and showed how to use it to assist producers with crop management decisions based on available moisture and precipitation probabilities.

In 1957, Dr. van Bavel became chief physicist at the U.S. Water Conservation Laboratory in Phoenix, AZ. For the next 10 yr, he studied water use by crops in an arid environment (4) and showed that the concept of Penman (2) was valid for such an environment. Dr. L. Fritschen (1) and he showed that evapotranspiration from sudangrass [Sorghum sudanense (Piper) Stapf] was entirely a function of the environment. He helped to develop accurate weighing lysimeters for this research (5). After spending a summer at the Citrus Experiment Station in Riverside, CA, Dr. van Bavel developed the leaf resistance porometer for measuring stomatal diffusion resistance (6). He demonstrated that, with a sufficient number of measurements, the transpiration rate of a cotton plant (Gossypium hirsutum L.) could be calculated. Commercially available leaf diffusion porometers, which researchers around the world use, reflect this work. Also, while at the Phoenix laboratory, Dr. van Bavel showed that crop temperature in an arid environment is often below air temperature in order to satisfy the energy balance of the field (2).

Dr. van Bavel became professor of soil physics and environmental agronomist at Texas A&M University in 1967, where he used computers to model the dynamics of crop water balance. Recent research has dealt with fundamental aspects of water use efficiency in crop production under field and greenhouse conditions. His models

of the flow of energy, water, and carbon in soil-crop-atmosphere systems have been based on fundamental principles and not empirical data. The work related to the energy balance of greenhouses has introduced new concepts for constructing, heating, and cooling, and automatically operating greenhouse systems, based on both physical and physiological processes, including the capture of solar energy in liquid circulated through double-walled greenhouse roofs (7).

Since 1977, Dr. van Bavel has developed models for interpreting remotely sensed microwave signals to detect the incidence and severity of drought stress and the rates of evaporation. His latest research has resulted in the development of an instrument using a heat source and a sensor to measure the flow of water in the stem of a single plant. He is presently adapting the instrument so that it can be made available to other researchers.

Dr. van Bavel has over 190 scientific publications and contributed to eight books. He is a Fellow of both the American Society of Agronomy and the Soil Science Society of America. He has received the Superior Service Award from the USDA, the Horton Award from the American Geophysical Union, a Fulbright Award, the Soil Science Award from the Soil Science Society of America, and the Faculty Distinguished Achievement Award from Texas A&M University.

Dr. van Bavel earned a national and international reputation as a scientist with a keen mind, a strong wit, and penetrating curiosity, which allowed him to grasp, explain, and utilize the underlying scientific principles. He is a deep thinker not satisfied with working at the surface of a solution, and has the unique ability to assimilate an array of apparently scattered facts into a unified explanation of a phenomenon. He has based his research and teaching on the fundamental physical sciences, which he readily transfers to practical applications, including the neutron and gamma probe, the diffusion porometer, and the water flow measuring device.

After 38 yr as a soil physicist and environmental agronomist, Dr. Cornelius H.M. van Bavel has retired but will continue his research part-time at Texas A&M University.

A symposium entitled "Physics in Agronomy" was held 3 Mar. 1987 at Texas A&M University to honor Dr. van Bavel on his retirement. Speakers included Drs. W.R. Gardner of the University of California, who spoke on the physical environment of soil organisms; J.S. Boyer of Texas A&M University, who spoke on how plant cells enlarge; C.B. Tanner of the University of Wisconsin, who spoke on physics needed in conservation tillage; R.D. Jackson of the USDA in Phoenix, AZ, who spoke on evaluating surface energy balance by remote sensing; and

K.W. Brown of Texas A&M University, who spoke on the soil scientists responsibilities on topics of public interest. His former students and associates from across the country participated in the symposium and honored him for his contributions to understanding the physical environment.

REFERENCES


Silage quality evaluation

One factor that may be used to evaluate corn (Zea mays L.) silage quality is flavor. The volatile fatty acids that build up during the anaerobic phase of the ensiling process ensure successful fermentation and preservation. These acids also give the silage a flavor that is somewhat sour, somewhat sweet, and close to the taste of sauerkraut.

