thus confirm the feeding habits deduced from their dental morphology. We suggest that the observed differences among the herbivorous animals are due to different Sr concentrations in their preferred foods, specifically to the concentrations of Sr in succulent herbaceous vegetation, higher than in grasses (*4*). *Hypohippus* and *Testudo*, both adapted to eating leafy vegetation, have the highest values. *Merycodus*, a form with very high-crowned teeth, is considerably lower in Sr than the browsers, a fact which reflects its probable diet of harsh grasses. *Pliohippus* is fairly low in Sr but higher than *Merycodus*. The *Pliohippus* at this locality has relatively shorter-crowned teeth than *Merycodus* and is also primitive in retaining side toes, suggesting that it was less exclusively a grazing animal than *Merycodus*. Carnivores are the lowest of all in Sr content. This agrees with the postulated progressive exclusion of Sr in the food chain.

Favorable conditions of fossilization appear to be prerequisite for obtaining ecologically meaningful information from the Sr content of fossil bones. Ten crocodile scutes from an Eocene locality in Carbon County, Wyoming, were analyzed for their Sr content. Bones at this locality show considerable enrichment of iron, manganese, and barium. The amounts of Sr found in the crocodile scutes were much more variable than for any of the Pliocene genera studied (coefficient of variation is 24 for the crocodiles, 3.1 to 6.4 for the various mammals and reptiles of the Pliocene fauna). It is doubtful whether statistically significant differences can be obtained from available samples under such conditions of high variability. The cause of variability probably lies in distortion of the original composition of the bone by intense postmortal chemical change.

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References and Notes

1. H. T. Odum, *Publ. Inst. Marine Sci.* **4**, 38–114 (1957).
2. G. G. Simpson, *Horses* (Oxford, New York, 1951).
3. B. H. Brattstrom, *J. Paleontol.* **35**, 543 (1961).
4. H. J. M. Bowen and J. A. Dymond, *Proc. Royal Soc. London, Ser. B*, **144**, 355 (1955); P. B. Vose and H. V. Koontz, *Nature* **183**, 1447 (1955).

28 June 1965

"Lunar Calendar" from the Hungarian Upper Paleolithic

Abstract. *A carved limestone object found in the East Gravettian site at Bodrogkeresztur, Hungary, has been identified as a uterus symbol. It may also be a lunar calendar. Prehistorians should reexamine similar objects for similar evidence.*

Marshack's interpretation (*1*) of certain objects from the Upper Paleolithic as lunar calendars was most interesting. Although such interpretations of Paleolithic paintings, engravings, and sculptures are seldom verifiable, one fact is clear: man of the glacial period led a complex spiritual-cultic life, and he can be compared in this respect with the people of today's (or yesterday's) "asymmetrical" cultures.

In 1963, loess excavated near Bodrogkeresztur in northern Hungary uncovered the remains of an occupied site belonging to the older level of the East Gravettian group (*2*). Among the finds was an object, carved from limestone, that was shaped like a halfmoon or horseshoe; it measured 56 by 56 by 17 mm. If the object, as it appears in Fig. 1*A*, were oriented, the top is "north" left is "west," and right is "east"; the base of the halfmoon is "south." Near the center of the northern edge are two near-vertical carved lines, 6 to 7 mm long, that slightly converge to the north. Eastward and westward from the lines, the sharp edges of the object are notched almost symmetrically. There are 11 notches on the eastern side and 12 on the western; all notches extend to the reverse side (Fig. 1*C*). Parallel with and near the southern edge is a carved line 12 mm long.

I do not propose to list all possible interpretations (*3*) of the object. Because of its positive-negative conformity with other objects that were found at Kostienki I (*4*), I chose to regard the Bodrogkeresztur object as a uterus symbol, although its lunar or solar shape was noted. However, on the basis of Marshack's paper (*1*) I have considered the following possible interpretation.

The western of the pair of converging lines (northern edge) may be regarded as the symbol of the new moon.

