of modeling severely undermines some of the reasons for studying these models from a mathematical standpoint in the first place.

In summary, "Mathematics Climate and Environment" is an attempt, as the Editors say in their preface, to cover some of the basic issues of climate and the environment for the mathematically-inclined scientist. For the non-specialist, some of the papers are good starting points on several of the topics. Many will appreciate the expository style of most of the lectures, avoiding excessive technicalities in the presentation. However, rapid progress in some areas of climate and the environment (of which some of the authors in the book can take responsibility) and a better definition of the role mathematics research plays in contributing to furthering our understanding of climate and the environment, makes some of the material that appears in the book somewhat dated. Alas, when compared to current research, the book is a testimonial of what makes this line of research so exciting to those of us who work in the field.

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10[65F10, 65H10, 65H20]—*Iterative methods for linear and nonlinear equations*, by C. T. Kelley, Frontiers in Applied Mathematics, Vol. 16, SIAM, Philadelphia, PA, 1995, xiv + 165 pp., $25\frac{1}{2}$ cm, softcover, $32.50

This volume gives an introduction to the topic of iterative algorithms for systems of algebraic equations. It gives an overview of a few methods for linear systems followed by a somewhat deeper summary of the main approaches for solving nonlinear systems.

The contents are as follows. The first three chapters concern linear equations. Chapter 1 introduces some basic concepts such as splitting operators. Chapter 2 gives an introduction to Krylov subspace methods and an overview of the conjugate gradient method, applicable to symmetric positive systems or the normal equations associated with other systems. Chapter 3 discusses methods for nonsymmetric systems with emphasis on GMRES. For both classes of methods, the presentation begins with theoretical properties (minimizing functionals over subspaces), and this is followed by discussions of implementation and some examples of numerical performance on model problems. The rest of the book (five chapters) concerns nonlinear equations. Chapter 4 presents introductory material such as fixed point methods and rates of convergence (linear, superlinear, etc.). Chapter 5 concerns Newton's method and simple variants such as chord methods which reuse the Jacobian matrix. Chapter 6 concerns inexact Newton methods in which the Jacobian systems are not solved exactly, but instead inner iteration is used to compute approximate solutions. Chapter 7 discusses Broyden's method as an example of quasi-Newton methods, which construct approximation to the Jacobian matrix. There is convergence analysis for all of these methods. Chapter 8 presents criteria on step-lengths to ensure global convergence.

I believe this book will be valuable as a reference and of some use as a graduate text for a "topics" course in iterative methods. It is very up-to-date and provides pointers to MATLAB software available through the World Wide Web or anonymous ftp. The exposition benefits from the author's decision to sacrifice some generality when simpler arguments are available. Pointers to an extensive bibliography provide additional details. Many "difficult" topics such as stopping criteria and implementation issues are discussed, and the experimental comparisons running through the book are useful. As a text it will probably need to be supplemented, especially for linear systems. (For example, there is nothing about symmetric indefinite linear systems.) I downloaded and ran one example of the software (GMRES) and found it easy to use as well as to modify.

The one flaw in the book concerns its editing. I noticed enough typographical and grammatical errors to prompt me to start keeping a running count; I observed ten such errors in one thirty-three page interval. Otherwise, the book is well-written and I believe well-suited as an introduction to this material.

HOWARD ELMAN

11[11R11, 11R29, 11Y40]—*Quadratics*, by Richard A Mollin, The CRC Press Series on Discrete Mathematics and Its Applications, CRC Press, Boca Raton, FL, 1966, xx + 387 pp., 26 cm, $74.95

The title refers to any and all aspects of quadratic fields. The author has written a large number of papers (many in collaboration with H. C. Williams) and this book serves very well as a platform for related topics. The most obvious purpose fulfilled by this book (and by none other at present) is the large bibliography with references of hundreds of papers, incidental or central to quadratic fields.

The book tends to accept the classical theory as a necessary evil in order to present the exotica, and indeed this book is not meant for the unacquainted to learn about quadratic fields. Nevertheless, a reader with only a casual acquaintance with quadratic fields will find very many rewarding byways. For this reader, the book is best appreciated at first contact by browsing all the way from beginning to end, and then going back. The review is written in this spirit, with a somewhat arbitrary choice of topics.

[The reviewer's reference to "exotica" among the contents is not necessarily negative. At one time, e.g., nonunique factorization was more or less in this category, yet it became the primary challenge of "main line" Number Theory.]

The author favors the ideal-theoretic approach very strongly but the reader should also understand that there is a case for quadratic forms which is characteristically *quadratic* rather than a special case of fields of arbitrary degree:

The composition of quadratic forms. *The theory of (binary) Quadratic Forms is nothing but the study of the (Gauss) composition identity*

$$(a_1x_1^2 + bx_1y_1 + a_2cy_1^2)(a_2x_2^2 + bx_2y_2 + a_1cy_2^2) = (a_1a_2x_3^2 + bx_3y_3 + cy_3^2),$$

with variables satisfying a bilinear relation over $\mathbb{Z}[a_1, a_2, b, c]$, *namely*

$$x_3 = x_1x_2 - cy_1y_2, \qquad y_3 = a_1x_1y_2 + a_2x_2y_1 + by_1y_2.$$

This identity involves three quadratic forms of discriminant $d = b^2 - 4a_1a_2c$, and the relation to algebraic number theory comes from the norm "N" in

$$ax^2 + bxy + cy^2 = N(ax + (b + \sqrt{d})y/2)/a, \ (d = b^2 - 4ac).$$