# Book Reviews

## Arrangement of the Planets

**The Titius-Bode Law of Planetary Distances.** Its History and Theory. MICHAEL MARTIN NIETO. Pergamon, New York, 1973. xii, 162 pp., illus. $11. International Series of Monographs in Natural Philosophy, vol. 47.

In 1766, Johann Daniel Titius inserted into his German translation of Bonnet's *Contemplation de la Nature* his own rule of planetary distances. In 1772, in the second edition of the translation, Titius removed the rule from the text and reinserted it as a translator's footnote, thus claiming authorship. That same year, there appeared in a footnote in the second edition of Bode's *Anleitung zur Kenntniss des gestirnten Himmels* the same rule described in much the same language. In this edition there was no reference to Titius, but in later works and certainly by the ninth edition (published in 1823), Bode acknowledged that he first saw the law in Titius's translation. Thus, Nieto assigns priority for discovery of the law to Titius.

In its original and still most widely quoted form, the Titius-Bode law states that the distance ($r_n$) of the $n$th planet from the Sun is given by $r_n = 0.4 + 0.3 \times 2^n$, where the unit of distance is the astronomical unit (A.U.). To apply this mnemonic, set $n = 0$ for Venus, 1 for Earth, 2 for Mars, 4 for Jupiter, and 5 for Saturn. For Mercury, one must take $n = -\infty$, an unesthetic complication. In 1766, the third "orbital" was vacant and no planets were known beyond Saturn. In 1781, William Herschel discovered Uranus at 19.2 A.U., remarkably close to the $n = 6$ value of 19.6. In 1801, the vacant orbital at 2.8 A.U. was filled by the discovery of the asteroid Ceres at 2.77 A.U. At that point, with two predictions to its credit, it would have been hard to deny the validity of this law. Since then it has not fared so well. Neptune was discovered at 30.1 instead of 38.8 A.U.; Pluto came in at 39.5 instead of 77.2 A.U. Thousands of asteroids were discovered in a wide belt between 2.1 and 3.3 A.U. The picture became untidy.

In the first 50 pages of his monograph, Nieto gives us a lively and broad summary of the history of the Titius-Bode law, supplemented with 131 references. The remainder of the book is devoted to the theory.

Most modern cosmogonists consider the approximately constant spacing ratio of the planets to be one datum, which, together with the planetary masses, angular momenta, chemical composition, and isotopic abundances, provides boundary conditions for theories of the origin of the solar system. The numerous variants of the Titius-Bode law, when they pretend to be an exact law governing planetary distances, are dismissed as exercises in numerology. I share this view.

Nieto is a member of an active minority who ascribe a fundamental significance to the law. He favors a variant developed by M. A. Blagg in 1913 and again by D. E. Richardson in 1945, which amends the constant spacing ratio by multiplying it by a periodic correction term. This does improve the fit and, to my mind, is a tribute to the ingenuity of the curve fitters. Nieto, on the other hand, takes the position that the planets were born in accordance with a constant spacing ratio and evolved to the periodic correction term. This notion stands by itself. It is neither supported nor rejected by the dozen theories of the origin of the solar system that he summarizes in the theory section of the book. His summaries are succinct and readable, and again he supplies a liberal number of references (93). His selection of theories is highly biased, as he admits, but he does provide references to more comprehensive reviews.

Nieto joins a continuing line of astronomers who have been absorbed by the Titius-Bode law for more than two centuries. Its history is fascinating. Its theory is weak.

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## Tropical River

**Limnology of a Small Malayan River Sungai Gombak.** JOHN E. BISHOP. Junk, The Hague, 1973. viii, 486 pp., illus. Dfl. 120. Monographiae Biologicae, vol. 22.

This is essentially a doctoral thesis in published form, and inevitably it has both the merits and the defects of such a document. The merits are its inclusiveness and careful documentation and referencing; the defect is that it is not easy for a reader to skim through it in search of points that are of interest to him. A good index to some extent offsets that problem.

The author made an intensive study of a small river near Kuala Lumpur, from its headwaters in the rain forest, through zones of rubber plantations and intensive cultivation, into a heavily populated area. This work thus covers a wide range of conditions in a part of the world where, as almost everywhere in the tropics, very little was known of stream limnology.

There is information on the climate, geography, geology, soils, and land use of the valley, and great amounts of data, in graphs and tables, on the light regime and rainfall in the valley, water chemistry, temperature, substrate types and erosional load of the river, and lithology and organic matter of the sediments. Most of these data were gathered monthly for at least a year, and they represent a prodigious amount of work.

The algae of the river and the invertebrate fauna, which were also sampled each month, and the fishes, which were sampled less often, are similarly dealt with in a somewhat massive manner, with long lists of names, indices of abundance, and tabulations of data. It is a pity that some of the peculiar creatures in this fauna were not depicted, as this would have added interest and made the book far more informative.

In addition to all this mass of facts there are sections on primary production, benthic sampling, zonation, drift, vertical distribution of the benthos, longitudinal migration, and pollution, which are accompanied by excellent and well-documented discussions. Moreover, these are undertaken from the unusual viewpoint of the tropics, and this greatly enhances their value.

While this is not a book for the general reader, it will be of particular interest to the biologists of Southeast Asia and of value to all serious students of running water. It provides