REVIEWS

Time and Space Relationships of the Taconic Allochthon and Autochthon; by E-an Zen. P. 107, 3 pls., 17 figs., appendix. New York, 1967 (Geol. Soc. America Spec. Paper 91, $5.50).—Did you know that the Taconic allochthon consists of four or five thrust slices nested one above the other? that the lower slices consist of relatively younger formations, the upper slices of older formations? that slivers of carbonate rock exotic to the Taconic sequence are wedged in between the thrust slices? that the emplacement of the allochthon was a submarine gravity slide phenomenon preceded by large-scale block faulting and accompanied by deposition of graywacke and a spectacular wildflysch-type conglomerate? that the entire exposure at the famous Deepkill type locality may be a submarine slide block? that the youngest formation of the Taconic sequence is both allochthonous and autochthonous and that the present boundary of the allochthon is indeterminant in many areas because of the comingling of soft sediments during thrusting? that the age of emplacement of the lower thrust slices and probably the whole allochthon can be pin-pointed to a certain graptolite zone in Middle Ordovician? that the root zone for the Taconic allochthon is at the Berkshire-Green Mountain pre-Cambrian core about 25 miles east of the present position of the allochthon? that the stratigraphy of the Taconic sequence bears a remarkable resemblance to the synchronous metasedimentary sequence east of the supposed root zone? that the allochthon today is marked by a negative Bouguer anomaly and the supposed root zone a positive anomaly? and that even a blind elephant groping among the geologists who have worked on the Taconic problem in this century could single out E-an Zen as the one who has brought all this into focus?

This reviewer finds Zen's evidence for most of these propositions very strong if not "whelming", and he commends this special paper to all geologists as *the* outstanding synthesis of this major North American structural problem. The strength of this synthesis, and, indeed, it is difficult to separate this paper from Zen's field work or dozen earlier publications on the subject, stems from some 15 seasons of detailed mapping at the north and southeast parts of the allochthon, and, importantly, from hundreds of spot studies, reconnaissance studies, field trips, and conferences which he organized with geologists throughout the Taconic region. This is no sweeping synopsis based simply on one study with extrapolations from the literature: Zen has probably studied more critical outcrops in the Taconics than has any other student of the Taconic problem, past or present.

The paper consists of three main parts, "Field Relations", "Regional Synthesis", and Appendixes. The non-Taconic geologist will find the first part tough sledding because of the geographic and stratigraphic details, but it is well illustrated with charts and maps and presents the evidence for "Regional Synthesis" which is unincumbered with that age-old plethora of formation names and which is probably the best "extant" summary of the evolution of the Taconic allochthon. The Appendix is notable for its summary and critique of other interpretations of the

Taconic Problem. The writing throughout this paper is distinctly according to Zen, and the editors are to be commended for not tampering with the author's mode of expression. On the whole, however, the writing in this paper is not Zen's best. While most of the plates and figures are valuable aids to the reader, plate I, a geologic map of the area in and around the allochthon, is difficult to decipher and gives no overall picture of the structure.

Some general and specific points that puzzle this reviewer are listed below, but even if all these should prove valid criticisms they would not even rock the boat of the allochthonous concept.

The most intriguing aspect of any allochthon is the location of its root zone, and Zen carefully analyzes and makes a convincing case for a root zone at the Green Mountain-Berkshire axis, from the point of view of the space problem, facies and thicknessess of formations east and west of the root zone, and the critical fact that a continuous pre-Cambrian core is not now exposed at the site of the root zone. However, this reviewer believes that Zen (p. 58) is not only overzealous but wrong in stating that the problem of this gap in the root zone "must be resolved if the allochthonous hypothesis is to become tenable". The evidence for the allochthon is unequivocal if we have to postulate a root zone a hundred miles away. Zen suggests that the Taconic sequence is about 2000 feet thick, perhaps one-tenth the thickness of the metasedimentary sequence east of the supposed root zone, and he (p. 46-47) gives some plausible explanations for the difference in thicknesses of these two, supposedly transitional facies. This problem may not be quite as great as Zen suggests for the reviewer estimates the Taconic sequence in the central part of the allochthon to be three times as thick as Zen's figure.

