9TH WORLD CONGRESS ON
MUMMY STUDIES
LIMA, PERU 10-13 AUGUST 2016

PROGRAM
& ABSTRACTS

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9TH WORLD CONGRESS ON MUMMY STUDIES
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PROGRAM & ABSTRACTS
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Organizing committee

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Vice-President
Universidad Peruana Cayetano Heredia

Elsa Tomasto-Cagigao
Secretary
Pontificia Universidad Católica del Perú

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Museo Arqueológico y Etnográfico de Tenerife, Spain

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Tulane University, USA

Albert Zink
Institute for Mummies and the Iceman, Italy
The short story of the world congresses on mummy studies

Conrado Rodríguez-Martín, MD
Instituto Canario de Bioantropología and Museo Arqueológico de Tenerife (OAMC-Cabildo de Tenerife)

Nine world congresses on mummy studies have been held up to the present. The first was in 1992 in Tenerife, the Canary Islands, Spain, followed in 1995 in Cartagena de Indias, Colombia; 1998 in Arica, Chile; 2001 in Nuuk, Greenland; 2004, Torino, Italy; 2007, Lanzarote, Canary Islands, Spain; San Diego, California, USA, 2011; and Rio de Janeiro, Brasil, 2013. And now this: Lima, Peru, one of the most important places on mummy research around the world.

These congresses have been very important in generating scientific attention to mummy studies, and especially to bring scientists interested on mummies together. On a broader scale, the mummy congresses have played a part in underlining that studying mummies is a truly scientific endeavour. Before the mummy congresses, the scientific results of mummy studies would be spread out over a plethora of medical, anthropological and archaeological meetings and publications, and, in some instances, gathering specialists of different countries, like the meetings of Manchester in the 1980s.

While this may be very appropriate in some instances, e.g. presenting paleopathological evidence of a specific disease at a medical conference discussing the epidemiology of that disease, it also atomised the field, so that the context of the find of the mummy, the rituals and taphonomy leading to the preservation of the mummy, and, very importantly, an understanding of the past population of which the once living person formed part, was perhaps published elsewhere, or not really recorded anywhere.

Along this last 25 years, the mummy congresses have become the venue of choice for presenting the results of mummy analyses, because they ensure that whatever one is presenting, the results are understood in a more holistic approach. Indeed, the interdisciplinary discussions arising from the presentations, are perhaps one of the most prominent features of these congresses.

We will also have the chance to experience Peru’s cultural and natural attractions, and the warm hospitality of the Peruvian people.
The 9th World Congress on Mummy Studies, a Celebration for Mummies

Sonia Guillén, Ph.D.
President, Organizing Committee

With its natural beauty and long history of human habitation, Peru is an obvious meeting place to gather and talk about mummies. Conservation conditions and cultural practices in some areas of this country have made it possible for ancient bodies to survive the perils of time and the negative impacts of development projects and looting. There are large numbers of mummies and funerary bundles in many museums in Peru as well as in other museums and collections around the world, and some of these collections are well curated. Unfortunately, human remains in general do not receive the conservation attention that they require. Fortunately this situation is improving, and there is now a better awareness of the preservation demands of organic remains as well as the need to protect their scientific potential and cultural context.

Presently in Peru, there are more people specializing in the study and conservation of human remains and more interdisciplinary projects focusing on this field than in any time in the past. Nevertheless, the number of full-time positions dedicated to mummies is still very small, as is the case for much of the rest of the world. This Congress will contribute to the promotion of the need to conserve and study mummies as an important part of our cultural and scientific heritage.

This Congress is organized by Centro Mallqui, a non-governmental organization established in Peru to focus on the conservation and study of mummies. The work of Centro Mallqui is made possible thanks to the support of the Institute for Bioarchaeology at the British Museum. Although we have gained a lot of experience in the conservation of archaeological collections, including mainly human remains, a lot of research by many people is still required to produce more meaningful results.

Past congresses on mummy studies have been pivotal to the development of research projects in Peru. In 1992 at the first meeting in Tenerife, I met Konrad Spindler, a colleague and friend who was instrumental in the productive collaboration which developed between Mallqui and Austrian colleagues, and there are several other collaborations which began in these congresses. Thus, my appreciation of these meetings also extends to gratitude for the opportunities they have generated. I have no question that many of us have similar stories about professional and academic collaborations as well as friendships that stem from our participation in these meetings.

The organization of this meeting has been a large group effort spanning some 18 months, and during this undertaking we have confronted serious limitations of time, resources, and support. Because we have been unable to secure translation services to provide a bilingual meeting, we have had to adopt English as our lingua franca. On the other hand, we have had an enormous response to the call for papers and posters. This congress is unique in that we have been gathering for the last 24 years without being part of a formal organization. We are a group of colleagues from around the world who have developed a notion of partnership and connection through these meetings. We come to this Congress to gather with old friends as well as with young professionals and students, and through this, our gathering becomes a celebration of the contribution of mummies to our identity, of our connection with our past, and of the open doors to science and knowledge.

The organizing committee and I are very grateful for the opportunity to celebrate this meeting in Peru, and we hope you will not only enjoy an outstanding conference but will also have the chance to experience Peru’s cultural and natural attractions, and the warm hospitality of the Peruvian people.
<table>
<thead>
<tr>
<th>Time</th>
<th>Empresarial Room</th>
<th>Ejecutivo II Room</th>
<th>Sol de Oro Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:15 to 9:00 am.</td>
<td>REGISTRATION</td>
<td>Ejecutivo III Room</td>
<td>1st floor</td>
</tr>
<tr>
<td>9:00 to 10:30 am.</td>
<td>OPENING CEREMONY</td>
<td>Room 1</td>
<td></td>
</tr>
<tr>
<td>10:30 to 11:00 am.</td>
<td>COFFEE BREAK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00 am. to 1:00 pm.</td>
<td>1. Age estimation in mummies</td>
<td>2. Research and conservation at the Egyptian museum in Cairo</td>
<td>3. Mummy conservation: continuing challenges for curation and research</td>
</tr>
<tr>
<td>1:00 to 2:00 pm.</td>
<td>LUNCH</td>
<td></td>
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</tr>
<tr>
<td>2:00 to 3:30 pm.</td>
<td>4. Biochemical methods and mummy studies</td>
<td>5. Host-parasite relationships and diseases</td>
<td>6. Bioarchaeology of war</td>
</tr>
<tr>
<td>3:30 to 4:00 pm.</td>
<td>COFFEE BREAK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:00 to 5:00 pm.</td>
<td>4. Biochemical methods and mummy studies</td>
<td>5. Host-parasite relationships and diseases</td>
<td>6. Bioarchaeology of war</td>
</tr>
<tr>
<td>5:00 to 6:00 pm.</td>
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<tr>
<td>3:30 to 4:00 pm.</td>
<td>POSTERS: 1 TO 12, EJECUTIVO III ROOM</td>
<td>POSTERS: 13 TO 24, EJECUTIVO III ROOM</td>
<td></td>
</tr>
<tr>
<td>7:30 - 9:30 pm.</td>
<td>Activities and reception at Museo Nacional de Antropología, Arqueología e Historia, Pueblo Libre</td>
<td>7:30 to 9:30 pm. Dinner</td>
<td></td>
</tr>
</tbody>
</table>
FRIDAY 12 AUGUST

Keynote lecture: Experimental human mummification: past, present and future. BOB BRIER & RONALD S. WADE, Empresarial Room

Empresarial Room
14. From autopsy to diagnostic imaging and metagenomics

Ejecutivo II Room
15. Paleocardiology

Sol de Oro Room
16. Mummies of the state of Queretaro, Mexico

COFFEE BREAK

14. From autopsy to diagnostic imaging and metagenomics

15. Paleocardiology

16. Mummies of the state of Queretaro, Mexico

LUNCH

17. Bioarchaeology of care

19. Andean mummies: scientific research and social impact

20. Mummies in the reconstruction of mortuary rituals

PLENARY SESSION - CLOSING DEBATE
Empresarial Room

SATURDAY 13 AUGUST

WORKSHOPS

MUSEO NACIONAL DE ANTROPOLOGÍA, ARQUEOLOGÍA E HISTORIA

9:00 am. to 12:00 m.
Making paleogenetics easier
Evelyn Guevara

9:00 am. to 12:00 m.
Keeping mummies at the MNAAHP
Patricia Maita

MUSEO DE SITIO ARTURO JIMÉNEZ BORJA PURUCHUCO

9:00 am. to 12:00 m.
Solutions to handle and preserve funerary bundles at the Puruchuco Museum
Selene Figueroa, Rubén Buitrón, Clide Valladolid

PARQUE DE LAS LEYENDAS

9:00 am. to 12:00 m.
Animal mummies at the Parque Las Leyendas
Lucénida Carrión

UNIVERSIDAD PERUANA CAYETANO HEREDIA

9:00 am. to 12:00 m.
Recovery of microfossils in botanical archaeological remains
Luis Huamán

COFFEE BREAK

17. Bioarchaeology of care

19. Andean mummies: scientific research and social impact

20. Mummies in the reconstruction of mortuary rituals

POSTERS: 25 TO 36, EJECUTIVO III ROOM
Registration

_Ejecutivo_ III Room, 1st floor
8:15 am.

Opening ceremony

Empresarial Room, 2nd floor
8:15 am.

Welcome. A celebration for mummies. The contribution of the World Congress on Mummy Studies in Peru

Sonia Guillén
9:30 am.

From 1992 to 2016, the impact of the World Congress on Mummy Studies

Conrado Rodríguez Martín
10:00 am.
Symposium 1
Age estimation in mummies

Chairs: Chiara Villa, Niels Lynnerup
Empresarial Room, 2nd floor
Time: 11:00 am. - 1:00 pm.

The mummies are silent witnesses of old cultures and represent an unique opportunity to shed light on health conditions, disease and tradition of old populations. To preserve their integrity, the mummies should be investigated using the non-invasive techniques. However, many of the traditional methods, for example those for age estimation, are based on macroscopic observation of the bones or teeth. This symposium will show how the age can be estimated in the mummies using visual inspection, analyzing CT images and 3D visualizations and through the endoscopy. Speakers from around the world will present their experiences.

