features can by explained by dynamic models of mantle convection compatible with seismic tomography.

The Viscous Flow Model proposed by Keith can briefly be summarized as follow. The continents and their thick keels act as thermal blankets on the underlying mantle, which therefore forms ascending currents under them; these currents originate horizontal flow moving radially away from continental cores; convective downwelling takes place below volcanic arcs, compressional mountain ranges, mid-oceanic ridges (the "Oceanic Range") and oceanic islands. Therefore, island arc lavas, mid-oceanic ridge basalts, oceanic island basalts and continental flood basalts are *all* assumed to have a common source in the partial melting of *downwelling* material, hypothesized to consist of thin sheets of recycled oceanic crust metabasalt mixed with variable amounts of sedimentary and mantle (peridotitic) components. Pressure-release melting of *upwelling* peridotitic material is assumed to be an important factor only in sub-continental areas—of which the Mesozoic volcanism in the Kaapvaal–Kalahari craton is offered as an example. Superimposed to this "near-steady state model" of convection, the author hypothesized the existence of episodic "surges", the triggering of which is tentatively ascribed to asteroid impact.

The author's attitude to the evidence changes when discussing data which are assumed to support his hypothesis. Expressions such as ". . . it seems more than coincidental that . . ." (twice on p. 175) and other similarly vague assertions abound. References are sometimes quoted selectively, sometimes misleadingly. An example of selective choice: statements to the effect that ". . . experimental studies (show) viscosity reductions associated with the onset of partial melting . . ." (see e.g. pp. 170, 171 and 180) give as main supporting reference an abstract, and the voluminous literature discussing the problem (how much partial melting does one need to reduce viscosity? What is the effect of non-equilibrium textures? What is the role of the partition coefficient of water?) is totally neglected. An example of misquotation: on p. 189 one finds a statement that ". . . A Coriolis effect (on mantle flow) cannot be ruled out . . . in view of the uncertainties regarding flow rate and the effects of variable viscosity and of mantle traction on the crust", followed by a reference. The reader who assumed that the reference supports the statement would, however, be mistaken: as a matter of fact, it does not deal with the Coriolis force at all, but it only makes the point that the strain rate and viscosity structure of mantle convection is likely to be highly heterogeneous.

The Viscous Flow Model, naturally, runs into problems when dealing with marine magnetic anomalies. The author analyzes at length this topic, and ascribes the anomalies to ". . . (1) buckling of the crust and repeated structure-controlled volcanism and (2) a superimposed sequence of ages related to crestward migration of the outer limit of volcanism on a subsiding Oceanic Range" (pp. 215–216). The idea is exceeding vague, and is nowhere submitted to critical evaluation. Similarly, the hypothesis that oceanic regions consist of a thin "elastic or visco-elastic" layer moving *towards* ridges contradicts most of what is known on the *worldwide* distribution (and not isolated values, which the author mentions as disproving the plate tectonics hypothesis) of heat flow, depth to the ocean floor and thickness of oceanic lithosphere.

A major problem with the Viscous Flow Model is that it is difficult to reconcile with the principle of conservation of mass under oceanic plates. Take for instance the Pacific and the Nazca plates: along a profile approximately from NW to SE, one encounters first the western Pacific subduction zones, then oceanic islands (Hawaii), then the East Pacific Rise and finally the Peru–Chile trench. According to the Viscous Flow Model, mantle flow below *each and every one* of these features is converging downwards from both directions. The author seems to be unaware of the problems created by this peculiar geometry.

The book also contains some strange loose ends for a work that admittedly has been many years in the making. Heat flow is usually given in mW/m^2, but $\mu cal/cm^2$ are used on p. 171 (which is, of course, wrong, but the omission of "seconds" in the denominator is probably a misprint), and HFU are mentioned on p. 181. The references are each given a number that does not correspond to their order of appearance in the text: actually, the long list consists of three or four sequences of alphabetically arranged entries, followed by additions in no particular order.

Finally, a word on the production of this book. It is a reprint of a long paper which appeared in *Earth Science Reviews*. The page numbers have not been changed: so, the book begins on p. 153 and ends on p. 337. The contents of the relevant volume of *Earth Science Reviews* and the instructions to the authors have, for some reason, been included. Strangest of all, the word "Earth" is missing from the title as given on the first printed page.

G. Ranalli

Ottawa, Canada

Lesser Himalaya

Pande, I. C. and Saklani, P. S. (editor) 1991. *Tectonic and Metamorphic Investigations in the Kumaon–Garhwal-Himachal Lesser Himalaya (Current Trends in Geology Vol. XIII)*. Today and Tomorrow's Printers and Publishers, New Delhi, India. Price Rs 495, $65.00.

This monograph from the Indian series *Current Trends in Geology* deals with the geology of the Kumaon, Garhwal and Himachal sectors of the Indian part of ther Lesser Himalaya. Much work has been done by a large number of Indian geologists in the Lesser Himalaya and a volume summarizing this confusing array of literature is welcome to students of Himalayan geology.

The most useful part of the book lies in the chapters dealing with the stratigraphy of these three areas of the Himalaya, particularly the historical aspect. However, the final chapters on the structure and metamorphic history have an out-dated flavour and show little resemblance, either in methods or models, to many studies that have recently been undertaken, or are ongoing in the Himalaya. Pande argues that the Himalaya orogen "did not originate from a single Tethyan geosyncline, nor did it form due to collision, subduction or abduction (?) of the Indian and Asian plates". He believes instead that "the Himalayan orogen owes its origin to activation of Deep Seated Faults which demarcate the Tethyan, Central Crystalline Axial, Lesser Himalayan Foothills zone and Indo-Gangetic Fore-deep". Pande is apparently more at ease with the Beloussov school of deep-seated faults penetrating the whole crust and vertical tectonics, and ill at ease with plate tectonics and large-scale horizontal movements. This view could not be more inappropriate for Himalayan geology, and I sometimes wonder whether we are looking at the same mountain belt.

The volume's reference list is largely restricted to Indian publications, yet in the last 10 years or so there has been a huge increase in the number of papers reporting quality research in the Himalaya on all branches of the geological sciences, by both Indian and foreign workers, published in international journals. None of this is referred to at all in this book. As long as this introverted approach remains there will be little or no new science. It is difficult to find aspects of this volume which will be useful to an international audience, except perhaps for the historical perspective of the stratigraphy of the Lesser Himalaya.

M. P. Searle

Oxford, U.K.