Regarding the correlation between and internal structure of individual thrust slices, mapping by this reviewer in the central Taconics shows that the gross structure of the lowest (Giddings Brook) slice there is, indeed, recumbent (see, Zen, p. 19). Detailed work in this area bears out Zen's (p. 26) suggestion that the upper slices, Rensselaer and Dorset Mountain, are one and the same. Zen (p. 21) implies that the gross structure of the Rensselaer slice is that of a normal sequence. This cannot be demonstrated to be entirely so on the eastern half of the Rensselaer Plateau, and there is a suggestion of a major recumbency. If the gross structure of the Rensselaer slice is recumbent the idea of a western source of sediment (p. 52) for the Rensselaer graywacke might have to be revised. Contrary to Zen's view (p. 22), we do find formations other than the dominant black, gray, and green phyllites and schists in the High Taconic sequence, and we can, indeed, establish a match (see p. 22) between these formations and those occuring in the lower thrust slices. Thus, Rensselaer graywacke, Bomoseen, Hatch Hill, and Poultney have been mapped in the High Taconic sequence indicating an age span from Early Cambrian to Middle Ordovician, contrary to Zen's (p. 67) view that the Rensselaer slice and slices of the High Taconic sequence contain only the oldest Cambrian (?) rocks. In terms of the

evolution of the allochthon this simply means that there is, perhaps, complete overlap in age of rocks from the lowest to the highest thrust slice (see p. 15), although this reviewer agrees with Zen that older formations dominate the younger thrust slices.

Zen (p. 6-7) postulates that the youngest formation of the Taconic sequence, the Mid-Ordovician Normanskill, lies conformably on autochthonous (Balmville) limestone. This relationship is critical to Zen's imaginative thesis that the youngest clastic sediments of the Taconic sequence are both allochthonous and autochthonous. This reviewer agrees that the paleontologic evidence and general field relations allow this interpretation but finds that the exact contact is not seen as clearly as indicated in this paper or in the original reference. There is need for a great deal of detailed mapping in the southern part of the allochthon.

Lest the non-Taconic geologist who reads Zen's paper think that the Taconic problem is solved, let this reviewer hasten to assure him that intriguing detailed and general sedimentological, structural, and stratigraphic problems will be with us in the Taconics until the last monadnock goes under the alluvium.

DONALD B. POTTER

Introduction to petrology; by Brian Bayly. P. xx, 372. num. figs. and tables. Englewood Cliffs, New Jersey, 1968 (Prentice-Hall, Inc., $9.95).—Bayly's book is a "self-contained" text that deserves consideration by those who offer general petrology courses to undergraduates. Two themes are emphasized: (1) Students must learn to think analytically *about* classification and methodology rather than simply to learn classifications and methods. (2) They must learn to employ experimental studies in the analysis of rock-forming processes.

The first theme is introduced in a too-short but refreshing chapter and is developed well in sections on each major rock group. Many a practicing geologist might benefit from Bayly's discussion of the too facile use of rock names (for example, quartz monzonite) whose use implies a quantitative knowledge of modal composition that has not, in fact, been obtained.

The second theme is managed quite well, but only experience will tell whether students with no prior knowledge of elementary physical chemistry will find the book "self-contained". The chapters on igneous petrogenesis set a pattern also followed in sections on sedimentary and metamorphic rock development. The behavior of binary melts during cooling and of mixtures of minerals during heating are described clearly and simply. Then these simple systems are employed to illustrate the development of deductive arguments about igneous processes, just as Bowen recommended in *Evolution of the Igneous Rocks.*

Not every important topic is handled as clearly. The (mineralogic) phase rule is introduced rather obliquely, and I doubt that the student will understand either the phase rule or the meaning of the term *com-*