Students practice ranking silage samples using several criteria, but flavor is the factor they tend to remember longest and find most entertaining. So that flavor differences may be judged and ranked more easily, I refrigerate one of the corn silage samples in a pie tin filled with a half liter of water one day before the judging. Most of the acid flavor is then removed from the silage by draining as much water as possible from the sample just prior to the taste test.

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Crop production poker

The first few minutes of each lecture are critical for capturing student attention and providing an orientation for the material to be presented. One technique that I have found successful for capturing attention in my junior-senior level Field Crop Production class is a 10-min game called "Crop Production Poker." Students are informed of a narrow subject area to be covered one to three lectures before game time. The subject area relates to topics immediately preceding game time as well as those to be covered in the lecture on the day of the poker game. Like the poker card game, stakes (points per question) are low at first and increase as question difficulty increases. Easy questions are asked first and become increasingly difficult. Like card selection in poker, a student is randomly selected to answer a question. The correctness of an answer is voted on by show of hands. If the student is right and the class agrees, the class gets points for that question. If the student is wrong and a class majority recognizes that the answer is incorrect, again the class gets the points for that question. If neither situation occurs, the instructor gets the points. Incorrect answers usually provide useful items for discussion and should be used to enhance learning as well as provide support to the student that gave the incorrect answer. Points received do not affect the student's grade. Accumulative totals are calculated after playing all of the poker games, commonly six to eight per semester with three to five questions per game.

Student-instructor scores are always adjusted by manipulation of question difficulty such that the students have the highest total at the end of the semester (but the students don't know this). Stakes of the poker game can be decided at any time: last year, a finals care package comprised of study questions, sources of information, a few cookies, and a can of pop was provided to all students for winning the poker game.

The poker games have increased student interest, participation in class discussion, comprehension, and performance.

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Nutrient mnemonics

Instead of creating a separate memory aid for micronutrients (J. Agron. Educ. 16:101), the traditional mnemonic for macronutrients, CHOPKNS CaFe Ms, was modified to include the 16 essential plant nutrient elements as follows: CHOPKNS CaFe CIZn; MoB CuMn Mg. In prose form the mnemonic is: C Hopk(i)ns Cafe closing; mob coming with machine guns. With poetic license this becomes: C HOPK(i)NS CaFe CIZn; Mob CuMn (with) M(achine) g(uns).

To remember the several elements considered essential or beneficial for at least some plants the words, SilVerSeAI NiCoTIaNa, can serve as a memory aid because they include the elemental symbols for silicon, vanadium, selenium, aluminum, nickel, cobalt, iodine, and sodium. Nicotiana is the generic name for tobacco, and Silverseal sounds like a cultivar name so their combination sounds natural.

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SELECTIONS FROM THE BOOKSHELF


This book summarizes actual or relative environmental impacts resulting from present and emerging agricultural production technologies. Its objective is to provide information useful in preventing or reducing environmental deterioration while allowing for needed future expansion of agricultural production.

The contents are organized into seven chapters and three appendices. Chapter 1 gives a brief introduction. Chapter 2 summarizes agricultural production trends, constraints to agricultural production increases, and several emerging agricultural technologies. Production constraints particularly addressed are: land use pressures; rising energy and water prices; and conservation and environmental improvement practices. Chapter 3 reviews case studies on the environmental impacts of several agricultural practices such as conservation tillage and organic farming. Trends and developments related to both nonirrigated and irrigated croplands are included. Chapter 4 presents detailed information on the effects of agricultural practices on the water and soil environment. Soil and water impacts are identified, models are given for their quantification, and management and control are discussed. In Chapter 5 a similar format addresses air quality impacts, and a summary of air pollution effects on agriculture is included. In Chapter 6 the same topical headings of identification, quantification, and management or mitigation are applied to noise. Chapter 6 also contains a section dealing with the identification, evaluation, and control of agricultural solid waste impacts. Chapter 7 examines 11 emerging agricultural production technological clusters, eight in crop production and three in animal production, and provides a trade-off analysis of each based on their anticipated efficiencies and environmental impacts. Crop production decision factors include land use efficiency, natural resource use efficiency, and environmental impacts relating to water quality, erosion, land quality, air quality, noise, and solid waste. Decision factors for animal agriculture include feed efficiency, reproductive efficiency, and environmental impacts similar to crop production except for land quality and erosion. The trade-off analysis identifies four crop production and two animal production practices as being the most promising. For crops these include plant genetic engineering; water management; plant growth regulation; and the soil-related cluster of soil management, erosion control, and waste utilization. In animal production, disease and pest control along with improved reproductive capacity rank highest.