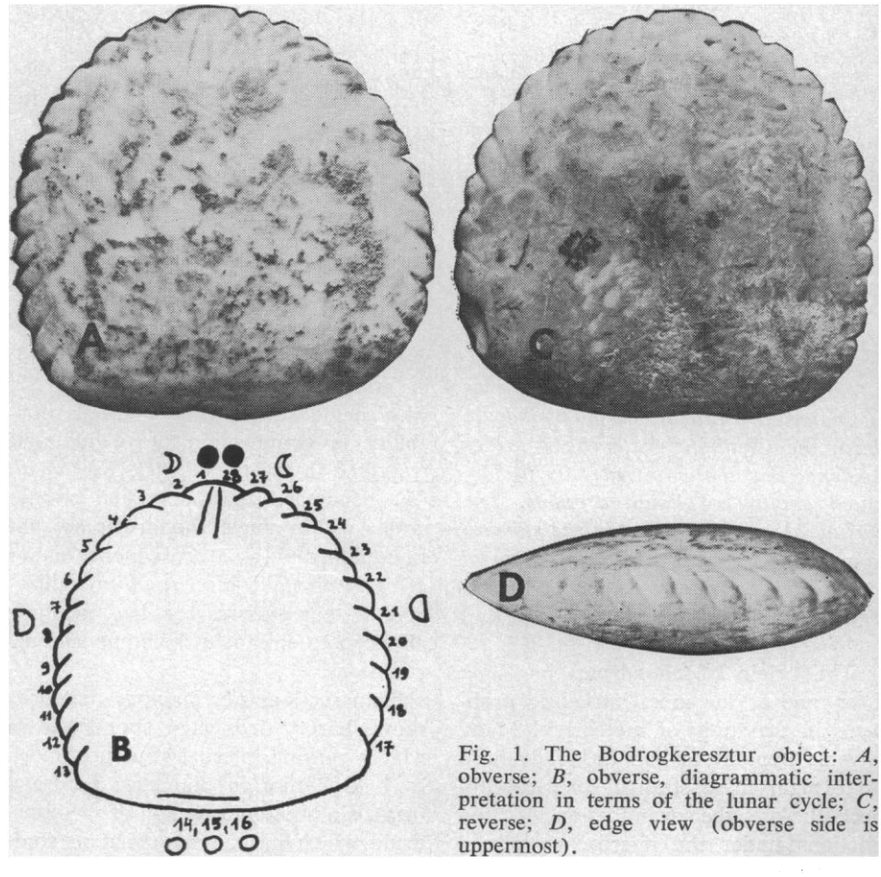

Fig. 1. The Bodrogkeresztur object: *A*, obverse; *B*, obverse, diagrammatic interpretation in terms of the lunar cycle; *C*, reverse; *D*, edge view (obverse side is uppermost).

The 12 notches to the west of this line symbolize the crescent moon (13 days, including the new moon). The unnotched southern side may represent the 3 days of the full moon: days 14 through 16. The 11 notches on the east side may represent the days of the waning moon: days 17 through 27. Finally, the eastern of the pair of lines may symbolize the vanished moon on the 28th day (or 29th day, if we allocate 4 days to the unnotched southern edge; the 28.5 days of the lunar cycle may have led primitive man to reckon either 28 or 29 days).

This interpretation does not prevent me from maintaining that the object is a uterus symbol, but the moon and uterus significances may be associated: the symbolisms of moon-uterus–*magna mater* are commonly associated in primitive cultic systems. I do know that cultic illustrations by primitive people can be even more complicated than this interpretation suggests; that such people conveyed their ideas in even more figurative ways. Compared with churingas or shaman's drums, carrying mythical tales, the message of the "lunar calendar" of Bodrogkeresztur is simple.

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References

1. A. Marshack, *Science* **146**, 743 (1964).
2. L. Vértes, "Die Denkmäler der Gravettien-Kultur in Ostungarn," Congr. Int. Ethnol. Anthropol. Archaeol. 7th, Moscow (1964).
3. C. Schuster, personal communications.
4. P. P. Efimenko, *Kostienki I* (Akademiia Nauk S.S.S.R., Leningrad, 1958), figs. 167–168.

