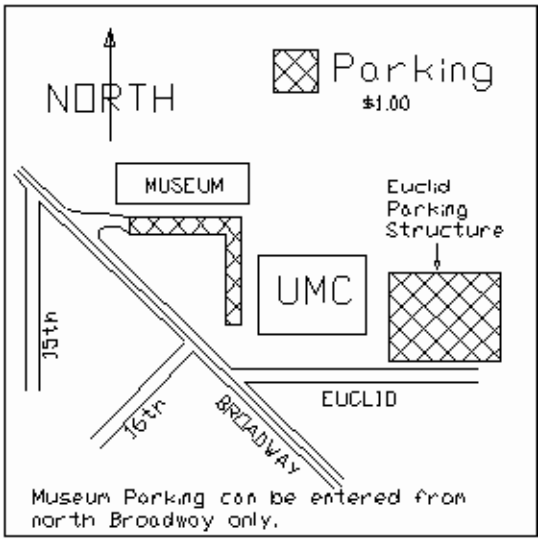
CALUMET

CONSERVATION PRESERVATION
EDUCATION EXPLORATION

Newsletter of the Indian Peaks Chapter of the Colorado Archaeological Society
FEBRUARY 2001

CALENDAR OF EVENTS

General (lecture) meetings are held in the University of Colorado Museum, Dinosaur Room Second Thursday of each Month at 7:00 PM. The public is always welcome.



The following is a situation that will last through next summer:
I'm sure you noticed that our Museum parking lot 208 is off limits to non-permit holders, even at night. So, would you please pass that on to your members? They can park in the Euclid parking structure for $1.25. Euclid parking lot is east of the Museum on Euclid. Just want to avoid tickets and towing.
Thanks, Carol Kliger

After parking in the Euclid Parking Structure, walk west on Euclid to Broadway, follow Broadway on the sidewalk for one block and drop down into the Museum parking lot. It is only a few hundred yards.

February 1 Executive Board, Alterra Villas at the Atrium, 7:30PM

February 7 AIA Presentation - Ms. Judy Greenfield, Art Objects Conservation, "Conservation in the Service of Archaeology". All AIA lectures, unless designated, are co-sponsored with the University of Colorado Museum of Natural History, are free to the public, and are presented at 6:30 PM at the Museum. Reservations are not required. Call 303-497-6454 for further information.

February 8 IPCAS Presentation - Shannon Smith, Firefighter and CU Grad Student.
Topic: Effects of fires and fire-fighting in and around archaeological sites.

February 28 AIA Presentation - Professor T. Hara Tsavella-Evjen, Classics Department, University of Colorado.
Topic: Greek Decorated Textiles: Past and Present.

March 8 IPCAS Presentation - Tom Meier, IPCAS Member.
Topic: Sand Creek Massacre Site.

April 12 IPCAS Presentation - Jeanie Mobly-Tanaka, CU Museum Staff and Doctoral Student.
Topic: Yellow Jacket Site in Southwestern Colorado.

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April 18 AIA Presentation - Professor David W. Anthony, Anthropology Dept., Hartwick College. Topic: The Earliest Horseback Riders and Charioteers - Evidence from the Steppes.

May 10 IPCAS Presentation - To be determined.

Biochemical evidence of cannibalism at a prehistoric Puebloan site in southwestern Colorado

Richard A. Marlar, Department of Pathology, University of Colorado School of Medicine, Denver, Colorado
Banks L. Leonard, Soil Systems Inc., Phoenix, Arizona
Brian R. Billman, Department of Anthropology, University of North Carolina-Chapel Hill, Chapel Hill, North Carolina
Patricia M. Lambert & Jennifer E. Marlar, Colorado Archaeological Society

The existence of cannibalism is one of the most controversial issues in the archaeology of the American Southwest. Disarticulated, cut-marked and heat-altered human remains from non-burial contexts at prehistoric Puebloan (Anasazi) archaeological sites in the Four Corners region of the American Southwest have been interpreted by some scholars as evidence of cannibalism. Osteological studies indicate that many of the disarticulated bodies found at these sites were processed in a manner consistent with food preparation. Opponents of this interpretation point out that non-cannibalistic practices such as secondary interment, corpse mutilation and ritualized witch executions might account for the assemblages. Osteological evidence alone does not document the actual ingestion of human flesh. Here we show consumption of human flesh did occur as demonstrated in preserved human waste containing identifiable human tissue remains from a site with osteological evidence of cannibalism.