Appendix A is a glossary of key agricultural terms used in the book, and Appendix B is an annotated bibliography of 118 pertinent references on environmental impacts of agricultural practices. In Appendix C the author has summarized the top lines of research identified for the 11 technological clusters described in Chapter 7.

The organization of the subject matter is probably as appropriate and logical as any. However, the subject matter on the impacts and management of solid wastes in agriculture seems out of place being addressed in the same chapter as noise. Solid waste is of sufficient importance to have merited a chapter of its own. The book contains a wealth of information extremely useful in any course dealing with environmental effects of agricultural activities. It also will be useful to researchers as a source of baseline information and references. Most of the data presented and references cited are from the 1970s and early 1980s through 1983.

Most chapters contain many tables of data or descriptive information with some of the tables being very detailed and lengthy (2–3 or more pages). The figures consist entirely of graphs, line drawings, and flow charts, some of which are quite complex. The general quality of reproduction of the figures ranges from good to poor.

The process of identifying the most important technology clusters and predicting their impact on environmental problems as well as agricultural productivity is an ongoing process. New technology, government programs, or economics can quickly interact with plant or animal production systems to significantly change the direction or severity of environmental impacts. One may differ with the emphasis that has been given or not given to a specific technology or its potential impact, but such will always be a problem when addressing environmental concerns.

The book could serve as a basic textbook for graduate level or upper level undergraduate courses concerned with the environmental effects of agricultural practices and activities. It also will be useful as a reference for lower level undergraduate courses but would require some specific guidance and interpretation from lectures or other sources to be used as the primary textbook.—LOU GREUB, Plant and Earth Science Department, University of Wisconsin, River Falls, WI 54022.


Alternative crops, specialty livestock, diversification, value-added products sold from the farm—these are the elements of a profitable, small-scale farming operation according to Booker Whatley, a successful entrepreneur from Alabama. Concerned with the viability of small farms, the author and editors outline a series of steps that the reader can follow to assure continuous cash flow by tapping into markets that are generally not considered by the mainstream farmer. The book is written in popular style and is easily understood by educators, extension specialists, and farmers who have interest in options other than those most frequently considered in our universities.

Throughout the book the emphasis is on low-cost alternatives. Careful planning of enterprises and expenditures, studying markets well before launching a new crop...
marketing provides useful ideas for both practical agricultural economics courses and extension marketing clubs. *How to Make $100,000 Farming 25 Acres* could be a valuable supplement to academic texts normally included in reading lists for agronomic classes. It is recommended as a reference to anyone who is serious about looking at alternatives in production and marketing of a diverse range of products in creative new ways.—CHARLES A. FRANCIS, Department of Agronomy, University of Nebraska, Lincoln, NE 68583-0910.


Plant Breeding Reviews has established a reputation as an important source of literature reviews on a wide range of subjects useful to plant breeders. The fifth volume is no exception, as it includes such topics as gametoclonal variation, breeding rabbit-eye blueberries (*Vaccinium ashei* Reade), and host-parasite genetics.

This volume, not intended as a textbook, should prove to be a valuable reference for anyone wishing to stay current in the constantly expanding fields of plant breeding and genetics. The final chapter in this volume covers the current status of host-parasite genetics. As many breeding programs include disease resistance as an important goal, this chapter will be useful, not only for updating researchers, but for providing a foundation for teachers as well. The high quality standards of the previous reviews have been upheld in this volume. It should be a useful reference for any researcher in plant breeding, and can provide a valuable source of information for plant breeding instructors.—DAVID A. KNAUFT, Agronomy Department, University of Florida, Gainesville, FL 32611.


This book presents a refreshing collection of experiences that many would-be hikers will find fascinating. Pern stopped along his journey periodically to study the vegetation, and captures the sense of exhilaration of seeing vistas that only a hiker will feel after a day of physical exertion, and the excitement that comes from sharing with others. I became caught up with the book and read it over a weekend. It reflected upon the many times I had crossed the “Great Divide” by car and by plane. It is a truly awesome and im-
mense landscape. To envision someone actually walking from Mexico to Canada is amazing.