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>James V. Schanandore, Summer Decker, Jonathan Ford</td>
<td>Applying qualitative and quantitative age at death methods to 2D sectional anatomy and 3D virtual models of mummies acquired from computed tomography scanning.</td>
</tr>
<tr>
<td>11:20</td>
<td>Chiara Villa, Niels Lynnerup</td>
<td>Age estimation in child mummies using CT scans and 3D visualizations.</td>
</tr>
<tr>
<td>11:40</td>
<td>Ronald G. Beckett, Gerald J. Conlogue</td>
<td>Challenges of age determination from field paleoimaging methods with a special focus on endoscopy.</td>
</tr>
<tr>
<td>12:00</td>
<td>Niels Lynnerup, Chiara Villa</td>
<td>Age estimation problems in bog bodies.</td>
</tr>
<tr>
<td>12:20</td>
<td>Hyejin Lee, Chang Seok Oh, Jong Ha Hong, Yi-Suk Kim, Von Joon Lee, Dong Hoon Shin</td>
<td>Considerations about age estimation in Korean mummy studies.</td>
</tr>
<tr>
<td>12:40</td>
<td>Discussion</td>
<td></td>
</tr>
</tbody>
</table>

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## Symposium 2

**Multidisciplinary practice in research and conservation of Egyptian mummies and artifacts at the Egyptian Museum in Cairo**

**Chairs:** Sahar Saleem, Mahmoud El-Halwagy, Moamen Othman, Islam Ezzat  
**Ejecutivo II Room, 1st floor**  
**Time:** 11:00 am. - 1:00 pm.

The Egyptian Museum in Cairo contains the world’s largest collection of mummies and other Pharaonic artefacts. Research and conservation of these priceless objects encouraged the collaborative work of experts in Egyptology, conservation sciences, and radiology. Radiology represents an accurate non-invasive method of mummy studies that has been used for decades. The first X-ray study of a royal Egyptian mummy from the museum was performed on Thutmose IV in 1903 by an Egyptian radiologist, Dr Khayat. Computed Tomography (CT) scanning provides a wealth of information and generates images of structures with different densities. The Egyptian Museum in Cairo is one of very few museums in the world that has a CT machine since 2004. This collaborative work helped to investigate and conserve several priceless objects including: human and animal mummies, wooden coffins, cartonages, stelas and other ancient objects that span more than 3,000 years, from the earliest kingdom to Grecoroman times.

Results helped identify age at death, gender, mumification style and date, detect hidden amulets, diagnose diseases, and suggest the cause of death. Preservation and maintenance of ancient mummies and human remains becomes doubtless one of the challenges for cultural heritage sciences. This experience entails the usage of conducted inert gases and oxygen free sacs and their characteristic benefits on keeping mummies stable. A comparative study between this technique and traditional ways of preserving mummies and human remains indicated the benefits of the modified technique.

| 11:00  | **Sahar Saleem, Moamen Othman, Sabah Abdel-Razek, Mahmoud El-Halwagy** | Multidisciplinary investigations of unidentified mummies and related objects at the basement vault of the Egyptian Museum in Cairo. |
| 11:20  | **Moamen Othman, Islam Ezzat, Mahmoud El-Halwagy, Sahar Saleem** | Conservation of archaeological artifacts at the Egyptian Museum in Cairo: value of multidisciplinary practice. |
| 11:40  | **Sahar Saleem, Moamen Othman, Mahmoud El-Halwagy** | Combining CT scanning and 3D printing of ancient Egyptian mummies and related objects: Potential applications in archaeology and museology. |
| 12:00  | **Moamen Othman, Islam Ezzat, Mahmoud El-Halwagy** | Conducted inert gases and oxygen free sacs in the preservation of ancient mummies in the Egyptian Museum in Cairo. |
| 12:20  | Discussion | |
### Symposium 3

**Mummy conservation: continuing challenges for curation and research**

**Chair:** John W. Verano, Mellisa Lund Valle  
**Sol de Oro Room, 12th floor**  
**Time:** 11:00 am. - 1:00 pm.

Mummified remains present special challenges, both in the field and in the museum setting. Some geographic regions, such as Andean South America and Egypt, have especially large collections of mummies, with new material being discovered on a regular basis due to urban expansion and construction projects. While some museums have the infrastructure and funding to properly conserve mummies, many do not, and most archaeological storage facilities lack adequate conditions for storing mummies and conducting research on them. This symposium will review some of the challenges of mummy conservation and highlight attempts to address these issues.

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>John W. Verano</td>
<td>Tribute to Alana Cordy-Collins†</td>
</tr>
<tr>
<td>11:10</td>
<td>Patricia Landa Cragg</td>
<td>Conservation challenges and solutions in the unraveling of funerary bundles from the Peruvian central Coast.</td>
</tr>
<tr>
<td>11:30</td>
<td>Mercedes González, Anna-Maria Begerock, Amalia Valls, Maria Belchi, Mariano Garza, Antonio Jardiel, Jesús Morales</td>
<td>“The Piquete of Quinto” (Zaragoza, Spain): the first Spanish museum of mummies.</td>
</tr>
<tr>
<td>11:50</td>
<td>Stephanie Zesch, Doris Döppes, Wilfried Rosendale, Vincent van Vilsteren</td>
<td>First worldwide 3D print of a bog mummy.</td>
</tr>
<tr>
<td>12:10</td>
<td>Marco Samadelli, Graziella Roselli, Serena Gabrielli, Vito Fernicola, Ludwig Mordoer, Albert Zink</td>
<td>Development of a new glass case system for the conservation of mummies - application to the mummy of Princess Anna of Bavaria, 1319 AD.</td>
</tr>
<tr>
<td>12:30</td>
<td>Mimi Leveque</td>
<td>An ethical approach to the examination and treatment of Egyptian mummies.</td>
</tr>
<tr>
<td>12:50</td>
<td>Discussion</td>
<td></td>
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</tbody>
</table>
Symposium 4
Application of biochemical methods to mummy studies

Since the 1970s, archaeological research has incorporated the use of stable isotope analysis to understand individual lives. Biochemical analysis has become one of the main research lines in bioarchaeology. Mummies provide a particularly unique availability of human tissues (skin, muscle, bone, teeth, hair and nails) of ancient populations that highlight important components of ancient lives, such as diet, nutrition, and migration patterns, at different stages of development. This session provides the opportunity to discuss biochemical methods, including stable isotope analysis, to improve our knowledge about the lifestyles, nutrition, health and funeral customs of mummy collections. We welcome presentations on biochemical studies of mummies and skeletal collections as well as on biochemical methods that expand the utility of these types of analyses.

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00</td>
<td>Caroline Solazzo, Janet Douglas, Stefan Clerens, Jeff Plowman, Jolon Dyer</td>
<td>Proteomics evaluation of the protein preservation in mummy’s hair.</td>
</tr>
<tr>
<td>2:40</td>
<td>Wieslaw Wieckowski, Kelly Knudson, Lars Fehren-Schmitz, Milosz Giersz</td>
<td>Mummies, stable isotopes and aDNA - the Castillo de Huarmey case study, Peru.</td>
</tr>
<tr>
<td>3:00</td>
<td>Jocelyn S. Williams</td>
<td>An osteological and stable isotope investigation of infant feeding practices, dietary stress and morbidity using mummified subadult remains from Huaquerones, Peru.</td>
</tr>
<tr>
<td>3:20</td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>3:30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:00</td>
<td>Corina M. Kellner, Verity Whalen, Alejandra Figueroa Flores</td>
<td>Diet, stress, and lifeways at the pre-Columbian Nasca site of La Marcha, Peru using biochemical methods.</td>
</tr>
<tr>
<td>4:40</td>
<td>Charlotte L. King, Sián Halcrow, Andrew Millard, Darren Grocke, Vivien Standen, Bernardo Arriaza</td>
<td>Using incremental isotopic analysis to analyse weaning behavior and female fertility during the agricultural transition in the Atacama desert, Chile.</td>
</tr>
<tr>
<td>5:00</td>
<td>Verónica Silva-Pinto, Andrew S. Wilson, Pablo Mendez-Quiros A., Mario Castro, Rubén Stehberg, Domingo C. Salazar-Garcia</td>
<td>Pilgrimage to death: isotopic dietary short-term change evidence (δ13C and δ15N on hair) in Capocochas Cerro Esmeralda and Cerro El Plomo, Chile.</td>
</tr>
<tr>
<td>5:20</td>
<td>Andrew S. Wilson, Virginie Cerdeira, Ruth Horry, Sonia Guillén, Karin Frei, Robert C Janaway, Ian Barnes</td>
<td>Sir Henry Wellcome’s legacy to mummy studies: seven mummies with South American attributes from the Wellcome Collection.</td>
</tr>
<tr>
<td>5:40</td>
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</tbody>
</table>
## Symposium 5
### Host-parasite relationships and diseases: lessons from the past

Many of the parasitic diseases that plagued ancient human populations continue to burden contemporary societies across the globe, and are far from being eradicated. Paleoparasitology is aimed at improving our understanding of the history of parasites and parasite population diversity over time, as well as the natural and anthropogenic conditions that contribute to parasite emergence and maintenance in human groups. Having contributed to shape the dynamics of modern human populations, the study of the extinct populations coupled with the one of extant populations will allow reconstructing the temporal distribution patterns of both the parasites and their hosts. Indirectly, host-parasite relationships glean from the archaeological record also provide information on climate conditions, paleodiet and cultural/mortuary practices.

Adauto Araújo participated in these studies. At the time of his death, he began participating in projects that would broaden the field. This symposium summarizes the field and Adauto’s participation, including papers addressing new perspectives.

### Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00</td>
<td>Shênia P. C. Novo, Elisa Pucu</td>
<td>Tribute to Adauto Araújo†</td>
</tr>
<tr>
<td>2:40</td>
<td>Elisa Pucu, Paula Cascardo, Marcia Chame, Gisele Daltrini Felice, Niède Guidon, Maria Cleonice Vergne, Daniela Leles</td>
<td>Sensibility and specificity of primers designed long before new sequences were deposited: a critical approach applied to the archaeological context.</td>
</tr>
<tr>
<td>3:00</td>
<td>Alena Iñiguez, Mônica Vieira, Lucélia Guedes, Morgana Camacho, Victor Hugo Borba, Alexandre Fernandes, Sergio Miranda, Karl Reinhard, Adauto Araújo †</td>
<td>Paleoparasitology in Brazil: status and perspectives.</td>
</tr>
<tr>
<td>3:20</td>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>3:30</td>
<td>COFFEE BREAK</td>
<td></td>
</tr>
<tr>
<td>4:00</td>
<td>Chang S. Oh, Min Seo, Ho Chul Ki, Jong-Yil Chai, Dong Hoon Shin</td>
<td>Current trends of paleoparasitology in Korean mummy studies.</td>
</tr>
<tr>
<td>4:20</td>
<td>Alena Iñiguez, Herminia Gijón-Botella, Maria del Carmen del Arco-Aguilar, Mercedes Martín-Oval, Conrado Rodríguez-Martín, Mercedes del Arco-Aguilar, Adauto Araújo †</td>
<td>Guanche mummies: integrating paleoparasitological and paleogenetic investigations.</td>
</tr>
<tr>
<td>4:40</td>
<td>Shênia P. C. Novo, Daniela Leles, Adauto Araújo †, Raffaella Bianucci</td>
<td>Identification of <em>Leishmania tarentolae</em> signature in a post-Colonial Brazilian human mummy re-opens questions on its ability to survive and spread systematically in human hosts.</td>
</tr>
<tr>
<td>5:00</td>
<td>Kelly Harkins, Lars Fehren-Schmitz</td>
<td>Challenges of using NGS to detect <em>T. cruzi</em> in human remains from pre-Columbian South America.</td>
</tr>
<tr>
<td>5:20</td>
<td>Discussion</td>
<td></td>
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</tbody>
</table>
This symposium on the bioarchaeology of war invites presentations that critically examine the various effects of war on communities, ranging from direct forms of deadly and sub-lethal violence to forms of structural violence that are seemingly indirect in their impacts. For example, times of war may exacerbate unequal access to dietary resources, making some groups more susceptible to malnutrition and the inability to effectively fight off disease. Warfare can also displace people, as families and communities migrate to unknown lands or are forcibly moved; this can have the added effect of severing kinship ties, trade alliances, and other networks necessary for a community to thrive. The traumatic effects of war can also get “under the skin”, altering the expression of genes, as recent epigenetic studies have shown.

