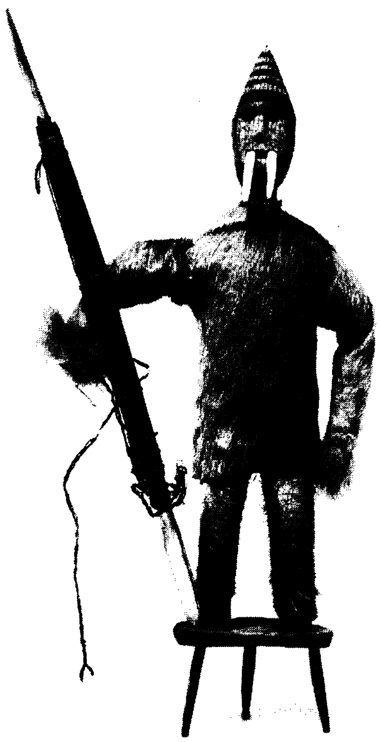

Walrus-man collected by E. A. McIlhenny, 1897; height 30 cm. "Alaskan Eskimos believed that in the mythical past all humans, animals, and spirits could change their physical forms at will. In the nineteenth century, only spirits and shamans retained [that] ability. . . . The belief in transformation explains the cautious way Alaskan Eskimos dealt with strangers and animals that behaved in peculiar ways. Such beings might have been dangerous supernatural characters or hostile shamans in disguise. The theme of a walrus-man transformation was commonly expressed in Eskimo material culture through the use of the double tusk motif. The walrus-man represented in this carving stands on a sealing stool, wearing a hunting visor, and holding a harpoon in his hand." [From *Raven's Journey*]

The most intriguing of the University Museum's collectors was Louis Shotridge, who is featured in the second essay, by Maureen Miller. A member of Tlingit aristocracy from Klukwan village, Shotridge was one of a handful of ethnographically and linguistically trained Native Americans who worked for museums and anthropologists in the early 20th century. Shotridge was affiliated with the University Museum for 20 years as a collector and documentor of Tlingit artifacts and culture, and he often published in Penn's *Museum Journal*. Shotridge's native status was both an asset and a hindrance to his collecting efforts. Intent on seeing his tribal heritage preserved at Penn, he sought quality and meaning in the pieces he collected, and his documentary notes are superb. At the same time, he was audacious in his pursuit of certain objects. Claiming rights to the contents of the Whale House at Klukwan by virtue of American laws of inheritance, Shotridge was the first of a series of individuals to bid unsuccessfully for the treasures of this clan house (which are today the subject of litigation, resting since 1984 in a Seattle warehouse). Shotridge's life was marred by tragedy; he lost two wives to tuberculosis, and in 1932 the museum was forced to cut him—with no pension—from its payroll. In 1937 he died, the apparent victim of a murder, "impoverished and in obscurity, to the extent that no mention of his death appeared in print" (p. 72). It is fitting that the centennial exhibit finally honors the contributions of this outstanding man.

The inclusion of the remaining two essays is perplexing. "The Knight Island robe" by Cheryl Samuel is an analysis of textile fragments recovered from a Tlingit grave during archeological excavations and thus not a study of ethnological collection material. Similarly, Adria Katz's piece on a Tahitian breastplate collected among the Tlingit, though its subject is of interest as an ethnographic anomaly and eminently worthy of a published article, does little to celebrate the richness of the museum's American collections. I believe the interests of the centennial exhibit would have been better served by essays of broader scope and larger relevance to the collections, dealing for example with the "most notable and interesting ceremonial hats and headpieces that . . . ever will be in any museum" (p. 74) collected by Shotridge or with the Sledge Island whaling outfit brought to the museum by schoolteacher W. B. Van Valin or providing an overview of the Athapaskan materials in the collection.

Despite these shortcomings, *Raven's Journey* offers a view of the unique Alaska collections of the century-old University Museum, and its authors remind us that in these materials much work remains for scholars and curators of the future.

MARGARET B. BLACKMAN
Department of Anthropology,
State University of New York,
Brockport, NY 14420

Ethnomathematics

Native American Mathematics. MICHAEL P. CLOSS, Ed. University of Texas Press, Austin, 1986. viii, 431 pp., illus. $35.

Native American Mathematics appears at a time when interest in ethnomathematics is on the increase. Educational projects devoted to developing mathematics materials relevant to the Native American heritage, style of learning, and economic environment are currently under way at Northern Arizona University, Oklahoma State University, and the Fort Ojibway School in Minnesota, to name but a few. An International Study Group on Ethnomathematics has been established, a newsletter on the subject is being published, and international meetings have been scheduled. Writers attempting to develop culturally related materials for schools are seriously in need of sources providing information on the mathematics or mathematics-like mental activities of the ancestors of our present-day Native American students, who find in the recognition of those activities a needed sense of pride. The reader of *Native American Mathematics* will find a variety of such information.