The witty style of the author's writing is intriguing and entertaining. Pern covered 2350 miles crossing the breadth of four states, New Mexico, Colorado, Wyoming, and Montana, with a brief sojourn into a fifth, Utah. The journal took five and a half months and he found that he had less than 12 hours to get through the final mountain pass to enter into Canada before it became impassable with snow. Time indeed does march on and is crucial, even when it appears that we have all the time in the world.

Periodically, the author reflects on a bit of history, from a British perspective, and provides occasional botanical or ecological lessons. He passed through, or was within sight of, an immense acreage of rangeland and encountered a number of actual, would-be, or has-been ranchers. He describes vestiges of former mining operations, ranches, dwellings, and towns that he witnessed on his journey. In the early part of the trip, in New Mexico particularly, windmills (windpumps a la Pern) became a signpost of survival in a barren landscape.

Other than incantations of vulgarity, which the author apparently felt obligated to record from various personalities that he met on his walk, the book was a delightful, fascinating narrative of a trek across the United States. The book might be used as a supplementary text for those agronomy and crop science students interested in the link between nature and plant science.—ROBERT F. BARNES, Executive Vice President, American Society of Agronomy, 677 South Segoe Road, Madison, WI 53711.

This book is divided into seven parts. Part I, "Plants, People, and Livestock," gives some general introductory remarks regarding the need for plants, both in food and nonfood terms. Part II, "Plant Form and Function," provides a short-course in botany by covering such topics as cells, tissues, photosynthesis, plant growth, and environmental effects on growth. The material is presented in a very condensed form that may require additional explanation for the uninitiated student.

Part III, "Plant Production and Technology," looks at soil and its preparation, crop establishment and harvesting, and cropping systems on a world basis. The photographs in the soils chapter do an admirable job of illustrating nutrient deficiencies. The cropping systems chapter is not very extensive but introduces the concept of rotation and a livestock-row crop-forage crop integrated system.

Part IV, "Plant Hazards," looks at the effects of environmental stress, weeds, insects, and diseases on plant growth and yield. Walton looks at not only how the stress impacts on growth but also discusses ways to avoid the stress. These include mechanical and chemical means as well as plant resistance. A brief discussion on plant breeding is given in Part V. It should not replace a plant breeding course but does introduce the idea of illustrating Mendelian genetics and hybridization. Tissue culture is also described.

Part VI contains six chapters on plant products. These include the grain crops; forage crops; oil crops; fiber crops; beverage, sugar, and drug crops; and fruit and vegetable crops. No mention is made of floriculture or landscape crops, and little reference is made to forest crops. In each chapter, the different crops are illustrated either by line drawings or photographs. A brief history is given for each crop as well as its area of production, culture, and uses. Little information is presented on any one crop due to the number of crops discussed. Supplemental material could be supplied on those crops of local importance.

The final part is a summary chapter called "The Future." This chapter looks at food substitutions, creating new genotypes, and making food available to all people.

In Parts I to IV, there is a review at the end of each major section. The material is presented in a condensed form that will give the instructor the freedom to emphasize material appropriate for the class. The 262 figures and 51 tables help illustrate the various concepts presented in each chapter. The line drawings are well done. Some of the terminology is not well explained and there is no glossary. The citations are limited and occasionally dated.

Although Principles and Practices of Plant Science has some limitations, it provides material for a basic plant science course. The book is organized in an orderly progression of topics, taking the student from the plant cell to the harvestable product.—MARJORIE E. BRADFORD, Arkansas State University, P.O. Box 1080, State University, AR 72467.


The various components and disciplines of multiple cropping, the world's oldest cropping system, are well integrated in this excellently edited volume. For some time there has been a real need to assemble the most up-to-date information on multiple cropping under one cover. This has been accomplished well by Francis and the other authors in this first worldwide review of multiple cropping.

Traditional agronomic researchers and teachers will find Multiple Cropping Systems useful, not only for the coverage of agronomic crops in multiple cropping systems, but also for the expanded horizons offered by the chapters concerning pest management, economics, sociocultural factors, and even statistical methods, among others.