<table>
<thead>
<tr>
<th>Time</th>
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<th>Title</th>
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</thead>
<tbody>
<tr>
<td>2:00</td>
<td>Al W. Schwitalla, Marin A. Pilloud</td>
<td>Women warriors among central California hunter-gatherers: egalitarianism or institutionalized inequality?</td>
</tr>
<tr>
<td>2:20</td>
<td>Beth Koontz Scaffidi, Tiffiny A. Tung</td>
<td>Warfare and foodways: violence, dismemberment, and dietary reconstruction at Wari-era Uraca (600 –1000 AD) in the lower Majes Valley, Arequipa, Peru.</td>
</tr>
<tr>
<td>2:40</td>
<td>Tiffiny A. Tung</td>
<td>Indiscriminant violence in times of war: a bioarchaeological study of terminal and post-Wari skeletal populations from Wari, Ayacucho, Peru.</td>
</tr>
<tr>
<td>3:00</td>
<td>Rick W. A. Smith, Tiffiny A. Tung, Amy L. Non, Ripan S. Malhi, Deborah A. Bolnick</td>
<td>Deeper than bone: assessing the epigenetic effects of violence among Wari and post-Wari populations in the Ayacucho Basin, Peru.</td>
</tr>
<tr>
<td>3:20</td>
<td>Discussion</td>
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<td>3:30</td>
<td>COFFEE BREAK</td>
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<tr>
<td>4:00</td>
<td>Tiffiny A. Tung, Natasha Vang, Theresa Miller</td>
<td>Dietary inequality in times of war: an isotopic study of post-Wari foodways, Ayacucho, Peru.</td>
</tr>
<tr>
<td>4:20</td>
<td>Maricarmen Vega</td>
<td>Warfare and violence from the Initial to the Early Colonial Periods in the Peruvian central coast.</td>
</tr>
<tr>
<td>4:40</td>
<td>Milena Vega Centeno, Patricia Maita</td>
<td>Digging up the history of war: soldiers of the battle Alto de la Alianza, Pacific War (1880).</td>
</tr>
<tr>
<td>5:00</td>
<td>Patricia Maita, Marcela Urízar</td>
<td>Warfare in the Chachapoya territory: bioarchaeological interpretation of violence in Kuelap.</td>
</tr>
<tr>
<td>5:20</td>
<td>Flavio Estrada</td>
<td>In war fathers bury their sons: violence against the subadult population in Lucanamarca and Umasi during the Peruvian internal armed conflict.</td>
</tr>
<tr>
<td>5:40</td>
<td>Discussion</td>
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</table>
Keynote lecture 1
Experimental Human Mummification: Past, Present, and Future

Bob Brier\(^1\) and Ronald S. Wade\(^2\)

_Empresarial Room, 2nd floor_
Time: 8:15 am.

Presenter:
Bob Brier
Senior Research Fellow
LIU Post
Long Island University

Twenty years ago, the authors mummified a human cadaver in the ancient Egyptian manner. In this paper, we review the goals, techniques, and results of that project. We also describe the monitoring of the mummy over the last two decades and make a preliminary assessment of the success of the mummification.

Suggestions are made for future research uses of our mummy and also for improvements that might be implemented in a future attempt at human mummification.

\(^1\) Long Island University
\(^2\) Anatomical Services Division, University of Maryland School of Medicine
Symposium 7
Ancient bodies: the interplay between ancient culture, spiritual beliefs and mummification

Chairs: Raffaella Bianucci, Despina Moissidou, Dong Hoon Shin
Empresarial Room, 2nd floor
Time: 9:10 am. - 1:00 pm.

Mummification implies the intention to preserve the dead’s features. Scholars have extensively focused their attention on the environmental conditions and embalming practices that allowed the process of mummification to occur and to the study of the ancient pathological conditions and life habits. A broad scientific knowledge has been acquired. On the other hand, the interplay between past populations witnessed by their mumified bodies and their afterlife world has been less investigated. Apart from the Egyptian civilisation that has received much attention over the past 200 years, the cultural contexts and the spiritual needs of past populations to maintain their ancestors’ identities have been investigated to a lesser extent. Mummy experts from different regions of the world are called to reconstruct the cultural/spiritual background of past populations introducing us into their lost worlds through the analysis of the corpses they left behind. Contact points and divergences in the cult of dead across the world will be pinpointed and the results of the seminar will be summarised in a report, the scope of which scope is to help scientists gain awareness of their own actions in the scientific field.

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<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Session Title</th>
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<tbody>
<tr>
<td>9:10</td>
<td>Niels Lynnerup</td>
<td>Experiences from the Greenland mummies.</td>
</tr>
<tr>
<td>9:30</td>
<td>Guido P. Lombardi</td>
<td>What do Peruvian mummies tell us about our ancestors’ spiritual beliefs? a chronological overview.</td>
</tr>
<tr>
<td>9:50</td>
<td>Amelie Alterauge, Peter Weber, Matthias Friske, Manfred Baron von Craisheim, Wilfried Rosendahl, Natalia Shved, Sandra L&quot;osch</td>
<td>Naming the dead: an interdisciplinary study on human mumified remains from 17th to 19th century crypts in Germany.</td>
</tr>
<tr>
<td>10:10</td>
<td>Dario Piombino-Mascali</td>
<td>Spontaneous and anthropogenic mummification methods in Sicily (1600-1900).</td>
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<tr>
<td>10:30</td>
<td>COFFEE BREAK</td>
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<tr>
<td>11:00</td>
<td>Jane A. Hill</td>
<td>Predynastic Egyptian religious practice: a case study in early mumification.</td>
</tr>
<tr>
<td>11:20</td>
<td>Iwona Kozieradzka-Ogunmakin</td>
<td>Looks can be deceiving: fake and composite mummies from a Ptolemaic Period cemetery at Saqqara.</td>
</tr>
<tr>
<td>11:40</td>
<td>Dong Hoon Shin, Mi Kyung Song, Ho Chul Ki</td>
<td>A neo-Confucian concept for world after death and accidental mumification in east Asia.</td>
</tr>
<tr>
<td>12:00</td>
<td>Kathleen Day</td>
<td>Unangax mummies as whalers: a multidisciplinary contextualization of human mumification in the Aleutian Islands, Alaska.</td>
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<tr>
<td>12:40</td>
<td>Discussion</td>
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</table>
**Symposium 8**

**Mummies and textiles**

Chairs: Jana Jones, Dong Hoon Shin, James M. Vreeland Jr.

**Ejecutivo II Room, 1st floor**

**Time:** 9:10 am. - 3:30 pm.

Mummies discovered worldwide become one of the most invaluable resources for studying on health and disease status of human populations in different time and space perspectives. Using the mummies and relating samples, invaluable information could be obtained successfully, by a variety of scientific techniques. However, they are not only the subject we could talk about mummies. Rather, very unique remains could be acquired from the sites where mummies have been discovered. Of them, it is the ancient textiles that get the most attention. In fact, different kinds of textiles used for clothing, ornament or simple patches could be collected from mummies discovered in the world. By studying on them, we can get very crucial clue for reconstructing textile history in each country, very helpful to comprehend the vivid aspects of human lives before 20th century. Although there were a number of fascinating reports about the mummy-relating textiles from every corner of the world, the comprehensive review on the findings has not been presented yet.
## Symposium 9
### Free topics

**Chairs:** Carlos Herz, Elsa Tomasto-Cagigao  
*Sol de Oro Room, 12th floor*  
**Time:** 9:10 am. - 3:30 pm.

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<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Topic</th>
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<tbody>
<tr>
<td>9:10</td>
<td>Gwyn Madden, Emma Kemp</td>
<td>“The Home of Truth” Commune 1930s Utah, USA: results of experimental application of milk/egg enemas in mummification process.</td>
</tr>
<tr>
<td>10:10</td>
<td>Gail Elliott, Siân Halcrow, Hallie Buckley, Vivien Standen, Bernardo Arriaza</td>
<td>Growth and development during the agricultural transition in pre-Hispanic northern Chile.</td>
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<tr>
<td>10:30</td>
<td><strong>COFFEE BREAK</strong></td>
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<tr>
<td>11:00</td>
<td>Otto Appenzeller</td>
<td>The bioarcheome in the anthropocene. A proposal.</td>
</tr>
<tr>
<td>11:20</td>
<td>Otto Appenzeller, Clifford Qualls, Spencer Lucas</td>
<td>Metabolism, function and biologic rhythms in feathered dinosaurs.</td>
</tr>
<tr>
<td>11:40</td>
<td>Wojciech Ejsmond, Kamila Braułińska, Marzena Ożarek-Szilke</td>
<td>Warsaw Mummy Project. An Interdisciplinary research program.</td>
</tr>
<tr>
<td>12:00</td>
<td>Robert Loynes</td>
<td>The “Free Limb Mummies” - are they from the Roman period?</td>
</tr>
<tr>
<td>12:20</td>
<td>Frank Rühli, Salima Ikram, Khaled El-Enany</td>
<td>Mortui viventes docent: A novel workshop format to teach young scientists on best practice in ancient Egyptian human remains research.</td>
</tr>
<tr>
<td>12:40</td>
<td>Discussion</td>
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<tr>
<td>1:00</td>
<td><strong>LUNCH</strong></td>
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</tr>
<tr>
<td>2:00</td>
<td>Raffaella Bianucci, Jana Jones, Dong Hoon Shin, Carl Heron, Do Seon Lim, Ron Oldfield, Michael Francken, Katerina Harvati, Johannes Krause</td>
<td>Third intermediate to Roman period heads from Abusi El Meleq: a glimpse at mummification in Middle Egypt.</td>
</tr>
<tr>
<td>2:40</td>
<td>Jasmine Day</td>
<td>His flesh is slain: fear of decay as the origin of Egyptian mummification.</td>
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<tr>
<td>3:00</td>
<td>Discussion</td>
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Symposium 10
Mummy genomics: molecular investigations of mummified human remains

Next generation sequencing (NGS), often in combination with DNA capture techniques, revolutionized the field of palaeogenetics in the last decade, providing a better understanding of human evolution through time, human population dynamics, and host pathogen interactions. The reconstruction of complete ancient human and pathogen genomes has led to insights into the ancestry of present day populations in the Old and New world and the evolution of some of the pathogens that caused major outbreaks in human history, such as plague, leprosy and tuberculosis.