Sometime around AD 1150 a small Puebloan habitation site (5MT10010) located along Cowboy Wash in southwestern Colorado was suddenly abandoned. The site inhabitants' principal residences were three pithouses (Features 3, 13 and 15). Several lines of evidence indicate that during the abandonment or soon after, the bodies of seven people of both sexes and various ages were disarticulated, defleshed and apparently cooked as if for consumption by other humans. Their incomplete remains were left directly on floors and in other non-burial contexts in two of the pithouses (Features 3 and 13).

The contexts and types of artifacts left behind in the pithouses and the conditions of their roofs indicate that the pithouses at 5MT10010 were suddenly abandoned. This site was excavated as part of a larger archaeological study of 17 Puebloan sites on the southern piedmont of Sleeping Ute Mountain. The project involved the excavation of 105 structures, including 36 pithouses or pitstructures dating from AD 450–1280. The abandonment observed in the pithouses at 5MT10010 differed markedly from the pattern seen at the other sites excavated during the project. The typical pattern of structure abandonment involved removal of virtually all artifacts and materials of value. Grinding stones, finely polished tools, ornaments and whole vessels were rarely left behind. Structural wood and stone, especially shaped slabs, were routinely scavenged for re-use. In cases where roofing materials were not stripped, the roof was typically set ablaze after useable artifacts had been removed from the structure.

In contrast, at 5MT10010, household goods, such as cooking pots and serving wares, valuable items, such as ornaments and polished stone tools, and salvageable construction materials, such as shaped stone slabs and wooden posts, were left in place in all the pithouses at abandonment. Many of the vessels, tools, ornaments and shaped stones were found directly on floor and bench surfaces with no sediment underneath, indicating that they were found at or near where they were originally left. Microstratigraphic evidence also indicates that the roofs of all the pithouses decayed gradually in place, rather than being burned or scavenged for re-use as was done with virtually all other southern Piedmont habitation structures.

The disarticulated human remains were found scattered and piled in similar contexts to the valuable artifacts. In Feature 3, over a thousand human bones and fragments were found piled in a side chamber while others were recovered directly from the floor of the structure, with no sediment underneath. The remains represented a minimum of four adults and one adolescent. In Feature 13, whole bones and fragments were left directly on the floor, piled in a side chamber and stacked on a bench. Scorched

tooth and bone fragments were also found in the central hearth and in ash piles on the structure floor. The bones in Feature 13 were from two subadults.

Other things were left in the pithouses during or soon after the site was abandoned. A set of stone tools consistent with use in butchering was scattered around the hearth on the floor of Feature 13. Several of the tools were tested by crossover immunoelectrophoresis for blood residues; two cutting tools tested positive for human blood. Although no human remains were left behind in the third pithouse at the site (Feature 15) near the time of abandonment, fragments of a cooking pot were found scattered throughout the structure. Some of the fragments were in direct contact with the floor. Finally, an unburned human fecal deposit (coprolite) was found in the ashy fill of the structure hearth. Its unburned condition demonstrated that it was deposited after the last use of the hearth. This was the only coprolite recovered from the site and may be the only one identified from a structure hearth from anywhere in the American Southwest.