The potential beneficiaries of the book, however, are much broader than traditional agronomists. Any modern agriculturist will find the information in this book crucial to be able to understand and address today and tomorrow's agricultural issues. The same can be said for agricultural economists and sociologists.

As excellent as this book is, however, it cannot cover all the latest information on a particular topic. As Francis' outstanding wrap-up chapter on perspectives for the future of multiple cropping in-
discontinues, the recent increased volume of research interest and literature on this topic necessitates a following of the current journal literature. *Multiple Cropping Systems* does provide, however, a wonderful foundation for anyone serious about this subject matter.

The chapter authors were carefully chosen and include several who would be listed in any "who's who" of multiple cropping. There are a few obvious omissions, however, and one can only surmise that limited time precluded their contributions. One could hope that a second edition would include some of them as authors.

The rather limited number of illustrations, with the exception of the excellent historical perspective chapter of Plucknett and Smith, may seem a detriment to some. In this reviewer's opinion, however, the very good supporting graphics and literature references of most chapters further enhance the value of this book as a reference tool for researchers, teachers, and students. Extensionists and decision makers should not shy away from the book due to the relative paucity of field photographs; they, too, will find it useful.

*Multiple Cropping Systems* is a very readable book, for the most part, and will prove to be of immense value to agricultural scientists and educators and to some decision makers who have training in and understanding of the technical disciplines represented herein. *Multiple Cropping Systems* should be placed in easy reach on one's bookshelf, as it will be referenced often.—JOHN J. NICHOLAIIDES III, *University of Illinois, Urbana, IL 61801.*

Population Genetics: Basic Principles—

This book is designed to be used as a textbook for an introductory course in population genetics. It contains 44 chapters, each of which is intended to correspond to the amount of material that could be covered in a single lecture. Its emphasis is on the genetics of domestic populations and begins by introducing the Hardy-Weinberg law as the basic law of population genetics. From there the author proceeds to consider the effects of changes in allele frequencies due to systematic and dispersive forces. The last section of the book introduces the topic of quantitative genetics with the preceeding material on population genetics as the foundation for quantitative theory.

The information presented has been divided into five major parts. Part I, The Hardy-Weinberg Law, deals with the law's derivation, the assumptions made in deriving the law, and several applications of the law.

Part II considers the consequences of making assumptions that differ from the standard assumptions of a randomly mating, diploid population of reasonably large size. This group of seven chapters deals only with changes in assumptions that do not affect the constancy of allele frequencies. The effects of multiple alleles, separate sexes, linkage, and polyploidy are discussed in relation to how a population approaches equilibrium.

The third and fourth parts are devoted to an explanation of forces that bring about changes in allele frequencies. Systematic forces, such as selection, mutation, and migration, are described in Part III as those forces that cause changes that are both predictable in magnitude and direction. Changes in allele frequencies associated with finite population size and the related topics inbreeding, genetic drift, and coinactery are dealt with in chapters of Part IV, Dispersive Forces.

Part V, Quantitative Inheritance, begins with a comparison of major gene inheritance and the polygenic nature of minor gene inheritance. This group of chapters also introduces the concepts of phenotype, the breeding value of a genotype, dominance deviations, and epistasis. Finally, methods of calculating heritability estimates based on variance components, selection experiments (realized $h^2$), and covariances between relatives are described in detail.

This book, by nature of its format of lecture-length chapters, is well suited for adoption as a textbook for an entry-level graduate course in population genetics. There are three review chapters included in the appendix for readers with little familiarity with genetics, probability, and statistics. The book systematically covers principles and concepts of population genetics in a concise and logical manner. The author does a particularly good job of balancing principles with applications to both animal and plant breeding. If there is any weakness in this book, it is with the treatment of algebraic expressions. Some readers may find the frequent use of such equations intimidating and therefore would benefit from more examples accompanied by detailed numerical solutions within the text. This shortcoming is partially compensated for by the inclusion of exercises at the end of most chapters with solutions found in the appendix.

