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The style for the list of references should conform to the style used in recent issues of the JOURNAL. This list should be headed Literature Cited. The following example illustrates the proper style to be used for references:

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A RECENT RECORD OF PORCUPINE FROM TENNESSEE

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and
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Hall and Kelson (1959) include the eastern half of Tennessee as the southernmost limitation of probable occurrence of the porcupine, *Erethizon dorsatum*, in the Appalachian Mountain range, although no living specimens have been recorded from the state. The fact that this rodent probably did inhabit the Appalachian Plateau throughout its length in prehistoric times is based on the recovery of teeth and lower jaw sections from two archaic (ca. 6,500-1,000 B.C.) rock shelter sites in Colbert County, northwestern Alabama (Barkalow 1961; Parmalee 1963).

The only prior evidence of the porcupine in Tennessee is: 1. a record by Kellogg (1939) who quotes H. C. Mercer as having found the dried feces and quills of a porcupine in Bigbone Cave near Elroy, Van Buren County; 2. a left mandible in the United States National Museum labeled simply "Tennessee Cave"; 3. fragmentary skeletal remains of at least two individuals in a late Pleistocene local fauna from Robinson Cave, Overton County (Carnegie Museum Section of Vertebrate Fossils: No. 8379). All three of these records may be Pleistocene. Bigbone Cave also produced a fragmentary desiccated *Megalonyx* (Barr 1961) with claws still intact, so dung and quills of the porcupine are not necessarily an indication of a Recent occurrence.

The specimens documented below are the first unequivocal evidence for the occurrence of the porcupine in Tennessee during Recent times.

Under the auspices of the Tennessee Valley Authority, the Nickajack Reservoir project was initiated in 1963 and a dam was scheduled to be built at Mile 424.7 on the Tennessee River 6.4 miles downstream from the Hales Bar Dam, approximately 18 miles west of Chattanooga. The completion of the Nickajack Dam and subsequent inundation of 3,970 acres is set for November, 1967. Since it was certain that numerous Indian sites located in the valley would be destroyed by the flooding, the Department of Anthropology, University of Tennessee, Knoxville, obtained a contract from the National Park Service to conduct salvage excavations. After surface reconnaissance and testing, two sites were chosen for excavation in the summers of 1964 and 1965: (1) the Westmoreland-Barber Site (40 Mi 11) and (2) the Pittman-Alder Site (40 Mi 5). Vertebrate remains recovered at 40 Mi 11 in 1965 were sent to John E. Guilday; a small sample of bone and shell excavated at the Lay Site (40 Mi 20) in this complex in 1965, and the faunal materials from the Bible Site (40 Mi 15), were sent to Paul W. Parmalee.

Over 10,000 bone fragments were recovered at the Westmoreland-Barber Site; in addition to the usual quantity of white-tailed deer, raccoon, beaver, fox, dog and turkey elements, the few remains of red squirrel *(Tamiasciurus hudsonicus)*, fisher *(Martes pennanti)* and porcupine are particularly noteworthy. Although of rare occurrence, recent records of red squirrel and fisher in Tennessee have established these mammals as part of the faunal complex of the state in historic times. Porcupine, however, apparently disappeared in the southern Appalachian Plateau prior to European settlement.

A section (incisor, ventral margin and ramus missing) of a lower left jaw and an incomplete lower right half (ramus, anterior third and all teeth except M_2 missing) of a jaw of porcupine were recovered at the Westmoreland-Barber Site. This is a Late Archaic/Early Woodland camp site situated on the south bank of the Tennessee River (longitude 85°, 32′ 45″ W.—latitude 35°, 1′ 15″ N.). Portions of the right and left lower jaws of *E. dorsatum* (same individual) were found in the small sample of bone excavated at the Bible Site, a site located along the north bank across the river from the Westmoreland-Barber camp site; it is also of a Late Archaic cultural time period. Incisors from both jaws and M_3 of the right were missing; this molar, the posterior half of the right jaw and portions of the left were probably broken away, as evidenced by fresh breaks, during excavation. There were no butchering or skinning marks on the jaws from 40 Mi 11 but both jaws from the Bible Site had light transverse skinning cuts at the base of the coronoid fossa, and along the ventral margin of the left side. This animal had obviously been taken, skinned and probably eaten by occupants of the site. No post-cranial elements of the porcupine were found at any of the sites in this group. At least three individuals are represented by these jaws.