Although paleogenetic studies of skeletal material from various geographic origins and time periods are generating an increasing amount of ancient genome-wide data, only few studies have focused on mummified remains. One of the first mummies for which whole genome reconstruction was attempted successfully, is the 5,300 year-old Tyrolean Iceman. The sequencing revealed detailed information on his ancestry, his physical appearance, physiological parameters and the presence of pathogens and disease susceptibility, showing the potential of genomics for mummy research.

In this symposium we will present possible applications of NGS approaches for the study of mummies and discuss its potential, the related methodological challenges and limitations. The contributions will range from state-of-the-art lectures on the application of NGS to ancient human remains as well as genomic and metagenomic approaches of ancient commensal and pathogenic microbes. A particular focus will be given to the application of these methods in the scientific study of mummies and the future perspectives of palaeogenetics in South America. The organizers of the symposium will try to bring together international experts in palaeogenetics as well as scholars from South America who are involved in mummy studies, in order to enhance the exchange of knowledge and discuss possible future directions.
Symposium 11
Animal mummies

Chairs: Salima Ikram
Empresarial Room, 2nd floor
Time: 4:00 pm. - 6:00 pm.

The mummies of animals deserve an important place in this meeting. Studies of animal remains have provided information on human migration, domestication processes, cultural practices that reflect social, economic and religious aspects of the history of human societies. Intentionally or not, a great variety of animals became mummified all over the world. Ancient Egypt is where the greatest amount and variety of animal mummies have been recovered and studied. Large and small, wild and domestic, birds, cats, dogs, crocodiles, cattle, monkeys and others were prepared to be used as food, afterlife company, ritual assistants. Life and death in Pharaonic Egypt had an important connection with the preparation, use, and burial of animal mummies that were prepared in some cases in industrial numbers.

The study of animal mummies in other parts of the world is also providing an interesting scenario with multidisciplinary approaches incorporating genetics, parasitology, study of zoonotic diseases, among other fields, to contribute to the reconstruction of cultural history. In some cases these studies have become pivotal to understand the evolution of diseases such as tuberculosis.

This symposium will include specialists from various disciplines that have focused their research on animal remains.

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<thead>
<tr>
<th>Time</th>
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<th>Topic</th>
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<tbody>
<tr>
<td>4:00</td>
<td>Karina Venegas Gutiérrez, Lucénida Carrión Sotelo</td>
<td>Burials of dogs and humans in Huaca 33, Complejo Maranga, Lima, Peru.</td>
</tr>
<tr>
<td>4:20</td>
<td>Lidiya M. McKnight</td>
<td>Thinking inside the box: clinical imaging of animal mummies in funerary containers.</td>
</tr>
<tr>
<td>4:40</td>
<td>Bruno Fröhlich, Darrin Lunde, Christine France, Christina Wurst, David Hunt, L. Samuel Wann, Randall C. Thompson</td>
<td>The Great Ape Wet Collection at the Smithsonian Institution.</td>
</tr>
<tr>
<td></td>
<td>M. Linda Sutherland, Bruno Fröhlich, James D. Sutherland, Samantha L. Cox, L. Samuel Wann, Gregory S. Thomas, Randall C. Thompson, Adel Allam, Caleb E. Finch</td>
<td>Application of high resolution CT scanning in the nondestructive study of Egyptian animal mummies and wet preserved great apes.</td>
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<td>5:00</td>
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<td>Discussion</td>
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Symposium 12
Radiography in bioarcheology

Chairs: James N. Skufis, Sonia Guillén
Ejecutivo II Room, 1st floor
Time: 4:00 pm. - 6:00 pm.

For the last 100 years radiography and forensic imaging have been helping researchers uncover pathologies, artifacts, biodata and even checking the authenticity of fake remains. This symposium will present papers that will highlight the role of radiography in bioarcheology showing its advantages as well as its limitations. There are examples about how its early application in the excavation process can contribute to the preparation, study and conservation of the recovered mumified remains. The advent and impact of new imaging technologies, and the selection of imaging modalities according to field and lab conditions will be discussed.

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<tr>
<td>4:00</td>
<td>Sonia Guillén</td>
<td>Tribute to Marvin J. Allison†</td>
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<tr>
<td>4:10</td>
<td>Andrew Nelson, Sonia Guillén, Gerald C. Conlogue, Ramona Gonzalez, Peter Zadori, Anthony Bravo†</td>
<td>Autopsy of a tuberculoid Chachapoya-Inca mummy: implications for differential diagnosis.</td>
</tr>
<tr>
<td>4:30</td>
<td>James Skufis, Sonia Guillén</td>
<td>X-raying mummies for registry, conservation and education. Fifteen years of collaboration between Washtenaw Community College and Centro Mallqui in Ilo, Peru.</td>
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<td>5:50</td>
<td>Discussion</td>
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Symposium 13
Identity and gender

Recently, studies on how people conceptualized and express themselves individually and inside their own groups are given more attention. This symposium is focused in how the study of the human body gives lights about social, cultural, ethnic and gender identity. How identity is embodied? Which body expressions make a person distinct from others? And, how these individual expressions affect the overall communal identity? The first goal of this conference is to link the biological and the social identities. We emphasize the importance of the observation of single cases and the possibilities that osteobiography offers in the study of the individual and collective identities through the reconstruction of the biological profile, the examination of the bodily expressions (e.g. tattoos, cranial modification, hairstyle), and other ethnic markers. At the same time, we want to deepen in the study of gender roles in the past. This perspective is crucial because its intersection with other social identities provides a more fluid and deeper discussion. Gender is a complex identity which is transformed through time and space. The ways in which an individual (and society) perceives and displays aspects of their own identity (and other types of identities) change during their different life stages and even beyond death. Thus, gender is far from being a monolithic and “non-problematic” identity; it is always in contestation and under construction. Therefore, the combination of biological studies and gender perspective will enrich the debate about the non-static role that individuals played in shaping societies of the past.

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<th>Time</th>
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<th>Title</th>
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<tr>
<td>4:00</td>
<td>Gonzalo Irureta Salvatierra</td>
<td>Age and sex: their relationship in the funerary treatment as a feature of identity in a sample from the necropolis of Ancon, Peru.</td>
</tr>
<tr>
<td>4:20</td>
<td>Maricarmen Vega, Sergio Barraza</td>
<td>From a code number to the reconstruction of identity: the case of mummy 7C from Villar Córdova, Cajamarquilla (Lima, Peru).</td>
</tr>
<tr>
<td>5:00</td>
<td>Christine Lee, Jennifer M. Mantie</td>
<td>Blond barbarians along the silk road: migration, admixture, and identity.</td>
</tr>
<tr>
<td>5:20</td>
<td>Kathryn Reusch</td>
<td>Modern investigation of the Two Brothers mummies at the Manchester Museum, UK.</td>
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<td>5:40</td>
<td>Discussion</td>
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Chairs: Maricarmen Vega, Sofía Chacaltana
Sol de Oro Room, 12th floor
Time: 4:00 pm. - 6:00 pm.
Keynote lecture 2
Trends, Trials, Tribulations, and Triumphs in Egyptian Mummy Studies

Salima Ikram

*Empresarial Room, 2nd floor*
*Time: 8:15 am.*

This talk will address the current state of research on ancient Egyptian human and animal mummies in Egypt, as well as in collections abroad. Examples from a variety of sites will be used to illustrate the challenges facing mummy studies, as well as the increased visibility and popularity of mummy studies and the advances that science has provided so that these artefacts can yield the maximum amounts of information about the ancient Egyptians, their physical world and their culture. Issues such as ethics in mummy studies will also be addressed.
From autopsy to diagnostic imaging and metagenomics: guidelines, levels of evidence and medical data

Bioethical guidelines in mummy research imposed scholars to avoid unnecessary damages to ancient people corpses. Therefore, in the past two decades, mummy professionals resorted mainly to the use of non-invasive techniques; these enable to verify the state of preservation of the internal cavities, without harming the bodily integrity, and to propose a series of differential diagnoses. Despite the undeniable advantages, also non-invasive techniques have their drawbacks. CT imaging does not always allow one to perform a clear differentiation between mummified organs, particularly when these are seriously deformed and dislocated by dehydration. Dehydrated organs display similarities in radio-densities, which, in turn, may lead to misdiagnosis. To mitigate possible biases in the interpretation of paleoradiological findings, guided endoscopy has been associated to CT imaging. Although some successful studies were reported, due to the narrow visual field of the endoscope, often organs still cannot be visualized at the desired extent. In the clinical field, the correct interpretation of CT images has been achieved throughout a continuous comparison process with the data emerged from repeated post-factum dissection, histological investigations included. Cumulative results from traditional autopsies performed on mummies from all areas of the globe should be reconsidered as a positive contribution to the field as they will help to prove the authenticity of diagnosis obtained through CT acquired data. Today, medical data acquired from both invasive and non-invasive techniques greatly benefit from the input given by paleogenetics. Recent advances in metagenomics, either performed on inner organ biopsies, teeth or dental calculus are constantly improving our knowledge on the antiquity and microevolution of human past diseases. Finally, guidelines on how and when to perform different diagnostic approaches on ancient mummies are lacking and are desperately needed.
Symposium 15
Paleocardiology

Chairs: Guido Lombardi, Linda Sutherland

Ejecutivo II Room, 1st floor
Time: 9:10 am. - 10:30 am.

