distinguished from lava, which flows.)

The book gives a background from classical literature of some of the myths surrounding Hekla, then proceeds to the placing of Hekla in the two active volcanic belts running southwesterly-northeasterly in South Iceland. The next discussion is of the eruption history of Hekla. The changes in types of lava and tephra during an eruption as well as in successive eruptions are described. The list of the 13 known eruptions starting with that in 1104 leads naturally to a detailed discussion of the 1947 eruption, which is then followed by a description of the 15th and last eruption of 1970.

Throughout the detailed accounts of the 1947 and 1970 eruptions the distribution of tephra in time and space is carefully analyzed, as is the flow of lava in both eruptions. A reader can very well become awe-stricken at the disasters which have flowed from the volcano through its tephra fallout. In the 1970 eruption alone tephra containing fluorine contaminated an area of 450 farms, owning 95,000 sheep, and over 6,000 lambs and 1,500 ewes were killed by fluorosis. Fortunately, the fluorine-contaminated tephra is ejected only during the Plinian phase, usually in the first two or three days of the eruption. The wind and weather determine the extent of damage.

Many geophysical problems arising from studies of the tephra and lava are mentioned. For example, the amazing difference in composition of the xenoliths ejected perhaps will give an insight into what is happening in the lower crustal layers which are the source of magma for this volcano. Fifteen figures, two plates, and 54 illustrations are carefully keyed to the text. The book is highly recommended to anyone interested in volcanoes.

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Pre-Tychonic Data Reanalyzed

Ancient Astronomical Observations and the Accelerations of the Earth and Moon. ROBERT R. NEWTON. Johns Hopkins Press, Baltimore, 1970. xx, 310 pp., illus. $10.

The secular accelerations of the earth's rotation and of the moon in its orbit are strongly interrelated with the definition of time, with the long-term behavior of the earth's interior, and with the question of variability of the gravitational constant, predicted by the Brans-Dicke scalar-tensor theory. Thus a study of these accelerations that declares that most of the classical work in this area is wrong is likely to attract attention. Newton sets about to destroy the credibility of the methodology of earlier investigators, to establish his own methodology as being without the flaws of his predecessors', and to reanalyze the available astronomical data from pre-Tychonic times. Having established a solution at roughly double the conventional value (due to Spencer Jones) of the lunar acceleration in modern times, Newton concludes with some geophysical speculations, attempting to explain how the accelerations could have changed as drastically since ancient times as his results indicate.

The degree of success attained by Newton will lie in the eye of the beholder. The great difficulty of his subject results from the nature of the observations: poorly documented accounts, frequently by inexperienced observers, of celestial events visible to the naked eye, such as eclipses and occultations. In some cases, the definitions of measurement terms are in doubt. Nearly always, the date and location of the observations are unknown. Perhaps Newton's greatest contribution is his critique of the usual procedure (the "identification game") for assigning dates and localities to such events, a procedure which he claims artificially minimizes the departure of the final result from the initial assumption, and which can lead to the classical result even if a table of random numbers is used. The situation is perhaps overstated, but it seems clear that there is much room to suspect the classical results of serious bias.

Newton is much less convincing in his own treatment of the observations, and many readers will reject the work outright because of its unsatisfactory aspects. This would be a mistake. He has replaced the "identification game" with a statistical guessing match fully as subjective. He criticizes other authors for failing to go to primary sources, and then does not bother to consult easily available references. Sometimes his statistical principles seem at variance with the proper ones as understood by this reviewer. Estimates of achievable observational resolution of eclipse magnitudes are based on laboratory tests with paper cutouts rather than on real eclipse experience. Conventional terminology and usage are widely flouted. But, it is not obvious that these flaws negate the numerical results. Even if they do, the ground has been broken for a thorough reexamination of this subject.

Newton's unconvincing geophysics need not undermine the view that such a reexamination is in order, for his calculations are based on acceptance of the "modern" value of the lunar acceleration. Van Flandern, however, has indicated a very large correction to the conventional value for the present epoch also, obtaining a value roughly compatible with the values obtained by Newton for 200 B.C. and A.D. 1000. These two studies in fact provide important support for one another's numerical results. Astronomers and geophysicists will be well advised to examine this work carefully.

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The Chandler Wobble

Earthquake Displacement Fields and the Rotation of the Earth. A NATO Advanced Study Institute, London, Ontario, June 1969. L. MANSINHA, D. E. SMYLIE, and A. E. BECK, Eds. Reidel, Dordrecht, and Springer-Verlag, New York, 1970. xii, 310 pp., illus. $19.80. Astrophysics and Space Science Library, vol. 20.

In 1891 S. C. Chandler, a businessman in Cambridge, Massachusetts, reported that his analysis of latitude observations showed two periodic components in the motion of the pole—an annual term, and a component with period 14 months. It was not long before the periods of Chandler's wobble were explained. The 14-month term turned out to be the Eulerian free wobble with period lengthened from the theoretical 10 months to 14 months because of elasticity of the earth. The annual component was nicely explained by the seasonal changes in the inertia of the atmosphere and the distribution of snow, groundwater, and ocean mass.

The mechanism of excitation and damping of the 14-month wobble has been debated to this day. Among the hypotheses advanced are nonseasonal changes in the inertia tensor of the atmosphere and in the ocean load, electromagnetic core-mantle coupling, and changes in the solid earth inertia tensor accompanying earthquakes. Some famous men attempted to find what excites the Chandler wobble, including Larmor,