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A Chondrule in the Chainpur Meteorite

Abstract. *The occurrence of glass as a major constituent in a chondrule from the Chainpur meteorite provides evidence that the chondrules formed by rapid cooling of liquid droplets. The virtual absence of nickel in the silicates suggests that it segregated into the metal phase in the molten stage, prior to crystallization of the silicates.*

The origin of chondrules has long been one of the most intriguing problems in the study of meteorites. Many diverse hypotheses had been advanced to explain these strange spherical objects before the examination of thin sections under the microscope placed severe limitations on possible modes of formation. Early investigators of chondrites recognized their similarity to volcanic rocks and concluded that their internal structure indicated that the chondrules had been quenched from high temperatures. This point of view was very clearly stated by Sorby (*1*), in 1877, when he summarized his conclusions by stating that "the conditions under which meteorites were formed must have been such that the temperature was high enough to fuse stony masses into glass; the particles could exist independently one of the other in an incandescent atmosphere, subject to violent mechanical disturbances; that the force of gravitation was great enough to collect these fine particles together into solid masses, and that these were in such a situation that they could be metamorphosed, further broken up into fragments, and again collected together." At a time when sophisticated techniques have allowed the study of many of the more esoteric properties of meteorites, it is perhaps instructive to review Sorby's conclusions, the validity of which remains unchanged.

Alternatives to the "liquid droplet" hypothesis have been proposed by several authors. The formation of chondrules by metamorphic recrystallization of solid matter has been advocated by Levin (*2*) and by Mason (*3*). The chondrule which is described here displays several features which cannot be explained by metamorphic recrystallization. Rather, it provides unusually clear evidence of having formed by quenching of a wholly or mostly liquid droplet.

The Chainpur meteorite fell as a shower of stones on 9 May 1907, beside the village of Chainpur, India (21°51′N, 83°29′E). The meteorite was described by Cotter (*4*) and, in greater detail, by Keil *et al.* (*5*), who demonstrated the unusual variability in composition of olivine and pyroxene in the chondrules. Keil *et al.* (*5*) concluded that individual silicate grains within single chondrules are not in equilibrium, as a consequence either of rapid crystallization or of crystallization at temperatures too low to allow diffusion to eliminate the compositional variations.

Thin sections of Chainpur meteorite show sharply delineated chondrules of widely varying internal structure, mostly 1 to 2 mm in diameter. Figure 1 (top) is a photomicrograph of the chondrule which has been studied in some detail. It is circular in section, except where metal and sulfide grains straddle the chondrule-matrix border. A protrusion of matrix into the chondrule can be seen in the lower right-hand corner of Fig. 1 (bottom). This indentation was apparently produced before the chondrule had completely solidified, since the olivine crystallites in the chondrule are aligned parallel to the indented margin. Either the matrix intruded the still-plastic chondrule, or the indentation formed by shrinkage on cooling.

Within the chondrule, crystals of olivine and pyroxene are set in a clear, colorless glass. The major crystalline

Table 1. Electron microprobe analysis of glass in Chainpur chondrule. Results are percentages by weight.

Compound	Analysis of the glass*	Glass analysis, recalculated to 100 percent, for $Na_2O = 8$ percent
SiO_2	67.3	64.0
Al_2O_3	16.5	15.7
MgO	5.6	5.4
FeO	2.9	2.7
CaO	1.8	1.7
K_2O	1.0	0.9
TiO_2	0.8	0.8
CoO	0.3	0.3
Cr_2O_3	0.5	0.5
MnO	0.2	0.2
Na_2O		8.0
Total	96.9	100.2

* Apparently, glass resembling some tektites can be derived from chondritic material by reduction and segregation of metal followed by crystalization differentiation and vacuum evaporation of sodium.

Table 2. Electron microprobe analysis of some mineral phases in Chainpur. Results are percentages by weight.

Mg	Fe	Ca	Mn	Ni
Olivine in chondrule				
33.4*	1.2*	0.1		
Olivine in adjacent matrix				
26.9	13.5	0.1		
23.4	18.9	0.1		
Chainpur olivines of different iron : magnesium ratios				
33.3	1.2		0.1	<0.01
29.6	8.3		0.6	<0.01
26.9	13.5			<0.01
25.7	14.1			<0.01
22.8	18.3			<0.01
Metal globule in chondrule†				
	46			53

* These are average values. The ranges were: Mg, 33.6 to 33.0; Fe, 0.8 to 1.6. The variation in magnesium and iron values is a consequence of weak normal zoning in the olivine. † Cobalt ~0.5.