This Marion County record of porcupine is approximately 50 miles south of the one mentioned by Kellogg (1939) and 90 miles south of Robinson Cave. These areas are characterized by heavy stands of deciduous forest covering a generally hilly and rolling terrain. Combined with steep river bluffs, creek banks and local rock outcroppings, the Cumberland Plateau formed ideal habitat for the porcupine. Why this rodent disappeared from the region in pre-Columbian times is a matter of speculation, but the paucity of remains found thus far in the southern half of the Appalachian Plateau would indicate it was never common and possibly unable to withstand even minor climatic changes following the glacial period. Because of the popularity of porcupine quill work this large, conspicuous, slow-breeding rodent may have been exterminated by Indians in marginal areas where it was never common. Perhaps ecological changes associated with the Colonial Settlement, especially logging and agriculture, may have eradicated them in the area. Each new find of porcupine in archaeological sites and cave deposits will aid in determining the prehistoric distribution and possible abundance of this rodent in Tennessee and neighboring regions in the Appalachian Plateau.

We would like to thank Alfred K. Guthe, Charles H. Faulkner and J. B. Graham, Department of Anthropology, University of Tennessee, Knoxville, for permission to publish this record.

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NEWS OF TENNESSEE SCIENCE

President of the Academy, M. R. Mayfield, has announced an appropriation to the Tennessee Academy of Science from the State of Tennessee in the amount of $3000 for each year of the 1965-67 Biennium. These funds, made available by Commissioner J. H. Warf through the Department of Education, at a time when federal support is diminishing, will assure the continued improvement and expansion of the Academy's contributions to science education in Tennessee. The programs of the Academy which will be especially benefited by this grant include: The Visiting Scientist Program directed by Professor Roger Rusk, the Junior Academy of Science directed by Dr. John Bailey, the Collegiate Division of the Academy directed by Dr. Richard Raridon, the Science Talent Search directed by Mr. James Major, and the Student Research Program directed by Dr. Norman Campbell.

Dr. Clanton W. Williams, former Chief Education Advisor for the Agency for International Development in India, has been named Special Adviser for Summer Institutes.

As Chief Education Adviser, Dr. Williams has been instrumental in launching an outstanding program of summer science institutes in India in cooperation with the Indian Ministry of Education. The institutes introduce Indian college and secondary teachers to modern methods of teaching mathematics and science. The first pilot project was held in the summer of 1963. The program was so successful that in 1964, the number of institutes was expanded to 44, with an attendance of 1,700 Indian teachers. During 1965 the number of institutes reached 94, involving more than 200 American educators and 3,500 Indian teachers. Ohio State University; the universities of Wisconsin and Houston; Teachers College, Columbia; and the National Science Foundation gave support to the program.

Dr. Williams was born in Montgomery, Alabama, and received his Ph.D. from Vanderbilt University.

Arrangements have been made for the transfer of the Jesse M. Shaver Herbarium from George Peabody College for Teachers, to Vanderbilt University. The herbarium of some 10,000 specimens represents a life-long interest of the late Dr. Jesse Shaver. It is particularly notable for the collections of ferns from which he studied for his outstanding *Ferns of Tennessee*, first printed in the JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE. Many of the fern herbanium sheets contain annotations made by Dr. Shaver as he prepared his manuscripts. The transfer is being made on a semi-permanent loan basis in order to insure more thorough utilization of the valuable collection.

THE COHESIVE ENERGIES OF IONIC CRYSTALS POSSESSING THE FLUORITE STRUCTURE

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ABSTRACT

The theoretical cohesive energies of the fluorides CaF_2, SrF_2, and BaF_2 are calculated using relationships based on the Born and Mayer model of an ionic crystal. The computed values of the theoretical cohesive energies are compared with the experimental values of the cohesive energies based on the Born-Haber cycle and thermochemical data.

INTRODUCTION

Using a theoretical approach, proposed by Born and Mayer (2), the cohesive energy of ionic crystals can be determined by summing the electrostatic energy, the first and second van der Waals energies, the repulsive energy and the zero-point energy. The theoretical cohesive energy, obtained using the Born and Mayer model, can be compared to an experimental value based on the Born-Haber cycle (4) and thermochemical data.

