REVIEWS
Edited by Joseph B. Dence

Reviews should be sent to Joseph B. Dence, Department of Chemistry, University of Missouri, 8001 Natural Bridge Rd., St. Louis, MO, 63121. Books on any area of undergraduate mathematics, mathematics education, or computer science are appropriate for consideration in this column. Reviews may be typed or neatly printed, and should be about two pages in length. The editor may undertake minor editing of a review, but only in connection with matters unrelated to the essential content or opinion of the review.

G. Urton. *The Social Life of Numbers: A Quechua Ontology of Numbers and Philosophy of Arithmetic.* University of Texas Press, Austin, 1997, pp. 267.

M. Ascher and R. Ascher. *Mathematics of the Incas: Code of the Quipu.* Dover Publications, Mineola, New York, 1997, pp. 166.

The Incan culture began sometime in the 12th century (edit. note: This clause beggars a generation of research and historical conjecture, especially since Incan history was transmitted only orally.), with the heyday of the empire being between 1430 and 1500 A.D. At its greatest extent, the territory governed by the Incan ruler Huayna Capac reached from Quito, Ecuador to the Rio Maule in Chile, a distance of more than 2500 miles. The end of the empire coincided with the occupation (conquest) of the region by the Spanish in November of 1532.

The Incas' feats of architecture, engineering, astronomy, and weaving, along with their ability to assimilate neighboring cultures peacefully and assess tribute (product and labor) fairly, are made more remarkable by the fact that they had no written language. As must always be the case, mathematics was an essential tool for the scientific and political success of the culture. (edit. note: Indeed, the German philosopher of history Oswald Spengler (1880–1936) maintained that each culture is characterized in part by a unique mathematic. See O. Spengler, *The Decline of the West,* Oxford University Press, New York, 1991, Chapter II, "The Meaning of Numbers," pp. 41–69.)

The books above cover two aspects of mathematics in Incan society. *The Social Life of Numbers* discusses the cultural dependence of the language of numbers and their use in everyday life. *Code of the Quipu* analyzes a particular artifact, the *quipu,* which was used to record numerical information by means of knots on string. Distance in time and lack of an adequate written record make both discussions difficult, yet interesting, for the light they shed on the interplay between numbers and life.

Quechua, the primary language of the Incan empire and of the present-day indigenous peoples of the Ecuadorian and Peruvian highlands, uses a decimal number system which evidences both addition and multiplication. For example, 469 is *tawa pachaq suqta chunka jisqonniyuq* (four-one-hundred-six-ten-possessor of nine). The "possessor of" phrase reflects the societal idea of imbalance – that the nine is an incomplete decimal unit. The naming of objects to reflect a hierarchical order or order of appearance, such as family units within a village or ears of corn on the same stalk, follows a reproductive model: first/most important is *mother,* second is *offspring,* third is *second offspring,* etc. In some circumstances enumerating members of a group is regarded as taboo since attaching numbers emphasizes the individuality and decreases the collective power of the group. At other times, counting (e.g., a crop of potatoes or a herd of llamas) may be considered socially unacceptable, as it represents an excessive concern that could bring bad luck. These are a few examples that Urton gives of the interaction between society and numbers.

At one point the Incan empire included over 10 million people. There is historical evidence from the Spanish of a very advanced government and taxation system. An upper class of *quipumakers* had responsibility for maintaining records of population, production, stores, labor, etc. for the regional administrators and rulers. We do not know how they did the computations, but the patterns on the *quipus* exhibit more than rudimentary capacity. Some *quipus* contain several groups of numbers (each on a separate string), each with a subtotal, an overall total, then further subtotals for color-coded strings. Other *quipus* show large and small numbers in a common proportion (up to rounding to the nearest integer), which probably represent the total population of a region and the proportional labor tribute assessed. *Code of the Quipu* is a primer on *quipu* making, with a mix of social and historical information that helps interpret what the knot records may be saying. Extensive examples and exercises scattered throughout the text would make this a practical and interesting addition to either a liberal arts, history, or education course.

The mathematician whose comfort zone is limited to theorem-proof-example will find *The Social Life of Numbers* a frustrating read, as its discussion and argument style is more common in the social sciences. (edit. note: The generalized idea in this sentence is discussed clearly in the important essay C. P. Snow, *The Two Cultures: And a Second Look,* New American Library, New York, 1963, p. 18.) Nevertheless, the well-organized presentation, peppered with vignettes, provides a breath of fresh air for the modern mathematician whose field is socially sanitized. This tandem gives as complete a picture as possible of the importance of mathematics to a culture making strides toward the modern world.

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