The abandonment of a cooking pot in Feature 15 opened the possibility that biochemical analyses might detect human tissue residues, supporting the hypothesis that human body parts were cooked. An immunological detection assay method (ELISA) has been used to identify animal meat residues in cooking pots from archaeological contexts. To test for the cooking of human muscle tissue in ceramic vessels, 11 shards from the Feature 15 cooking vessel were analyzed for human myoglobin. Myoglobin is a protein molecule that transports oxygen from the inner surface of the membrane of skeletal and cardiac muscle cells to the energy-generating components within the cells. Five shards from other vessel types, or from vessels that were already broken before the events surrounding the abandonment of 5MT10010 began, were also analyzed for human myoglobin. One of these was from the floor of Feature 3, where it was found lying directly under the face of a disarticulated human adolescent. The other four were from the floor of Feature 13, the same structure where blood residues were detected on cutting tools. Only the shards from the cooking vessel in Feature 15 tested positive for human myoglobin (2.8–48 µg of human myoglobin per shard).

For controls, 29 shards from other archaeological sites were tested using the same procedures: 14 cooking vessel shards from a midden area associated with a contemporaneous Pueblo II/Pueblo III (AD 1075–1175) site (5MT5501) from southwestern Colorado, and 15 shards from an intermittent campsite (5JF321) southwest of Denver that contained a Woodland Ceramic Tradition component (AD 150–1150) with associated shards from a minimum of 6–8 cooking vessels. All control shards were negative for human myoglobin (< 1 ng per sample). The presence of human myoglobin only on cooking vessel shards from 5MT10010 is consistent with the hypothesis that human muscle tissue was cooked in that vessel.

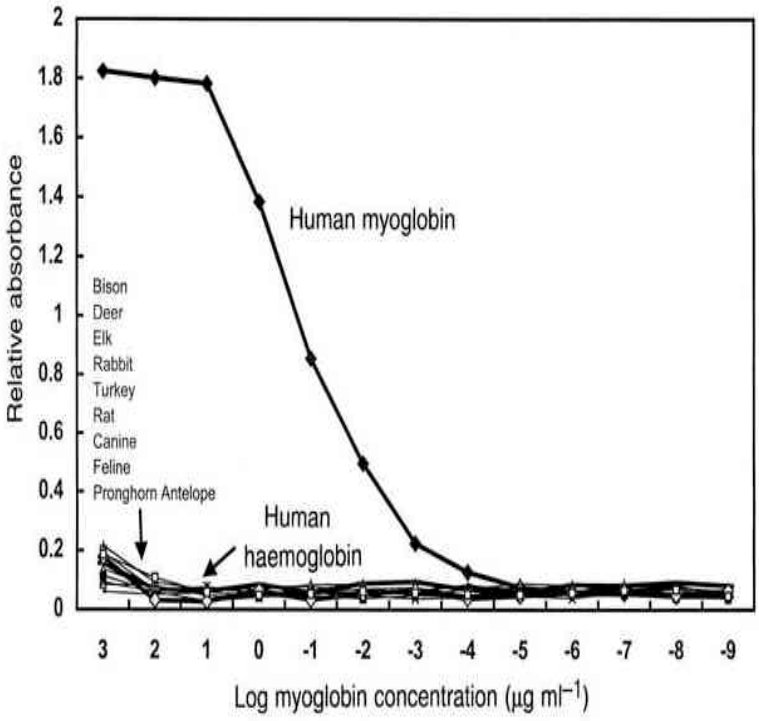
The discovery of a coprolite that was deposited near the time of abandonment of the site, during or shortly after butchering and cooking of human remains, provided the potential to yield direct evidence of cannibalism. The coprolite was found in Feature 15 and consisted of a single mass of desiccated fecal material, 30 g dry weight, of a size and shape consistent with human origin. The position and condition of the coprolite indicated that it was defecated directly into the cold hearth in Feature 15. Macroscopic analysis of the human coprolite revealed no detectable plant remains, which is extremely unusual for an ancient Puebloan coprolite. Microscopic analysis indicated that starch granules and phytoliths were virtually absent. The absence of starch granules is considered a strong indicator that maize in particular was not part of the meal(s) represented in the coprolite. The only pollens identified were from Cheno-Am, low-spine Composite, and trace amounts from Poaceae, all of which could have derived from wind-borne, ambient pollen. The absence of plant remains except for these pollen types is consistent with the hypothesis that the depositor of the coprolite had not consumed plant foods 12–36 h before defecation.