Computed tomographic evidence of atherosclerosis has been found in the bodies of mummified human remains. This symposium reviews the findings of atherosclerotic calcifications in the remains of ancient people who lived across a wide span of human history with a wide range of diets and lifestyles. Study of the genetic risk factors for atherosclerosis in ancient people and cross-species may offer insights into this common ancient and modern disease.

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<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Title</th>
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<tbody>
<tr>
<td>9:10</td>
<td>Randall C. Thompson, Adel Allam, Guido Lombardi, L. Samuel Wann, M. Linda Sutherland, James D. Sutherland, Bruno Fröhlich, Caleb E. Finch, Janet Monge, Samantha Cox, Samantha King, Clide M. Vallodolid, Muhammad Al-Tohamy Soliman, Michael Miyamoto, Albert Zink, Lucia Watson, David Michalik, Jagat Narula, Gregory S. Thomas</td>
<td>Evidence of atherosclerosis in 300 human mummies from around the world.</td>
</tr>
<tr>
<td>9:50</td>
<td>Randall C. Thompson, Bruno Fröhlich, David Hunt, L. Samuel Wann, Navneet Narula, Jagat Narula, M. Linda Sutherland, James D. Sutherland, Adel Allam, Gregory S. Thomas, Christine France</td>
<td>Assessment of missing links in atherogenesis: Study of mummified great apes.</td>
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<td>10:10</td>
<td>Discussion</td>
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Symposium 16
Mummies of the state of Queretaro, Mexico

**Chairs:** Elizabeth Mejía Pérez Campos  
*Sol de Oro Room, 12th floor*  
**Time:** 9:10 am. - 10:30 am.

The first human mummy ever found in the State of Queretaro was located about 21 years ago. It went into oblivion until, with authorization from the local authorities, we started an interdisciplinary research project. The body, nicknamed ‘Clara’ after being found at the Sta. Clara convent, was considered to date from the Colonial period. This symposium presents the first results from two studies. Another mummified body found in Mexico and studied 13 years ago, with the same interdisciplinary approach, is known as ‘Pepita’; the results of her body’s studies are about being published using top-notch visual technology, including augmented reality and virtual imaging.

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<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Presentation</th>
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<tbody>
<tr>
<td>9:10</td>
<td>Elizabeth Mejía Pérez Campos, Guadalupe Zárate Miguel</td>
<td>Discovery of a Colonial mummy at Queretaro city.</td>
</tr>
<tr>
<td>9:50</td>
<td>Alberto Herrera Muñoz, Vania Herrera Mejia, Elizabeth Mejía Pérez Campos, Ximena Chávez Balderas</td>
<td>Virtual reality applied to the presentation of the mummified remains in Queretaro, Mexico.</td>
</tr>
<tr>
<td>10:10</td>
<td>Vania Herrera Mejia, Alberto Herrera Muñoz, Elizabeth Mejía Pérez Campos</td>
<td>Pepita through the monitor.</td>
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</table>
Symposium 17
Bioarchaeology of care

Since the development of mummy studies as a scientific discipline in the 1970’s, the diagnosis and epidemiology of soft tissue diseases has been a dominant research theme. Despite the disciplinary background of the field’s researchers, however, there has been relatively little attention paid to the behavioral and cultural context of disease and in particular the presence and nature of any health-related care. The recently developed bioarchaeology of care is an approach that provides a framework for reconstructing evidence of health-care at a case-study level. Given that bone is limited in its response to pathogens, to date the analytical focus has typically been opportunistic, restricted to the relatively few serious and potentially disabling diseases capable of registering in the skeleton. The preservation of soft tissue and other associated material (e.g., gut contents, coprolites) affords the opportunity to observe a wider range of pathological conditions and presumably a greater chance of observing, or inferring, evidence of care. The reconstruction of care and provisioning represents a significant and worthwhile avenue of investigation for mummy studies, one that will complement current foci in the field while fostering a more holistic approach to the investigation of prehistoric disease. Advances in medical imaging and molecular analyses have improved our ability to identify, diagnose, and discuss the evolution and impact of disease in the past. By considering evidence of accommodation and provisioning within its cultural and historical context, researchers have the opportunity to contribute significantly to our understanding of the human response to disease.

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<th>Topic</th>
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<tr>
<td>2:00</td>
<td>Kenneth C. Nystrom</td>
<td>An introduction to the bioarchaeology of care and mummy studies.</td>
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<tr>
<td>2:20</td>
<td>Lorna Tilley</td>
<td>The nuts and bolts of a bioarchaeology of care: a user’s guide.</td>
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<tr>
<td>3:00</td>
<td>M. Linda Sutherland, Guido Lombardi, Lucia Watson, Kenneth C. Nystrom, James M. Vreeland, Jr., Randall, Thompson, Muhammad Al-Tohamy Soliman</td>
<td>Utilizing CT evidence to evaluate the presence of care.</td>
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<tr>
<td>3:20</td>
<td>Discussion</td>
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Symposium 18
The history and archaeology of Andean mummies

Chairs: Christopher Heaney, Alexander Menaker
Ejecutivo II Room, 12th floor
Time: 11:00 am. - 1:00 pm.

This set of papers offers varying methodological approaches and wields multiple lines of evidence to trace and illuminate how the often-mummified dead in the Andes were produced, cared for, and interpreted from the late pre-Hispanic period and to the recent past and present. Following the enduring and indelible presences of pre-Hispanic pasts and the tangled legacies of colonialism and nationalism, these papers address the shifting meanings, circulations, and contexts of the remains of the past and those who lived it, and studied it. In doing so, these investigations offer new evidence and compelling interpretations of the inevitable importance of death and life, and their particular manifestations and unanticipated trajectories of appreciation and study in the Peruvian Andes and beyond. Moreover, while the primary evidence for some of this research draws from Spanish and European colonialisms and their enduring effects, other evidence comes from the reconstruction of the study and transmission of mummies in the twentieth century. Together these papers provide productive ways to use these findings to yield new insight into the roles of mummies and the dead in recent histories of archaeology, as well as deeper pre-Hispanic histories.

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<tr>
<th>Time</th>
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<tr>
<td>11:00</td>
<td>Christopher Heaney</td>
<td>Huayna Capac’s hand: making Inca mummies, and making mummies Inca, in the Early Modern Atlantic World, 1532-1749.</td>
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<tr>
<td>11:20</td>
<td>Christopher Heaney</td>
<td>The study and circulation of Peruvian mummies in the Atlantic World and Americas, 1790-1893.</td>
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<tr>
<td>11:40</td>
<td>Lucia C. Watson</td>
<td>New contributions to Ancon bundles studies based on their intervention made between 1956 and 1962.</td>
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<tr>
<td>12:00</td>
<td>Alexander Menaker, Víctor Falcón</td>
<td>The mummies of Andagua, southern Peru: an archaeological, ethnohistoric and ethnographic assessment.</td>
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<td>12:20</td>
<td>Stefan Ziemendorff</td>
<td>The Marquis of Santiago de Oropesa and the mummies of the Inca royalty.</td>
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<tr>
<td>12:40</td>
<td>Antonio Coello, Brian Bauer</td>
<td>Following the traces of the Royal Inca mummies at the San Andres hospital in Lima.</td>
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**Symposium 19**

**Andean mummies: scientific research and social impact**

*Chair: Sonia Guillén*

*Ejecutivo II Room, 12th floor*

*Time: 2:00 pm. - 5:00 pm.*

Andean mummies have become part of their communities, either as a myth, a direct presence, an attraction to visitors, and/or a source of identity and pride. This session presents several cases that over many years have had local and regional impacts. The review includes contextual information on a variety of mummies as well as the development of additional scientific and development projects.

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<td>2:00</td>
<td>Régulo Franco</td>
<td>The Lady of Cao, the tattooed mummy from the northern coast of Peru.</td>
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<tr>
<td>2:20</td>
<td>Mellisa Lund, Elsa Tomasto-Cagigao</td>
<td>The Paracas mummies, from myth to reality.</td>
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<tr>
<td>2:40</td>
<td>Guillermo Cock</td>
<td>Mallqui, ancestors of the Ayllus. Documentary and archaeological evidence.</td>
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<td>3:00</td>
<td>Anna-Maria Begerock</td>
<td>Mummies and art.</td>
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<tr>
<td>3:20</td>
<td>Discussion</td>
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<td>3:30</td>
<td>COFFEE BREAK</td>
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<tr>
<td>4:00</td>
<td>Stefan Ziemendorff</td>
<td>A mummy of the Chachapoya culture in the works of Gau- guin, Munch and others.</td>
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<tr>
<td>4:20</td>
<td>Christophe Bou, Larbi Benali, Christophe Lair, Arnaud Ansart</td>
<td>Chachapoya mummy and drilling trepanation: an experimental anthropological study.</td>
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<tr>
<td>4:40</td>
<td>Discussion</td>
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Symposium 20
The study of mummies in the reconstruction of mortuary rituals

**Chairs:** Elsa Tomasto-Cagigao, Lucía Watson

**Sol de Oro Room, 1st floor**

**Time:** 11:00 am. - 3:30 pm.

Death rituals imply a series of actions whose traces are not always fossilized in the archaeological record. Among these actions, those related to the preparation of the body count among the least frequently preserved due to the facility with which soft tissues of the body decompose and are destroyed together with all nearby organic materials. Different phases of ritual and also aspects of the construction and reconstruction of identities can be defined based on their relationship to the processes of body decomposition and desiccation. In these phases more elements around the body can be added but also removed, replaced or rearranged. In this symposium we present studies of mummies and associated elements and their implications for the reconstruction of mortuary ritual. These studies include the application of different methodologies from different theoretical perspectives, and present also different challenges to the preservation of diverse materials.

