sinan Period from before 80,000 to about 22,000 years ago. Its hunting potential was excellent for humans adapted to cooler climatic conditions. Bone fragments that must be considered as potentially modified by humans and even true artifacts such as the fleshing tool have been found there. Though these could have been made from well-preserved older bones that were collected from reopened sediments after the time of the last glacial lake, there remain specimens observed in the old sediments whose status as artifacts this reviewer, in his experience, cannot dispute, such as NbVl-2:12 and MlVl-2:27–1 with their cutting marks. It must be kept in mind, however, that they all are isolated finds and that archeologists need stratified assemblages before they can prove the presence of humans beyond doubt. It is to be hoped that such sites will soon be found in the Old Crow Basin.

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Kin Organizations

The Versatility of Kinship. Essays Presented to Harry W. Basehart. LINDA S. CORDELL and STEPHEN BECKERMAN, Eds. Academic Press, New York, 1980. xviii, 382 pp. $40. Studies in Anthropology.

Explanations of family can emphasize the relation between kin organization and changing ecological, economic, and political conditions; they can emphasize the limited human possibilities for regulating mating and sexual relations, for rearing children and perpetuating the gene pool, for cooperatively accomplishing domestic labor, and for passing on wealth and productive means to the next generation; they can also emphasize the cognitive and linguistic abilities one must acquire and use to properly identify and interact with relatives; and of course, these emphases can be integrated. The anthropological literature on kinship, moreover, contains firsthand reports of kin organizations, analyses of these descriptions, and abstract comparisons that focus on individual development, on change within groups, and on synchronic variation within and among groups and even over the primate order itself.

The Versatility of Kinship reflects several of these concerns. The volume is a collection of 15 essays honoring Harry W. Basehart, professor emeritus at the University of New Mexico. The contributors are mostly Basehart's colleagues and students and scholars who share his professional interest either in African ethnology or in the Native American ethnology of the Southwest.

The book conjoins these interests with, for example, studies on Tierra del Fuego food foragers of historic times, of Eastern Creek Indian resurgence in modern Alabama, of Swiss peasants, and of urban immigrants to New Zealand and to New England. In doing so, it attempts to pinpoint some of the variables that affect the way families and communities are organized in various times and places. Many of the contributions are explicitly comparative either across time or between geographically or culturally related peoples.

The paper by Keesing, for instance, traces the relationship between the Solomon Island Kwaio's childhood dependence on kin and the "ultimate" moral imperatives that regulate cooperative living; the paper by Spuhler compares cultural, linguistic, archeological, geographical, and genetic covariance among Hopi-Tewa and related Aztec-Tanoan groups; the paper by Aberle compares marriage rates and the rules that regulate them among various Navajo and Western Apache peoples; and the paper by Lamphere, Silva, and Sousa describes how predominantly rural Azores-Portuguese families change when the women enter the work force upon immigrating to New England.

Despite the admirable attempt by Cordell, Beckerman, and Hammel to relate the papers in this volume, there is little coherence beyond the versatility theme. Many of the papers will be of interest only to area specialists. Three, however, are innovative enough to make the volume important, and at least one contains a statistical muddle that could be pedagogically useful for methodologists.

I was particularly disturbed by Netting's use of statistics in analyzing Torbell (Swiss) marriages. Briefly, he reviews 250 years of marriages among patrilines. He then partitions the patrilines into groups of patrilines, choosing the number of groups and their membership so that groups will have the highest possible rate of endogamy. Comparing the rates of marriage between "groups," he tautologically finds the rate of group endogamy much greater than chance (.0001). From this, he concludes that economic stability during the last three centuries has led to "quantitative consistencies of marital choice" (p. 266). Of course, with such methodology even economically unstable villages that have limited numbers of patrilines and therefore recurring patriline marriages could be shown to have patterned endogamy. It is difficult, in fact, to imagine any random phenomena that could not be grouped after the fact into some number of patterns and "proved" highly unlikely by such an approach.

The best papers in this volume are three on the resilience of kin organizations that trace descent exclusively through females. Since Morgan's pioneering research on the Iroquois during the last century, it has been observed that such organizations are statistically associated with economies where females make a substantial and valued contribution to a horticultural subsistence base. The corollary to this observation is that once political economic change begins to alter this horticultural base the inheritance rules are increasingly challenged, giving way to the patrilineal and cognatic estate distribution rules we find in the modern world.

This inference has some support—several southeastern and midwestern Native American groups were once matrilineal and now are not—but the evidence is too inconclusive to warrant a confident statement that 20th-century matriliny is doomed. On the contrary, the evidence presented by Klara Kelley on the Navajo, by Karla Poewe on the Zambian Luapula, and by Elizabeth Colson on the Gwembe and Plateau Tonga of Zambia strongly suggests that under some conditions matriliny may be versatile enough to persist.

Kelley describes the changing political economy of the Navajo immediately prior to their 1864 incarceration at Fort Sumner. Although pastoralism almost always favors male property rights, the development of commercial livestock production among the Navajo failed to destroy matrilineal organization. Kelley suggests that the establishment of the reservation made land inalienable and therefore permitted largely matrilineal residence rights to persist. Since trade and credit were controlled by non-Nava-

jo "mercantile interests," moreover, no class of wealthy commercial stockmen developed to challenge the matrilineal inheritance system.