*Population Genetics* lays a solid foundation in population and quantitative genetics and therefore should be a very useful textbook or reference for those interested in plant and animal breeding.—DARRELL J. COX, Department of Agronomy, North Dakota State University, Fargo, ND 58105-5051.


This book fills the needs of students or professionals wanting either an overview of the science of remote sensing or an introduction to the subject as a precursor to additional studies. It is organized into Basic Concepts (Chapters 1 and 2), Sensors and Their Images (Chapters 3–8), Quantitative/Analytical Approach (Chapters 9–12), and Applications (Chapters 13–17). The chapters are outlined into major and minor subdivisions by numbers and varied print size and boldness making the logic of each chapter easy to follow. The author has reviewed the procedures and appropriateness of both manual and automated interpretation methodology. The high-quality line drawings and numerous black-and-white imagery and aerial photos enhance the narrative and provide examples for the readers benefit. Each chapter is summarized, allowing the reader to either recap the material or skim the unit. Review questions and well-documented references complete each chapter.

The author has done an outstanding job of reviewing all forms of remotely sensed data from traditional to contemporary formats. A real challenge in a fast-breaking science where technological advances are rapid and come from private and governmental sources throughout the world. For example, thematic mapper (TM) and SPOT imagery are displayed and discussed.

Application sections review the use of remotely sensed data in the areas of plant, hydrologic, and earth sciences plus land use/land cover. Both manual and

automated interpretation techniques are presented so that the reader can both appreciate the efforts of others or begin to analyze imagery of their own.

I found the book to be well written, documented, up-to-date, and illustrated; it contains 55 tables, 335 figures, and 20 color plates. It would serve well as a text or as a reference. Agronomists either actively using remote sensing technology or wanting an overview of the science will find this book of value.—GARY D. LEMME, Plant Science Department, South Dakota State University, Brookings, SD 57007.


This book is the compilation of 27 papers presented at a national conference on Ground Water Quality and Agricultural Practices held 1-2 May 1986 at the University of Oklahoma in Norman. It is both multidisciplinary and wideranging. Any compilation of presentations by many authors from several disciplines has some organizational problems with overlap and terminology comfortable to people from one discipline (such as hydrology, geology, soil science, etc.), but not completely familiar to readers from other disciplines.

The book begins with an overview of the USDA Agricultural Research Service commitments to research on groundwater quality issues and results of a national survey of pesticides in drinking water wells. Following these overview presentations the remaining papers are clustered in four broad areas: groundwater usage, agricultural chemical usage, groundwater pollution sources and evaluation, and groundwater protection and management.

There were more papers dealing with Oklahoma and groundwater issues in the western states than in other regions of the country. Several authors focused their presentations on groundwater quality studies in the Big Spring Basin in northeastern Iowa or on models for water quality parameters that were tested against water quality data generated over several years of sampling and study from the Big Spring Basin.

The multidisciplinary authorship and wide range of topics from fertilizer, pesticides, sewage sludge, and animal waste to how irrigation and cropping practices impact on groundwater quality make this a very good reference to begin investigating the many broad concerns of agricultural practices and water quality. Some presentations closed with 10 to 20 selected references that would be an excellent and current springboard into the literature on these groundwater quality issues. Other presentations either by the authors' preference or the general nature of the topic ended with few or even no references cited.

Basically, the book has something for almost everyone: survey and overview of groundwater issues and problems, soil salinity, models of nitrate and pesticide transport and pesticide persistence, crude oil degradation, water conservation, and extension education efforts in sewage sludge and animal waste applications on land.

In conclusion, I feel this book should be in the collection of agricultural, engineering, and geology libraries and that it would be a valuable reference for many professionals, especially those wanting to read work published in other related disciplines. Because of overlap and the extreme variation in topics covered, I doubt that it would prove successful as the text focusing on groundwater quality from one discipline's perspective such as in a geology or soil science course.

The entire text, including graphics, is in black and white. A few computer-generated figures are a bit lower in quality, but on the whole, the paper, printing, graphics, and editorial quality are quite acceptable. Many books on selected environmental issues aimed for what are perceived to be limited sales opportunities are priced at $100 or more. This reference is a good value at $49.95.—DAVID A. MUNN, The Ohio State University, Agricultural Technical Institute, 1328 Dover Rd., Wooster, OH 44691.