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<td>Lucía Watson</td>
<td>Bundles from the necropolis of Ancon: a methodological proposal for the study of museum material.</td>
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<td>11:40</td>
<td>Christophe Moulherat, Philippe Charlier, Sylvain Ordureau, Omar Bouhelal, Paz Núñez-Regueiro</td>
<td>A pre-Columbian funeral bundle from the Santa Rosa necropolis (Lima, Peru), an example of virtual excavation.</td>
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<td>12:00</td>
<td>Martha Palma Málaga, Krzysztof Makowski</td>
<td>Funerary behavior of highland mitmaes in the central coast of Peru: Pueblo Viejo - Pucara, Lurin valley (Late Horizon).</td>
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<td>12:20</td>
<td>Lucie Dausse</td>
<td>Did the Paracas have a single mummy bundling tradition?</td>
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<td>1:00</td>
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<td>2:00</td>
<td>Ann H. Peters</td>
<td>Reconstructing practices at the necropolis of Wari Kayan in late Paracas times: patterns in organic conservation as both data challenge and source of information.</td>
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<td>Giancarlo Marcone, Francesca Fernandini, Nina Castillo</td>
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<td>Elsa Tomasto-Cagigao, Denise Pozzi-Escot, Isabel Cornejo, Carmen Thays</td>
<td>Who is this child? Study of a Republican burial at the Sanctuary of Pachacamac.</td>
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<td>Bruno Fröhlich, Tsend Amgalantugs, David Hunt, Judith Littleton</td>
<td>Mongolian cave burials, trauma, and the reconstruction of nomadic behavior.</td>
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<td>3:20</td>
<td>Oswaldo Camarillo, Judith Ruiz Gonzáles</td>
<td>Revaluation of the Mexican mummified bodies through time: model for a diachronic study.</td>
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## POSTERS

**Chairs:** Marcela Urizar, Alejandra Valverde  
*Ejecutivo III Room, 1st floor*

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<td>Analysis, conservation and cleaning of two mummies from Huamanmarca in the Lima highlands (Caranía, Yauyos), Peru.</td>
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<td>Mercedes González, Patricia Prieto, Anna-Maria Begerock, Amalia Valls, Coralee Castillo</td>
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1.1 Applying qualitative and antitative age at death methods to 2D sectional anatomy and 3D virtual models of mummies acquired from computed tomography scanning.

James V. Schanandore¹, Summer Decker², Jonathan Ford²

Non-invasive investigation such as CT scanning of mummies is becoming common practice. As the mummy field continues to increase the use of imaging technology, considerations should be made about how the technology fits into our current practices or if new practices should be developed to fit the technology. One of these practices is estimating age at death. Estimating age at death is not a straightforward task and it takes training to be able to interpret bone features properly. Additionally, when medical imaging such as CT is utilized, more factors such as scan parameters can affect how important skeletal features are visualized virtually in order to make accurate age at death estimations.

Research has shown that certain scan parameters preserve important bony features important for estimating age at death. Along with scan parameters, post-processing of the CT data using external imaging software can also help preserve bony features. If post-processing of CT data is not properly completed bony features important for age at death can become less defined. Even with optimal scan parameters and post-processing, virtual models are hard to interpret for age at death. Applying current age at death estimation methods to virtual models is possible in some cases, but there is potentially a more efficient way to utilize virtual models or the 2D sectional anatomy acquired from CT scanning. With the quantitative capabilities of most post CT scan processing software, quantitative methods could be a better fit for imaging technology. Quantifying the qualitative features commonly used to estimate age at death can improve our ability to interpret age at death from virtual models.

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² University of South Florida Morsani College of Medicine
1.2 Age estimation problems in bog bodies

Niels Lynnerup ¹, Chiara Villa ¹

Bog bodies represent a challenge, not least for the physical anthropologist wishing to estimate age at death by applying the standard skeletal methods. The problems arise when the diagenetic changes are so massive that remaining tissues, including bone, are severely degraded. Owing to the acidic bog environment, calcium is leached from the bones, causing demineralization of the bony tissues, which consequently lose their hardness and become pliable. When a bog body is X-rayed, bones are often very badly visualized, and the bones have an appearance as if they were made of glass. The demineralization is not necessarily uniform, but may differ within the skeletal system or a single bone. Furthermore, other tissues seem to acquire a more radiodense structure. This is especially true for some of the connective tissues. The probable reason for this is the deposition in collagenous tissue of mineral salts, containing metal ions such as iron coming from the soil.

CT-based age evaluation was performed on three bog bodies from Denmark and three bog bodies from Ireland. The traditional aging methods based on the macroscopic evaluation of the degenerative changes of the cranial suture, the pubic symphysis, the auricular surface and the sternal rib end were applied using 3D visualizations of the bones. In addition, methods specifically developed on CT scans evaluation based on the trabecular bone changes in ribs, vertebrae and pelvis bone were also used.

This attempt to apply both the macroscopic methods and the trabecular bone methods showed that great care is required when dealing with CT-scan data of bog bodies. It also shows that general guideline for all the mummies should not be established, and specific selection of age estimation methods should be based on the type of mummy and on the degree of preservation of the specimen.

1. Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen.
Email: nly@sund.ku.dk
1.3 Challenges of age determination from field paleoimaging methods with a special focus on endoscopy.

Ronald G. Beckett¹, Gerald J. Conlogue¹

The application of paleoimaging methods in the bioanthropological study of human remains is well established. Imaging within or as near to the original context is critical in order to avoid post-depositional change to the ‘internal’ environment, or spatial relationships among anatomical structures of the mummy. With standard field radiography important considerations regarding obtaining data for age estimations include positioning and image quality. Limitations to viewing age determinant structures within mummified remains associated with standard radiography include the superimposition of shadows as well as views obscured by associated artifacts. Complementary to radiography, endoscopy has been used in field and laboratory studies to collect data that may assist in age estimations. Endoscopic targets include dentition, arthritic changes, suture fusing on the internal table of the crania, hard palate suture fusing, sternum segment development, and pubic symphysis wear, to name a few. The challenges to collecting data via endoscopy include appropriate entry route into the remains, maneuvering space within the remains, interpretational expertise, operator skill and knowledge of instrumentation and bioarchaeological constructs.

¹ Bioanthropology Research institute Quinnipiac University.
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1.4 Age estimation in child mummies using CT scans and 3D visualizations

Chiara Villa¹, Niels Lynnerup¹

The methods for age estimation in human remains of children are based on the dental development, the degree of fusion of the bones, and the length of the long bones. Differently from the adults, the age estimation in children can be more accurate and precise. The traditional methods applied on skeletal remains can also be applied on child mummies using CT images and 3D visualizations of the relevant bones.

The age-at-death of 16 child mummies was estimated: ten child mummies from Greenland, three Inca child mummies from Argentina and three Graeco-Roman child mummies from Egypt. The 3D visualizations of teeth were compared with the dental development chart produced by Ubelaker (1989); the state of fusion of the vertebrae, and the presence and the degree of development of long bone’s secondary centers were evaluated from the CT images and 3D visualization, and an age was estimated using Schaefer et al. (2009). Finally, the 3D models of the long bones were virtually measured and the formulas of Mechant and Ubelaker (1977) and Primeau et al. (2016) were applied. Revised age estimations were obtained for the three Graeco-Roman child mummies and the three Inca child mummies, previously investigated using X-ray and visual inspection of the CT images. 3D visualizations of the teeth and of the long bones could be easily created, investigated with a 360-degree view, avoiding problem such as the superimposition of structures that prevent clearly seeing deep areas or structures.

In conclusion, the traditional methods for age estimation applied on human remains of children can be applied on child mummies with no difficulty. 3D visualizations are important tools for the application of the traditional methods and in these cases helped in providing revised and additional information.

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Email: chiara.villa@sund.ku.dk
1.5 Considerations about Age Estimation in Korean Mummy Studies

Hyejin Lee¹, Chang Seok Oh², Jong Ha Hong¹, Yi-Suk Kim³, Won Joon Lee¹, Dong Hoon Shin¹

In the case of age estimation of Korean mummies of the Joseon Dynasty (1392-1910 CE), there are some factors of prime consideration for concerned researchers. As the preservation status of Korean mummies was excellent, we thought that their faces could say many things about their biological profiles, for example, about their age at death. However, in most cases where we knew the exact age of the dead person by various historical evidences, even if the first impression of the face of the mummified person looked older, their ages were proven not to be as old as he/she looked. In this presentation, we show some examples of success and failure in our mummy studies, evidently caused by the errors in age estimation based on the facial impressions of Korean mummies. Actually, this means that when we tried to estimate the age of the mummified person in South Korea, the facial impression could not be so informative and decisive for scientists. Rather, like in many osteological cases, age markers in the bones and teeth should be considered first for correct estimation of age of most mummy cases. In this study, we discuss why the mummified face looked much older than the exact age, we also try to show the possible mechanism by techniques of craniofacial reconstruction and histology.

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² Ministry of National Defense, Agency KIA Recovery & Identification, Seoul
2.1 Multidisciplinary investigations of unidentified mummies and related objects at the basement vault of the Egyptian Museum in Cairo

Sahar Saleem¹, Moamen Othman², Mahmoud El-Halwagy³

Mummies, statues and Pharaonic jewelry recovered in excavations made by legendary archaeologists filled the Egyptian Museum at Tahrir Square in Cairo. Many objects made its way to the museum showrooms, but most of them were locked in the vaults of the museum before being studied or ever displayed.

Multidisciplinary research practice at the Egyptian Museum aims at studying unidentified mummies and other mysterious objects, especially those hidden in its vaults. CT scans permitted a non-invasive look inside objects of unknown identity, some had been locked away for more than a century. The study involved unidentified unwrapped mummies, a mummy inside a pot jar, wooden coffins, stelas and more. Correlating the CT findings with the archaeological data, helped in the identification of the objects, and a revision of the museum’s database. Some of the items are considered for public display for the first time. The display of CT images showing the inside of the mummies and other objects has been very appealing to the museum visitors and helps in the in arrangement of popular exhibits.

1. Radiology Department-Kasr Al Ainy Faculty of Medicine, Cairo University. Email: saharsaleem1@gmail.com
2. Director of Conservation Department, Egyptian Museum, Cairo
3. Head of Regional Egyptian Museums and Former Director General of the Egyptian Museum in Cairo.
2.2 Conservation of archaeological artifacts at the Egyptian Museum in Cairo: value of multidisciplinary practice

Moamen Othman¹, Sahar N Saleem², Ahmed El-Gheriany³, Mahmoud El-Halwagy⁴

The examination of archaeological artefacts such as coffins, cartonages, and stelas using a multidisciplinary approach can provide important data for their conservation; based on the determination of the materials, structures, and technology of manufacture, as well as any ancient attempts of restoration. The use of Computed Tomography (CT) technology to study the archaeological objects provides images in 2D and 3D for reconstructions and to discriminate structures based on densities and appearances in the images. The use of CT technology has helped the museum scientists to plan successful conservation strategies in objects such as collapsed cartonages and damaged stelae.

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2. Radiology Department-Kasr Al Ainy Faculty of Medicine, Cairo University

3. Conservation Department, Egyptian Museum, Cairo

4. Head of Regional Egyptian Museums and Former Director General of the Egyptian Museum in Cairo.

La conservación de artefactos arqueológicos en el Museo Egipcio en Cairo: el valor de la práctica multidisciplinaria.