The verbal numeration systems are a source of delight. Who will soon forget that the Abipones of Paraguay express four as *geyenkute*, "the ostrich's toes"? Although the bases of numbering systems of many Native American tribes were 10 or 20 for fairly obvious anatomical reasons, a base of four was used with surprising frequency, and the reason for its widespread use has not been firmly established. Madison S. Beeler suggests a clue in his chapter on Chumash numerals: "I have seen it stated in the literature on quaternary counting systems that some speakers of such languages could report the practice of holding sticks between the fingers." Thus we have four sticks for each hand.

Michael Closs in a chapter on numbers in Ojibway pictography gives a fascinating account of birchbark scrolls with clearly rendered diagrams. His interpretation of the scrolls illustrates the use of numerical concepts in a fraternal order consisting of four lodges or degrees. However, an agreed-upon theory explaining the ubiquitous use of four in Native American mythology is still lacking.

Some of the most attractive illustrations in the book are found in Closs's account of the mathematical notation of the Maya. The diagrams and photographs bring to life the theories concerning the origin, meaning, and purpose of the numerical representations. Most mathematics educators have learned in their course in the history of mathematics that the Maya had a base-20 place-value numeration system in which the basic numerals were represented by configurations of dots and bars. Closs also introduces and illustrates the "head variant numerals." Twenty Maya-style block faces in profile were used to represent the numerals 1 through 19 and 0. Examples of the use of these hieroglyphics on Mayan tablets are not only shown but interpreted in an understandable step-by-step manner.

The ancient Incas employed a device called *quipu* for recording numerical concepts. As defined by Marcia Ascher in a chapter on the mathematical ideas of the Incas, a quipu is "an assemblage of colored knotted cords. The colors of the individual cords, the way the cords are connected together, the relative placement of the knots and spaces between the knots are all part of the logical-numerical recording." The quipus were featured dramatically in the movie *Chariots of the Gods*, but Ascher provides diagrams of quipus with examples of the numerals represented in place-value notation by the knots. She also shows that the knots and colors of the cords of a quipu may represent a matrix-like array of numbers.

Petroglyphs have been found and puzzled over on every continent of the world, but William Breen Murray in his study of numerical representations in North American rock art indicates that only recently have archeologists been able to provide much material evidence bearing on the early forms of numbers. Archeologists assume that a particular example of rock art is more likely to be a number if its graphic representation displays certain logical properties of the numbering process such as symbolic repetition, graphic symmetry, and complex ordering. A particularly intriguing "petroglyphic count stone" found in Mexico is analyzed in detail. Breen provides photographs and diagrams indicating that the marks on the stone constitute a lunar calendar.

What is the motivation for a society to develop the concept of number? This question is addressed in a chapter by J. Peter Denny. Denny illustrates the point that people need numerals when describing objects having unknown properties with a charming account of a courtroom situation in which a hostile attorney concluded that because an Indian hunter did not know how many rivers were in the region under litigation he was unfamiliar with the territory and his testimony should be discounted. According to Denny the hunter had no need for the number of rivers because he knew intimately every turn of every river there. The need for number is also created by machines that turn out identical objects. Numbers are needed in describing sets of objects that differ only in their quantity.

At various points in the papers presented in *Native American Mathematics* reference is made to the opposing viewpoints of the diffusionists and the independent inventionists. As A. Seidenberg writes in a chapter on the zero in Mayan numeration, "The Diffusionist tends to regard the duplicate appearance of a cultural element, say an invention, as evidence of historical connection. Correspondingly, the Independent Inventionist tends to regard such occurrences as evidence that the mind works similarly under similar circumstances." Scholars of the diffusionist persuasion find it easy to believe that some of the culture of the pre-Columbian Native Americans was influenced by contact with the Old World. The writers of *Native American Mathematics* do not come down definitely on either side of this issue.

Only a few of the 13 chapters in *Native American Mathematics* have been mentioned here. The book should be on the shelf as a companion to a standard history of mathematics, and it will be essential for educators concerned with the mathematical training of modern Native American students. Educators and others interested in ethnomathematics owe a debt of gratitude to the historians, anthropologists, archeologists, and linguists who have contributed to the book.

CHARLES G. MOORE
Department of Mathematics, Northern Arizona University, Flagstaff, AZ 86011

