subject is unified, and not least because of his own original contributions to it. Also the book is timely, being, for example, the first to describe the generalized Lagrangian mean.

Craik's list also omits a fourth kind of theory, namely, the qualitative theory of differential equations. This covers, for example, the evolution of the type of dynamically similar flow as the Reynolds number increases slowly. The evolution from steady flow to steady flow, to time-periodic flow, to quasi-periodic flow, to phase-locked flow, to turbulence, say, is the broad canvas on which the weakly nonlinear theory paints some details. The modern theory of bifurcation and chaos indicates what routes to turbulence are possible and what are typical. This fourth kind of theory thus gives many insights and a conceptual framework by use of which laboratory and numerical experiments may be interpreted. However, Craik uses this kind only briefly in passing when he discusses some detailed results of the weakly nonlinear theory or of experiments.

The book is appropriately one of a series of monographs, for it is at a level suitable for research workers. The author typically begins his treatment of a topic with a short description of a relevant experiment, following with an authoritative statement of the key theoretical results and a short summary of some recent papers. A lot is assumed. The linear theory is usually taken for granted, although it may be extensive and difficult, describing complex physical mechanisms. Sometimes advanced results, like those of the inverse scattering transform, are casually mentioned. This is fair, but the reader needs to be warned what to expect. The chapter headings are symptomatic of the systematic development of the subject along theoretical lines, rather than according to its physical applications.

The author has neglected or ignored several topics (for example, double diffusion, flow in a porous medium, Saffman–Taylor instability), approached others, and chosen the balance of the book in ways which do not conform precisely with my prejudices. The indexing might be improved. But a reviewer demeans himself by admonishing an author for not writing the book the reviewer might have written, rather than welcoming the good points of and identifying the limitations of the book. So I welcome this monograph as an authoritative modern account of wave interactions.

P. G. DRAZIN

GJERTSEN, D., *The Newton Handbook* (Routledge and Kegan Paul, London and New York, 1986), pp. xiv + 665, £25.

The last few decades have witnessed a remarkable revival of Newtonian scholarship. On the textual side there is the Royal Society's 7-volume edition (1959–77) of the *Correspondence*, and D. T. Whiteside's monumental edition (1967–81) in 8 volumes of the *Mathematical Papers*, not to mention the great *variorum* edition of the *Principia* by Koyré and Cohen. An edition of the optical papers is in preparation. In addition there have been several fresh contributions to the long tradition of Newtonian biography, intended to supersede earlier work, which was often incomplete and biased. The volume under review falls into neither the textual nor the purely biographical category. An alternative descriptive title might be "A Newton Encyclopedia". It takes the form of more than 500 articles under alphabetically arranged headings, with many cross-references, varying in length from a few lines to the 47 pages devoted to the *Principia.* Out of this unusual method there emerges a survey of Newton's life and scientific work, his administrative work at the Royal Mint and his lucubrations on alchemy, chronology, theology, church history and many other topics. Biographical notices are given of persons connected in any way with Newton. Some of the articles are purely factual, some expository, while others offer informed critical comment. There are very full bibliographies of Newton's more important works, and of books and articles dealing with Newton, and an account of portraits, statues and medallions of Newton.

While the book does not set out to present new material it brings together for easy reference and in readable—or at least browsable—form an enormous amount of material in many cases not readily available elsewhere. Printing and binding are admirable.

It is to be regretted that the text of this valuable contribution to Newtonian studies is marred by a greater number of misprints than one would expect in a scholarly work. This blemish should not, however, impair the usefulness of the book to anyone interested in Newton and his times.

ROBERT SCHLAPP

FISCHER, G., *Mathematische Modelle: Mathematical models*, Volume 1 132 photographs, Volume 2 Commentary (Vieweg & Sohn, Braunschweig and Wiesbaden, distributed by John Wiley, Chichester, 1986) pp. xiii + 129, viii + 83, two volumes in slip-case £41.15.

Of these two volumes one is a collection of 132 photographs of mathematical models with a foreword explaining how to manufacture them; the other is a commentary. The volume of illustrations is captioned in German and English; the commentary volume is available in separate German and English editions. In this review page references are to the commentary while italic numerals refer to the photos. It is understandable that some geometers should be enthusiastic modellers because, over the real field, there are cubic surfaces with all their 27 lines and Kummer quartics with all their 16 nodes real, and the collection here reviewed can boast the zealous patronage of both Kummer and Felix Klein. By 1881 several models of cubic surfaces had been made by Klein's pupil Rodenberg.

The coloured photo *5* shows a right circular cone and circular cylinder intersecting in two equal circles in parallel planes; generators of the cone are red threads, those of the cylinder yellow. When a half-turn is imposed on either circle these threads become, in *6*, the two systems of generators of a one-sheeted hyperboloid. For the algebraic explanation see p. 3.

10, 11, 12 depict Clebsch's diagonal surface. Clebsch so named it because 15 of its 27 lines are diagonals of 5 plane quadrilaterals. The other 12 lines compose a Schläfli double-six which appears on the model with the 6 lines of one half green and those of the other half red. This surface intrigued Klein and he took a model to display at Chicago in 1894.

The commentary on cubic surfaces includes (p. 12) a list of possible isolated singularities both in classical and modern notation. Schläfli and Cayley, followed by Salmon and others, attached a suffix showing by how much the singularity diminished the class 12 of the non-singular surface; the suffixes used now for the singularities of all surfaces, whether or not cubic or even algebraic, are relevant to the appropriate Coxeter diagrams and are less by 1 than Cayley's for conic nodes and binodes but by 2 for unodes. The diagrams are given and (p. 13) are used to show what possibilities there are for different isolated singularities occurring on the same cubic surface. It is suggested that the shape of the diagonal surface may have given Klein and Rosenberg some faint inkling of all this. Photos *13–31* show cubic surfaces with singularities. *32* is the cubic scroll and *33* Cayley's special form of it.

Photos *34–39* display the Kummer surface in different affine shapes. It is curious that the references on p. 21 do not include Hudson's classical book of 1905 of which the frontispiece is an example of *34*. *35* is the quadruple tetrahedroid whose equation, on p. 93 of Hudson's book, is just that on p. 15 here homogenized. Moreover Hudson, in his eleventh chapter, obtains Kummer surfaces with 8 real nodes (*36*) as well as with 4 (*37*) and refers in a footnote to a model of the former and to a catalogue of mathematical models of date 1903. Presumably that dated 1911 in the footnote to the opening page of the foreword here is a newer edition of it.

If $\varphi=0$ is a quadric the quartic surface $\varphi^2+\lambda L_1L_2L_3L_4=0$, where each L_i is linear, has 12 nodes at the intersection of $\varphi=0$ with the six edges of the tetrahedron T. So Kummer, whose interest in quartic surfaces was by no means confined to those with 16 nodes, chose T to be regular and $\varphi=0$ to be a sphere S concentric with T (*45*). When S touches the edges of T the nodes coalesce in pairs at six binodes (*40, 41*); when S circumscribes T the nodes coalesce in threes at the vertices producing unodes (*46, 49*) where the uniplanes meet the surface in quartics with triple points.

Photos *42, 43, 44* are of Steiner's surface modelled, if not by Kummer himself, at least under his direction; it has three nodal lines concurring at a triple point. Each line, so far as *real* pairs of