El uso de una propuesta multidisciplinaria en el examen de artefactos arqueológicos como ataúdes, cartonaje y estelas, puede proporcionar importante información para su conservación permitiendo la determinación de materiales, estructuras y tecnología de manufactura, así como la identificación de antiguos intentos de restauración. El uso de tomografía computarizada para estudiar los objetos arqueológicos proporciona vistas en 2D y 3D para realizar reconstrucciones y discriminar estructuras en base a densidades y apariencia en las imágenes. El uso de la tomografía computarizada ha ayudado a los científicos en el museo a planificar exitosas estrategias de conservación en objetos como cortonajes colapsados y estelas dañadas.
2.3 Combining CT scanning and 3D printing of ancient Egyptian mummies and related objects: potential applications in archaeology and museology

Sahar Saleem¹, Mahmoud El-Halwagy²

The aim of this work is to study the potential applications of Computed Tomography (CT) scanning in combination with 3D printing in archaeology and museology. A 3D model based on a CT dataset can be printed using different commercially available 3D printers, choosing a wide variety of different material types (plastic, metal, and ceramics) available in different states (powder, filament, pellets, granules, and resin). This study was applied on ancient Egyptian mummies and related objects at the Egyptian Museum in Cairo.

3D CT scanning technology enables the virtual exploration of mummies, coffins filled with intact mummies and objects, it allows detailed study of each piece without damaging them. Combining CT studies and 3D printing allows paleopathological findings in mummy studies, accurate age estimation, and identification of mummification techniques. The technology can provide a better understanding of the construction of ancient coffins and cartonages, as well as in the identification of unusual amulets.

Illustrated CT images and 3D prints of mummies and related objects can be used to plan museum exhibits. Visitors can manipulate the 3D printed versions while originals are preserved. This can provide an educational interactive experience in the exhibits and allow visitors to take home a 3D printed version of their favorite pieces. 3D printing can allow blind visitors to experience the exhibit by touching replicas of some masterpieces.

Combining CT scanning with 3D printing can be valuable in studying ancient Egyptian mummies and related objects, as well as in the preservation work and the exhibits in the museum.

1. Radiology Department-Kasr Al Ainy Faculty of Medicine, Cairo University. Email: saharsaleem1@gmail.com
2. Head of Regional Egyptian Museums and Former Director General of the Egyptian Museum in Cairo.
2.4 Conducted inert gases and oxygen free sacs in preservation of ancient mummies in the Egyptian Museum in Cairo

Moamen Othman¹, Ahmed El-Gheriany², Islam Ezzat², Mahmoud El-Halwagy³

The preservation and maintenance of ancient mummies and human remains is doubtless one of the challenges of cultural heritage sciences; requires the use of updated technological applications and consideration to the sensitivity of their attributes. This study involves the usage of conducted inert gases and oxygen free sacs and their characteristic benefits on keeping the stable condition for mummies at the Egyptian Museum. Air sampling and cold plasma deposition analyses were implemented to evaluate the stability of relative humidity, temperature and pressure. Minimal inhibitory tests (MIC) were used to measure the percentages of oxidizing and reducing gases. The study provides a comparative presentation between this technique and other traditional ways of preserving mummies and human remains which leads to an accuracy of the modified technique of 64% more than other ones.

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3. Head of Regional Egyptian Museums and Former Director General of the Egyptian Museum in Cairo

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Gases inertes conducidos y sacos libres de oxígeno en la preservación de antiguas momias en el Museo Egipcio en Cairo

La preservación y el mantenimiento de momias y restos humanos antiguos son sin duda, uno de los retos de las ciencias del patrimonio cultural, ya que requieren del uso de aplicaciones tecnológicas al día, además de la consideración de la sensibilidad de sus atributos. Este estudio involucra el uso de gases inertes conducidos y sacos libres de oxígeno y sus características benéficas para permitir el mantenimiento de condiciones estables para las momias en el Museo Egipcio. El análisis del muestreo del aire y la deposición de plasma frío fueron implementados para evaluar la estabilidad de la humedad relativa, la temperatura y la presión. Pruebas mínimas inhibitorias fueron usadas para medir los porcentajes de gases oxidantes y reductores. El estudio concluye con un cuadro comparativo entre esta técnica y otros métodos tradicionales para preservar momias y restos humanos, que indican un acierto en la técnica modificada de un 64% mayor a los otros métodos.
3.1 Conservation challenges and solutions in the unraveling of funerary bundles from the Peruvian central Coast

Patricia Landa Cragg

In spite of new image technologies that have revolutionized the ways in which mummy bundles can be studied non-destructively, researchers still face situations where unwrapping of bundles is necessary.

Unwrapping of mummy bundles occurs for two principal reasons: 1) Cases where the bundle is disintegrating and information is in danger of being lost, and 2) unwrapping of a bundle answers a scientific question difficult to obtain even with the use of new technologies. In these situations, conservation of all objects found inside and recording their place in the bundle is vital.

Mummification in the Peruvian Central Coast results from a combination of a dry environment, non-acidic soils, and the presence of multiple layers of textiles that surround the body. In our research we have found funerary bundles ranging from very good condition to disintegration. Even if the preservation of the remains and associated objects is good, deterioration begins with exposure to new environmental conditions after bundles are recovered.

Dryness, humidity, fungal infestation and disintegration are some of the problems we have to address during the unwrapping process. Using case studies, we will show some of the problems that we have encountered and the strategies we used to solve them. The conservation techniques used depended on the state of preservation of the bundle and the resources that were available. We will also address issues involved in recording of information, conservation of objects after their removal, and methods for packing and storing materials.

1. Independent research. Email: planda55@yahoo.com
3.2 “The Piquete of Quinto” (Zaragoza, Spain): the first Spanish museum of mummies.

Mercedes González¹, Anna-Maria Begerock¹, Amalia Valls¹, María Belchi², Mariano Garza³, Antonio Jardiel⁴, Jesús Morales⁴

This museography project responds to the challenges presented by the need to exhibit to the public a selection of mummified bodies that were exhumed from the ancient church of La Asunción (Quinto, España) –better know as “The Piquete”– during archaeological excavations conducted in 2011. In preparation for the exhibit, a thorough cleaning of the mummies and their clothing was carried out, as well as restoration of some textiles and footwear.

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3. Bloquetech Engineering
4. Quinto City Hall

“El Piquete de Quinto” (Zaragoza, España): el primer museo español de momias.

Este proyecto museográfico responde a los retos planteados por la necesidad de exponer al público una selección de algunos de los cuerpos momificados que fueron exhumados en la antigua iglesia de La Asunción (Quinto, España) –más conocida como “El Piquete”– durante la campaña arqueológica llevada a cabo en el año 2011. En primer lugar, se llevó a cabo una minuciosa limpieza de las momias y su indumentaria, así como la restauración de algunos de los textiles y calzado.
3.3 First worldwide 3D print of a bog mummy

Stephanie Zesch1, Doris Döppes1, Wilfried Rosendahl1, Vincent van Vilsteren1

3D scanning is a modern method for non-contact recording of three-dimensional objects. In addition to their use in design, industry and medicine, 3D scanners are useful for documenting buildings, topographic surveys, excavation sites, caves, archaeological findings and objects from museum collections. By using 3D printers, colored display models from various materials can be created directly from the converted 3D data.

One of the world’s most famous bog mummies is the Yde Girl which was discovered in the Dutch province of Drenthe in 1897 and is nowadays exhibited at Drents Museum Assen. Due to its fragility, the mummy is unsuitable for loans and no replica can be created by using classic cast methods.

In a joint project of the Reiss-Engelhorn-Museen Mannheim (Germany) and the Drents Museum Assen (The Netherlands), the surface of the bog mummy was documented by the mobile 3D scanner Artec EVA. The entire scanning process took about 1.5 hours, in episodes of five minutes. The scanner captures fifteen frames per second and immediately connects the data by using the 3D scanning program Artec Studio. Afterwards, the data set was prepared for 3D printing with the Geomagic Studio software. For this purpose, the scanned surface layer was thickened by another 3 mm. Afterwards, the 3D color printer Zprint 850 was used to print the object by using a very fine gypsum powder.

The Yde Girl is the first bog mummy from which a replica was created with modern 3D scanning and 3D printing technique. The replica was presented for the first time in the exhibition “Mummies - The dream of everlasting life” (6/2015-1/2016) in the Musée national d’histoire et d’art Luxembourg. Modern 3D scanning permits a non-destructive, undistorted and sustainable documentation of objects, and 3D printing offers new perspectives on handling and analyzing fragile archaeological findings such as mummies.

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Primera impresión 3D a nivel mundial de un cuerpo momificado de las turberas.

El escaneo 3D es un método moderno para registrar objetos en tres dimensiones sin contacto físico. En adición a su uso en diseño, industria, y medicina, los escáneres 3D han demostrado su utilidad en la documentación de edificios, en levantamientos topográficos, excavaciones arqueológicas y en producir imágenes de objetos en museos. Usando impresoras 3D se pueden producir modelos con varios materiales directamente.

Uno de las momias del pantano más famosas es la “Yde Girl” que fue descubierta en la provincia de Drenthe (Holanda) en 1897, y que hoy día está en exhibición en el Museo Drents en Assen. Debido a su estado muy frágil, la momia no puede ser prestada para exhibiciones en otros lugares, tampoco es posible crear una impresión de la momia usando métodos tradicionales.

Mediante una colaboración entre el Museo Reiss-Engelhorn de Mannheim (Alemania) y el Drents Museum Assen (Holanda), la superficial de la momia fue documentada usando un escáner móvil 3D Artec EVA. El proceso duró aproximadamente 1.5 horas. El escáner captó quince tomas por segundo y procesa los datos usando el programa Artect Studio. Después, los datos son procesados para imprimirse con el programa Geomagic Studio. La impresora color 3D Zprint 850 fue usada para imprimir la momia usando un polvo fino de yeso.

La “Yde Girl” es la primera momia de pantano de la que se ha creado una réplica en 3D. La réplica se presentó por primera vez en la exhibición “Mummies - The dream of everlasting life” (junio de 2015 hasta enero de 2016) en el Musée national d’histoire et d’art Luxembourg. Los escáneres en 3D permiten una documentación no destructiva y sin distorsión de objetos, de igual modo las impresiones en 3D ofrecen nuevas oportunidades para el manejo y análisis de restos arqueológicos frágiles como momias.
3.4 Development of a new glass case system for the conservation of mummies – application to the mummy of Princess Anna of Bavaria, A.D. 1319.