Books Reviewed in *Science* 23 May 1986 through 15 May 1987

Accretion Power in Astrophysics, J. Frank *et al.*, 1 Aug. 1986, 582
Acid Rain and Friendly Neighbors, J. Schmandt and H. Roderick, Eds., 1 Aug. 1986, 581
Adaptational Biology, C. L. Prosser, 14 Nov. 1986, 883
Advances in Plant Nutrition, vol. 1, P. B. Tinker and A. Läuchli, Eds., 8 Aug. 1986, 673
Advantage and Disadvantage, R. D. Block and E. G. J. Moore, 10 April 1987, 204
African Pygmies, L. L. Cavalli-Sforza, Ed., 30 Jan. 1987, 600
Agent Orange on Trial, P. H. Schuck, 30 Jan. 1987, 597
Altruism and Aggression, C. Zahn-Waxler *et al.*, Eds., 8 May 1987, 728
The American College and the Culture of Aspiration, 1915–1940, D. O. Levine, 13 Feb. 1987, 798
American Professors, H. R. Bowen and J. H. Schuster, 3 Oct. 1986, 92
The Anatomy of a Business Strategy, G. D. Smith, 23 May 1986, 1016
Ancestors, E. Delson, Ed., 23 May 1986, 1026
Anger, C. Z. Stearns and P. N. Stearns, 12 Dec. 1986, 1447
The Anthropic Cosmological Principle, J. D. Barrow and F. J. Tipler, 23 May 1986, 1036
Applications of Social Science to Clinical Medicine and Health Policy, L. H. Aiken and D. Mechanic, Eds., 17 Oct. 1986, 373
Applying the Humanities, D. Callahan *et al.*, Eds., 23 May 1986, 1013
Are Australian Ecosystems Different?, J. R. Dodson and M. Westoby, Eds., 9 Jan. 1987, 226
Arms Control Verification, K. Tsipis *et al.*, Eds., 27 Feb. 1987, 1090
Assessment of Depression, N. Sartorius and T. A. Ban, Eds., 4 July 1986, 115
The Atlantic Alcidae, D. N. Nettleship and T. R. Birkhead, Eds., 11 July 1986, 232
Atmospheres and Ionospheres of the Outer Planets and Their Satellites, S. K. Atreya, 8 May 1987, 729
Atmospheric Chemistry, B. J. Finlayson-Pitts and J. N. Pitts, Jr., 6 March 1987, 1263
Atmospheric Chemistry and Physics of Air Pollution, J. S. Seinfeld, 6 March 1987, 1263
Autobiography of Dr. Karl Ernst von Baer, J. M. Oppenheimer, Ed., 24 April 1987, 472

The Behavior of Teleost Fishes, T. J. Pitcher, Ed., 10 Oct. 1986, 223
Behavioural Ecology, R. M. Sibly and R. H. Smith, Eds., 13 June 1986, 1446
Big Blue, R. T. DeLamarter, 19 Dec. 1986, 1592
Biological and Inorganic Copper Chemistry, K. D. Karlin and J. Zubieta, Eds., 29 Aug. 1986, 992
Biology of New World Microtus, R. H. Tamarin, Ed., 29 Aug. 1986, 992
Biotechnology, M. Kenney, 5 Dec. 1986, 1278
Birds of Eucalypt Forests and Woodlands, A. Keast *et al.*, Eds., 31 Oct. 1986, 620
Birth and Evolution of Massive Stars and Stellar Groups, W. Boland and H. Van Woerden, Eds., 18 July 1986, 372
Black Holes, K. S. Thorne *et al.*, Eds., 14 Nov. 1986, 882
Blackbirds of the Americas, G. H. Orians, 23 May 1986, 1030
Blueschists and Ecologites, B. W. Evans and E. H. Brown, 23 Jan. 1987, 491
The Botany of Mangroves, P. B. Tomlinson, 17 Oct. 1986, 373
The Burgess Shale, H. B. Whittington, 2 Jan. 1987, 94

Cancer in Atomic Bomb Survivors, I. Shigematsu and A. Kagan, Eds., 3 April 1987, 99
The Cayo Santiago Macaques, R. G. Rawlins and M. J. Kessler, Eds., 3 April 1987, 101
Cell Motility, H. Ishikawa *et al.*, Eds., 24 Oct. 1986, 492
Centennial Field Guide, vol. 6, T. L. Neathery, Ed., 19 Dec. 1986, 1595
Central Plains Prehistory, W. R. Wedel, 17 April 1987, 339
A Century of Controversy, E. R. Service, 18 July 1986, 371
Chemical Neurobiology, H. F. Bradford, 5 Sept. 1986, 1101
Child Development and Education in Japan, H. Stevenson *et al.*, 10 April 1987, 205
The Chimpanzees of Gombe, J. Goodall, 6 Feb. 1987, 694
Circulation, Respiration, and Metabolism, R. Gilles, Ed., 24 Oct. 1986, 491
Collisionless Shocks in the Heliosphere: A Tutorial Review, R. G. Stone and B. T. Tsurutani, Eds., 5 Dec. 1986, 1279
Collisionless Shocks in the Heliosphere: Reviews of Current Research, B. T. Tsurutani and R. G. Stone, Eds., 5 Dec. 1986, 1279
The Communist Party and Soviet Science, S. Fortescue, 15 May 1987, 861
Comparison of Ab Initio *Quantum Chemistry with Experiment for Small Molecules*, R. J. Bartlett, Ed., 20 June 1986, 1559
Confronting Nature, T. Pinch, 9 Jan. 1987, 225