The idealized model of an ionic crystal consists of positive and negative ions having charges that are multiples of the electronic charge. The interaction between ions is assumed to be primarily electrostatic interaction between spherical charge distributions. The ions attract or repel one another by coulomb interaction of their charges. Attraction also occurs from the van der Waals interactions between the ions resulting from the polarization of each ion in the field of the other. As the ions are brought closer together their outer electron shells begin to overlap and a characteristic repulsive force resists the overlapping of the electron distributions with the neighboring ion cores. The repulsive force opposes the electrostatic attractive force and causes the ions to come to equilibrium at a finite value of the internuclear distance. The ions form a stable crystal because the electrostatic attraction between unlike ions is larger than the repulsion between like ions. An additional energy term, referred to as the zero-point energy, can be obtained from the Debye limiting frequency.

THEORETICAL COHESIVE ENERGY EQUATIONS

The energy, U_T, for the formation of one mole of an ionic crystal may be expressed as

$$U_T = U_E + U_{D6} + U_{D8} + U_R + U_Z \qquad (1)$$

where U_E is the electrostatic energy term, U_{D6} and U_{D8} are the first and second van der Waals energy terms, U_R is the repulsive energy term and U_Z is the zero-point energy term.

The electrostatic contribution to the cohesive energy is

$$U_E = -Z^2e^2 N A r^{-1} \qquad (2)$$

where Z is the largest common factor of the positive and negative ions, e is the charge on the electron, N is Avogadro's number, A is the Madelung constant for the structure and r is the separation between nearest neighbor ions in the structure.

The first and second van der Waals energy terms are given by the equations

$$U_{D6} = -ND_6r^{-6} \qquad (3)$$

and

$$U_{D8} = -ND_8r^{-8} \qquad (4)$$

where

$$D_6 = 0.5\ (S_6'''C_{++}{}^6 + S_6''C_{--}{}^6) + S_6'C_{+-}{}^6 \qquad (5)$$

and

$$D_8 = 0.5\ (S_8'''C_{++}{}^8 + S_8''C_{--}{}^8) + S_8'C_{+-}{}^8 \qquad (6)$$

The values of S_6', S_6'', S_6''' and S_8', S_8'', S_8''', for the fluorite structure, have been computed by Benson and Dempsey (1) and their values are given in Table I. The formulae for the constants $C_{ij}{}^6$ and $C_{ij}{}^8$ are given by Mayer (10) as

$$C_{ij}{}^6 = \frac{3}{2}\alpha_i\alpha_j\left(\frac{e_ie_j}{e_i+e_j}\right) \qquad (7)$$

and

$$C_{ij}{}^8 = \frac{9\ C_{ij}{}^6}{4\ e^2}\left(\frac{\alpha_ie_i}{p_i}+\frac{\alpha_je_j}{p_j}\right) \qquad (8)$$

where α_i is the polarizability of the ion i, e_i is an energy characteristic of the ion i and p_i is the effective number of electrons in the outermost shell and was taken as 5.5 after Huggins and Sakamoto (8).

TABLE I

$N = 6.02472 \times 10^{23}$	$A = 5.03878$	$e = 4.80288 \times 10^{-10}$ e.s.u.
$V_+ = 1.0$	$V_- = 2.0$	$Z = 1.0$
$f_{++} = 1.5$	$f_{+-} = 1.125$	$f_{--} = 0.75$
$n_{++} = 12.0$	$n_{+-} = 8.0$	$n_{--} = 6.0$
$n'_{--} = 12.0$	$k_1 = 1.63299$	$k_2 = 1.15470$
$S_6' = 8.708806$	$S_6'' = 7.089124$	$S_6''' = 0.762218$
$S_8' = 8.157501$	$S_8'' = 4.395394$	$S_8''' = 0.253163$

The repulsive term can be expressed as

$$U_R = U_1 + U_2 + U_3 + U_4 \qquad (9)$$

where

$$U_1 = N\ b\ v_+\ b_+\ b_-\ f_{+-}\ n_{+-} \exp\ (-r/\rho)$$

$$U_2 = 0.5\ N\ b\ v_- b_-^2\ f_{--} n_{--} \exp\ (-k_2 r/\rho)$$

$$U_3 = 0.5\ N\ b\ v_- b_-^2\ f_{--} n'_{--} \exp\ (-k_1 r/\rho)$$

$$U_4 = N\ b\ v_+ b_+^2\ f_{++} n_{++} \exp\ (-k_1 r/\rho)$$

In these expressions $b_+ = \exp\ (r_+/\rho)$ and $b_- = \exp\ (r_-/\rho)$, n_{ij} are the numbers of nearest neighbors of the positive and negative ions and n'_{--} is the number of next nearest