Although bone fragments and keratinous elements, such as hair, were not detected among the gross contents, the absence of plant material indicated that the meal(s) represented by the coprolite were probably composed entirely of meat.

To test the hypothesis that human flesh was consumed, it was necessary to identify a human-derived substance in the coprolite, but many human molecules normally occur in human stool material. For example, cells from the intestinal lining are constantly shed during the peristaltic process and blood from intestinal lesions may be present in stool samples. Therefore, it was necessary to identify a human substance that could only be present in the coprolite because it had been consumed by the depositor and could not be derived from his/her own tissues during digestion and elimination. Myoglobin is found only in skeletal and cardiac muscle cells, and not found in cells of the blood, skin, connective tissue, vascular tissue, tissues of the lymphatic system, nor in the smooth muscle cells of the digestive system. Therefore, human myoglobin should only be present in fecal material if it is consumed and passed through the digestive system by the depositor of the feces. Furthermore, the chemical composition of myoglobin differs among animal taxa, making it possible to identify the type (species) of flesh consumed (J.E.M., unpublished results). Consequently, the ELISA technique can distinguish the presence of taxon-specific meat remains in the feces of meat consumers. Bovine myoglobin, for example, was detected in samples from modern individuals that had consumed cooked beef within the last 24 h, demonstrating that taxon-specific myoglobin can be detected in fecal material.

Analysis of the coprolite from Feature 15 by ELISA detected human myoglobin (18–62 ng of human myoglobin per g of coprolite). The amount of myoglobin (> 5 s.d. above the average of the negative control) was lower than the amount detected on some of the shards from Feature 15 (7–10 s.d.). Apparently, the majority of the human myoglobin was broken down (degradation and hydrolysis) in the cooking process and in the gastrointestinal system of the consumer, and only a small amount remained in the coprolite that was recognizable to the human myoglobin-specific purified antibody. Human myoglobin was undetectable (< 5 s.d.) in 39 modern human fecal extracts used as controls, including samples from patients with positive blood in the stool sample.

Furthermore, 20 prehistoric coprolites were tested as controls and showed no human myoglobin (< 5 ng of human myoglobin per gm of coprolite). The control coprolites were from Salmon Ruin, an open-air Puebloan site with occupation contemporaneous to 5MT10010. Although a possible cannibalism assemblage has been described from Salmon Ruin, all of the control coprolites were recovered from a deep latrine deposit that clearly predates events surrounding the formation of the possible cannibalism assemblage (K. Reinhard, personal communication). To rule out contamination from insects in the coprolite from 5MT10010, internal larval proteins were tested for cross-reactivity with human myoglobin; the results of these tests were negative.



Direct evidence for the consumption of human tissue by humans is necessary to demonstrate definitively that human cannibalism occurred at an archaeological site. Previous archaeological and osteological studies have strongly indicated that cannibalistic episodes took place among the ancient Puebloans, but the evidence has been essentially circumstantial. The analysis of the coprolite and associated remains from 5MT10010 at last provides definitive evidence for an episode of cannibalism involving ancient Puebloans. Results of the human myoglobin ELISA analyses of the human coprolite and shards from a ceramic vessel are consistent with the archaeological and osteological evidence of cannibalism at 5MT10010. During or after the sudden abandonment of the site, disarticulated, defleshed and heat-altered human remains were left in non-burial contexts in association with butchering tools with human blood residue, a cooking vessel with human myoglobin residue and a human coprolite containing human myoglobin. These data demonstrate that humans both processed and consumed human flesh at the site.

Cannibalism has occurred in a wide range of societies for a wide variety of reasons, including starvation, ancestor worship and political terrorism. With the presentation of the first direct evidence of cannibalism in the American Southwest in the prehistoric era, we hope that the debate will shift from the question of whether or not cannibalism occurred to questions concerning the social context, causes and consequences of these events.