Poewe's approach to her Zambian data is, by contrast, ahistorical. She argues that support for or opposition to matrilineal inheritance among contemporary Luapula depends on class and gender. Male capitalists having annual incomes ranging from 1500 to over 400,000 Kwacha, as well as wives of small capitalists, favor father-centered households, father-son inheritance, and Christian ideologies that advocate these goals. Rich female capitalists and the poorer strata of both sexes support matrilineal inheritance. The rich females have an obvious interest in the status quo and the wives of small capitalists have an understandable interest in change, but why do the poorer strata prefer matriliny? Poewe says they hope for advancement through windfall inheritances, but surely any inheritance system can foster such hopes. One wonders therefore whether some of these people may not be supporting matriliny to avoid offending superiors. Poewe's discussion of this important issue is inconclusive.

Colson has been doing research among the Tonga for 35 years, and the advantages of such extended study are obvious here. Despite extensive change during the present century, neither Plateau nor Gwembe Tonga have altered the main elements of their matrilineal family organization. Among the Plateau Tonga of the 1940's, for example, only the few wealthy males were inclined to follow attempts by British Colonial authorities to undermine matriliny. And even those males acted indecisively because they were uncertain that the advantages of a change in inheritance rules outweighed the disadvantages.

The Gwembe Tonga also support the matrilineal system and have supported it for a variety of reasons not only earlier in the century but in recent periods as well. In the late 1950's particularly, the damming of the Zambezi forced resettlement of the Gwembe Tonga. This led to radical change in the demand for agricultural labor, but it did not destroy the preference for matrilineal labor organization. Nor, when Zambian independence led to a "revolutionary change" in occupational aspirations, did the Gwembe Tonga alter their support for the inheritance rules. Nor, finally, did an increase in immigration to Lusaka and the change to urban living destroy matriliny. Rather, through all these changes, Gwembe Tonga seem to have creatively used their matrilineal beliefs to deal with the new conditions.

Although Kelley, Poewe, and Colson are careful to express doubts about the long-term ability of matriliny to survive, their work taken together clearly indicates that matrilineal family organization may well be much more adaptable to modern conditions than many of us have supposed. Conceivably we will have to explain the demise of those matrilineal systems that have disappeared not by worldwide "unilineal" developments alone but by some much more complex combination of such developments with the specific historical circumstances particular peoples are confronting.

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Sophisticated Designs

The Mechanical Properties of Biological Materials. Papers from a symposium, Leeds, England, Sept. 1979. Published for the Society for Experimental Biology by Cambridge University Press, New York, 1981. x, 514 pp., illus. $69.50. Symposia of the Society for Experimental Biology, No. 34.

The mechanical properties of biological materials is a relatively new topic that draws on engineering, materials science, polymer science, morphology, and physiology. This book of symposium proceedings is a collection of 18 papers and 11 poster session presentations that spans nearly the entire range of plant and animal materials, including wood and plant cell walls; bone, teeth, cartilage, and keratins; and mollusk shells, silk, insect cuticle, and mucus. Fundamental papers on fracture, composites, elasticity of rubber-like materials, and viscoelasticity, plus the abundant details in the applied papers, provide sufficient background for the nonspecialist in materials science to comprehend this unusual approach to certain areas of biology.

The book emphasizes three categories of features exhibited by the mechanical properties of biological substances. First, organisms utilize both a remarkable variety of physical characteristics and composites of different materials to solve their design problems. Many living organisms cope with excessive loads not by overdesign with large factors of safety but by deflecting under load. For example, small plants such as grasses stand up to routine loads from the wind and their own weight, but when trodden upon they simply buckle and deflect and in due course recover. A tension structure, such as a tendon, is subdivided so as to minimize the transmission of strain energy between fibers. Bending structures, such as the feathers of birds, are made of many isolated and weakly interconnected elements, so that the loss of individual components does not weaken the structure as a whole. Many soft materials such as skin and artery walls have J-shaped stress-strain curves that are initially almost horizontal. Thus, there is virtually no shear modulus at low and moderate strains, and the materials exhibit great tear resistance.

A second category is the importance of a number of levels of structure in determining the mechanical properties of tissues. An excellent example is bone, which can be viewed on four levels of organization. On the molecular level, bone is composed of organic components, principally collagen, which has the good energy-absorbing characteristics of polymers, and inorganic components, chiefly small crystallites of hydroxyapatite, which has two-thirds the stiffness of steel but is quite brittle. The organic and inorganic components are combined on a second level to form a complex heterogeneous and anisotropic composite. The third level is demonstrated by the densely packed concentric lamellar structure, the Haversian system or osteon, which is in part responsible for both the elastic and the viscoelastic behavior of mature cortical bone. On the fourth or macroscopic level, the size and shape of the whole bone must be considered.

Perhaps most amazing of all is the remarkable degree of sophistication of the mechanical properties achieved through evolution. The dragline silk of the *Araneus sericatus* spider has a breaking energy of 158 megajoules per cubic meter and fails at a strain of 0.2 to 0.3, values five to ten times those of cellulose. If the dragline had the same tensile strength but a lower extensibility, less energy would be required to break it and it would be unable to stop the fall of the spider. The energy cost of producing the web is one of the largest energy expenditures of the spider, so it is definitely advantageous to produce a web with a minimum volume of silk and therefore a minimum expenditure in the form of protein secreted. The maximum force that the radial fibers of a web can support is a function of their extensibility, and dragline silk has close to the theoretical optimum value.