Artifact, coprolite and stool sample processing

We processed the shards, coprolite and control samples in an identical manner. We immersed the shards in artifact buffer (0.02 M Tris, 0.5 M NaCl, 0.5% Triton X-100, pH 7.4), sonicated them for 2 h and centrifuged them to remove particulate matter. We removed Triton X-100 by dilution/concentration three times using ultra-filtration membranes (cut-off at relative molecular mass < 10,000; Amicon). We dissolved the coprolites (100 mg) and control stool samples (500 mg) in artifact buffer and processed them as for the shards. The final volume was one-fifth the starting volume.

Myoglobin detection assay

We used a sandwich-type ELISA to analyze for human myoglobin on shards, human coprolite samples and human stool samples. We applied a 100 µl aliquot of 1/1000 dilution of the capture antibody (immuno-purified rabbit anti-human myoglobin antibody from the purified immunoglobulin fraction, Sigma) in 0.05 M carbonate buffer, pH 9.6, to the plate overnight at 4 °C. We removed the unbound antibody by washing five times with ELISA wash buffer (0.025 M Tris, 0.14 M NaCl 0.025% Tween, pH 7.4) in an automated ELISA washer.

We diluted the sample and controls 1/100 in ELISA dilution buffer (0.5 M Tris, 0.14 M NaCl, 0.03 M KCl, 0.2% Tween, 0.4% PEG-8000, pH 7.4) and applied 100 µl to the appropriate wells for 1 h at 22 °C. After washing the wells (as above), we applied mouse monoclonal anti-human myoglobin (Sigma; 100 µl diluted 1/4,000 in ELISA dilution buffer) for 1 h at 22 °C. We washed the wells three times and applied the detection antibody (Sigma; 100 µl of sheep anti-mouse IgG conjugated to horse radish peroxidase, diluted 1/10,000 in ELISA dilution buffer) 1 h at 22 °C. We washed the wells three times and added the substrate (TMB/Urea; Sigma) for 5 min. We stopped the reaction with 2 M H_2SO_4 and read the plate at 450 nm on an ELISA reader (Dynex MRX, Chantilly, VA). We assayed each sample or control using six replicates, three times each by two individuals. We averaged the values from each experiment and compared them statistically to the negative controls using the Student's *t*-test. We considered the results as positive when $P < 0.001$ and at least 5 sd above the average negative control.

The commercial rabbit anti-human myoglobin antibody reacted minimally with myoglobin from several other species used as possible food sources. To remove these cross-reacting antibodies, the rabbit anti-human myoglobin antibodies were immuno-adsorbed with different species of myoglobin (deer, bovine, sheep, antelope, rabbit, turkey, chicken, elk, mouse and rat). The individual myoglobin samples were coupled to Sepharose (Pharmacia) to bind the antibodies specific for the different species of myoglobin. The remaining human-specific antibodies were concentrated and used in the ELISA procedure. The immuno-purified poly-clonal rabbit anti-human myoglobin antibodies recognized only human myoglobin in a dose-dependent manner. The concentration of human myoglobin detected in the coprolite ranged from 18 to 62 ng ml^{-1}. No detectable concentrations of myoglobin were observed with serial dilutions of myoglobin (> 1 mg ml^{-1}) from the other species, including the 'food source' species found in the region. Cross-reactivity with non-human primates was not considered, because no evidence of non-human primates has been found in prehistoric archaeological contexts in the continental United States. Furthermore, the nearest contemporaneous non-human primate populations were located in tropical Mexico.

Artifact and fecal controls

The control shards from 5MT5501 were provided by Jerry Fetterman, Woods Canyon Archaeological Consultants, Inc. The site occupation was contemporaneous to the Cowboy Wash site (5MT10010), but lacked any indication of possible cannibalism. 5MT5501 is located about two miles west of Dolores and 18 miles north of Sleeping Ute Mountain, in southwestern Colorado. The control shards from 5JF321 were provided by the Colorado Archaeological Society from their excavation about ten miles southwest of Denver in the Ken Caryl Valley. These shards are of the Woodland Ceramic Tradition. Some control shards from both 5MT5501 and 5JF321 were positive for deer and rabbit myoglobin and/or blood, but control shards from ancient Pueblo or Plains cultures did not contain human myoglobin residue.

Control fecal tests were conducted to determine whether human myoglobin was present in feces from modern normal individuals (25 samples), modern individuals with blood in their stool samples (ten samples), or modern individuals who had consumed cooked beef within 24 h of defecation of the specimen (four samples). These controls did not show detectable levels of human myoglobin (< 5 s.d. of the average negative control). This result is consistent with the hypothesis that human myoglobin is not derived from the tissues of a defecator, even when the stool sample is positive for blood. In contrast, the

control samples from the beef consumers tested positive for bovine myoglobin, demonstrating that orally ingested myoglobin can survive the processes of cooking and digestion, can be detected in human fecal material, and can be identified as to biological taxon of origin. The modern stool samples were collected for clinical testing and the remaining material was considered 'discarded specimen material' from the clinical laboratory. The only personal information available to the authors was the patient's occult blood status.

Passport In Time (PIT) Web-Page

The USDA Forest Service Passport in Time Program is pleased to announce the posting of their new web page. The page includes program information, a listing of projects available for participation, articles on past projects, and an on-line application. Check out http://www.passportintime.com for the latest on PIT. Included is a dinosaur-track-recording project in May in Colorado's Picketwire Canyon - application deadline is February 15th.

Indian Peaks Chapter Membership List

The following is a list of the active and recently inactive members of the Indian Peaks Chapter of the Colorado Archaeological Society. The first line of each membership contains the member name or names, the date of membership renewal, and the kind of membership (F-family, I-individual, S-student). The second and third lines contain the mailing address and the telephone number. If you would prefer that any part of this information not be published in the future, please contact any IPCAS officer or board member. **If the renewal date has past, please renew your membership**. If a membership has not been renewed for four months, that membership will not receive the Calumet. We have many volunteer projects that are restricted to active members of CAS. If you have any corrections, please contact Cheryl Damon by telephone at (303) 678-8076 or email at cherdam@cs.com.

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Laura Viola 11/01 I
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Ricky Weiser 7/00 I
John & Kathy Wilson 8/01 F

Magnolia Excavation Plan

I've scheduled the Magnolia Shelter testing for my class (and CAS) for **April 7 and 15, 2001** (Saturdays), with a weather alternate date of April 28th. We'll do a GPS survey of the immediate area of the shelter with my Trimble GPS for a later site area map. I have all the equipment necessary for testing and will bring that up. We definitely need to scan the artifacts because digital camera resolution (unless you have a 3 MB+ camera) is too coarse for good research imaging. We have had excellent results in flatbed scanning and developed good techniques for doing so. Also, I have a comprehensive lithic collection for comparative analysis of materials, debitage study, etc. I could have CAS members come here (UNC in Greeley) to do the analysis using my lab facilities, collections, etc. - Robert Brunswig -

This newsletter is published each month, except June and August, by the Indian Peaks Chapter of the Colorado Archaeological Society. The views expressed in articles or editorials appearing in this publication do not necessarily reflect those of the membership or the Executive Board of the Indian Peaks Chapter, Colorado Archaeological Society.

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Please check the chapter web-site at: **http//www.indianpeaksarchaeology.org**

MEMBERSHIP APPLICATION - INDIAN PEAKS CHAPTER

____ **Individual** $25 / Year ____ **New** _____ **Date**
____ Family $28 / Year ____ **Renewal**
____ **Student** $12.50 / Year, with Calumet delivery by e-mail

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When you join or renew you will receive the ***Calumet***, our monthly newsletter, and ***Southwestern Lore***, the quarterly publication of the Colorado Archaeological Society. And you will have opened the door to Colorado Archaeology.

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