Marco Samadelli¹, Graziella Roselli², Serena Gabrielli³, Vito Fernicola³, Ludwig Mordoer⁴, Albert Zink¹

The goal of this project was to construct a new type of glass case combining the requirements of proper conservation and presentation of mummies in museums or at their original discovery sites. For this, different techniques already in use within museum environments were analyzed and a new concept of an optimized glass case was developed. As a model, a glass case was designed for the mummy of Princess Anna (died in 1319 A.D.), a daughter of King Louis IV, called the Bavarian, who is preserved in the St. Petrus Church in Kastl, Germany. In a first step, the environmental conditions inside the church were analyzed in order to obtain the ideal conservation parameters for the mummy. The temperature and humidity measurements were used for mathematical calculations during the design of the glass case in order to ensure that the casing not only contributes to better conservation, but also facilitates the maintenance and visibility of the mummy. In the new conservation system, humidity can be adjusted to exact specifications by the use of a special humidifier. Additionally, the humidifier can also be used for disinfection and sterilization purposes by adding chemical solutions. Finally, a wireless system is included to monitor the atmospheric conditions in the glass case, thereby allowing a constant surveillance of the conservation parameters. The new glass case is constructed in a way that it can be adapted to all kinds of dry mummies conserved in different environmental conditions.

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Desarrollo de un nuevo sistema de vitrina para la conservación de momias - aplicación a la momia de la princesa Ana de Baviera (1319 dC).

El objetivo de este proyecto fue la construcción de un nuevo tipo de caja de cristal que combinara las exigencias de la conservación y de presentación adecuada de las momias en sus sitios originales de descubrimiento. Para ello, las diferentes técnicas que ya están en uso en los ambientes de los museos fueron analizados y se ha desarrollado un nuevo concepto de una caja de cristal optimizado. Como modelo, una caja de cristal fue diseñado para la momia de la princesa Ana (murió en 1319 dC), hija del rey Luis IV de Baviera, que se conserva en la iglesia de St. Petrus en Kastl, Alemania. En una primera etapa, las condiciones ambientales en el interior de la iglesia fueron analizados con el fin de obtener los parámetros de conservación ideales para la momia. Los cálculos matemáticos de las mediciones de temperatura y humedad se utilizaron durante el diseño de la caja de cristal con el fin de asegurar que la carcasa no sólo contribuye a una mejor conservación, sino que también facilitara el mantenimiento y la visibilidad de la momia. En el nuevo sistema de conservación, la humedad se puede ajustar a las especificaciones exactas por el uso de un humidificador especial. Además, el humidificador también se puede utilizar para los propósitos de desinfección y esterilización mediante la adición de soluciones químicas. Por último, se incluye un sistema inalámbrico para monitorear las condiciones atmosféricas en el caso del vidrio, lo que permite una vigilancia constante de los parámetros de conservación. La nueva vitrina se construye de una manera que se puede adaptar a toda clase de cuerpos momificados y conservados por deshidratación en diferentes condiciones ambientales.
3.5 An ethical approach to the examination and treatment of Egyptian mummies

Mimi Leveque

In 1984 I conducted a survey of conservators working with collections of Egyptian mummies in museums in the US and realized there were no agreed upon protocols for approaching their treatment. In 1987, following the treatment of a large group of mummies at the Museum of Fine Arts, Boston, I published a paper on an ethical basis for the treatment of human remains. Since that time I have published individual mummy treatments but have not had an opportunity to gather all the information and experience gained through examinations and treatments of Egyptian mummies over the last 30 years in both large and small museum collections. This paper is an attempt to bring this material together.

I will discuss the need for complete documentation of a mummy prior to treatment, including textile analysis, wrapping techniques, and examination of any trappings, such as cartonnage. Thorough medical examinations using x-rays and CT are critical both for the understanding of the mummy and to guide the treatment options.

Treatment decisions are based on the aim of stabilization and respect for the integrity of the mummy. Treatments are chosen with the aim of complete reversibility. Any modern materials added should be able to be safely removed in the future if better methods of treatment or analysis are developed.

There will also be a discussion of working with curators and museum exhibition staff on the most sensitive way to approach the exhibition of Egyptian mummies.

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4.1 Proteomics evaluation of the protein preservation in mummy’s hair

Caroline Solazzo¹, Janet Douglas¹, Stefan Clerens², Jeff Plowman², Jolon Dyer²

Human hair has been extensively used for archaeological studies of population (DNA), diet (isotopes), and presence of metals (trace element analysis). However, the diagenesis of hair is still incompletely known as previous studies have only focused on the morphological changes and structural damage of hair, using mostly microscopic techniques, imaging and histological examination. Molecular information of damage at the protein and amino acid levels in human hair are therefore not available, yet they will be extremely valuable for other biomolecular studies such as ancient DNA and isotopes. Hair is less apparent than wool in archaeological records because it is rarely used as a raw material and is not worked and processed the way wool is. However though processes of mummification (natural or artificial), some mummies produce extremely well-preserved hair at the macroscopic level.

Proteomics studies on wool have shown that the burial conditions influence the degradation of hair, targeting different structures and proteins, and that the processing of the fibers (“cosmetic” changes) such as dyeing played an important role in slowing down or accelerating degradation. Although proteomic studies have been done on modern hair to look at chemical damage, aging and photo-degradation, such analyses have never been performed on archaeological human hair. Therefore it is unclear how ancient hair will be affected by these parameters at the molecular level. In this objective, this project looks at cosmetic and chemical treatments, and in particular at the effects of mummification. Hair from Egyptian and Peruvian mummies and from shrunken heads were analyzed though a full proteomics study using LC-MS/MS and targeted modifications evaluated using redox proteomics which is based around characterization of the complex cascade of oxidation and reduction events occurring at the protein primary level.

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4.2 Community differences in dietary changes over the life course: stable carbon and nitrogen isotope analysis of bone collagen and hair keratin pairs on the central Peruvian coast

Sara J. Marsteller¹, Kelly J. Knudson¹, Natalya Zolotova¹

This project uses stable carbon and nitrogen isotopes in archaeological human bone collagen and hair keratin pairs to explore how individual changes in diet over the life course vary between economic specialist communities on the pre-Columbian central Peruvian coast. Focusing on the Ychsma polity (c. AD 900-1470) of the Rimac and Lurín Valleys, this study compares bone collagen and hair keratin pairs from 53 adults and adolescents buried at the sites of Armatambo (n=37) and Rinconada Alta (n=16). Ethnohistoric, archaeological, and isotopic data suggests these two sites were associated with distinct communities socially constructed on the basis of economic specialization as fishers and farmers. Sub-trends in isotope values from bone collagen, however, reveal substantial intra-community dietary diversity, suggesting subsistence practices were potentially more complex than current models of socioeconomic organization allow. To refine these models, the present study compares bone collagen and bulk hair keratin values to assess for differences in life course changes in diet among individuals buried at the two sites. Results indicate that 12 individuals (Armatambo: n=7; Rinconada Alta: n=5) exhibit differences in bone collagen and hair keratin ?15N outside the range of normal variation (?15Ncol-ker=+0.5-+1.3‰; O’Connell et al. 2001), indicative of a change in dietary protein sources during the last months of life. Of these, 86% (n=6/7) of those from Armatambo exhibit an increase in ?15N during the last months of life (?15Ncol-ker=+1.9±0.2‰ to +3.4‰±0.2‰), while 100% (n=5/5) of those from Rinconada Alta exhibit a decrease in ?15N (?15Ncol-ker=-5.9±0.2‰ to -2.0‰±0.2‰). Potential implications for community differences in seasonal subsistence strategies are discussed, and future avenues of research are proposed.

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4.3 Mummies, stable isotopes and aDNA - Castillo de Huarmey case study, Perú

Wieslaw Wieckowski¹, Kelly Knudson², Lars Fehren-Schmitz³, Milosz Giersz¹

A Wari-affiliated elite mausoleum discovered recently at Castillo de Huarmey has provided a unique bioarchaeological dataset for Andeanists. There were 64 individuals buried within the main chamber and additional seven in the contexts directly associated with the mausoleum. The upper layers of the building also yielded a collection of human and animal remains. The state of preservation varied depending on the taphonomical processes. In order to establish the geographical origins and potential mobility of the group, we performed both bioarchaeological and biogeochemical analyses. Biogeochemical data, including analysis of strontium, oxygen, nitrogen and carbon isotopes – provided insights not only in the origins but also into the dietary preferences of the individuals. Preliminary DNA analysis widens the scope of information obtained, although additional analyses are necessary.

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2. Arizona State University.
3. University of California Santa Cruz.

1. Momias, isótopos estables y ADN antiguo – Caso de estudio del Castillo de Huarmey, Perú.

Un mausoleo de élite Wari descubierto recientemente en el Castillo de Huarmey ha proporcionado un conjunto de datos bioarqueológicos único para los andinistas. Se encontraron 64 individuos enterrados dentro de la cámara principal y 7 individuos adicionales enterrados en los contextos asociados directamente con el mausoleo. Adicionalmente, las capas superiores del edificio también brindaron una colección de restos humanos y animales. El estado de conservación varió dependiendo de los procesos tafonómicos que afectaron los materiales. Con la finalidad de establecer los orígenes geográficos y la movilidad potencial del grupo se realizaron análisis bioarqueológicos y biogeocimicos. Los datos biogeocimicos, que involucraron análisis de isótopos de estroncio, oxígeno, nitrógeno y carbono - aportaron conocimientos no sólo en los orígenes, sino también en las preferencias alimentarias de los individuos. Los análisis preliminares de ADN amplían los alcances de la información obtenida, aunque son necesarios análisis adicionales.
4.4 An osteological and stable isotope investigation of infant feeding practices, dietary stress and morbidity using mummified subadult remains from Huaquerones, Peru

Jocelyn S. Williams

The purpose of this study was to establish whether dietary stress impacted infant feeding practices, subadult diet and subadult morbidity at Huaquerones, Peru. Furthermore, it aims to elucidate the impact of Inca imperialism on the central Peruvian coast. The study population included 21 subadults (10 infants 24 months) exhibiting various degrees of mummification. Multiple tissues were sampled for stable carbon and nitrogen isotope analysis including bone (n = 19), hair (n = 19), skin (n = 13) and nail (n = 4). These tissues grow in different ways and turnover at different rates; as a result their isotopic composition reflects different lengths of time and periods of an individual’s life. Seven individuals were mummified; however, it was possible to examine the skeletons of 13 partially mummified individuals. Although the extent and severity of lesions varied, all 13 individuals exhibited lesions consistent with metabolic diseases such as anemia, scurvy and/or rickets. Together the isotope data demonstrate that most infants breastfed. However, the prevalence of lesions suggests that breastfeeding’s protective benefits were diminished, perhaps due to maternal dietary stress.

Some infants were weaned/weaning at the time of death, but the age of onset varied. Together the isotope and osteological data suggest that dietary stress affected infant feeding practices and subadult morbidity. If food resources were scarce and/or limited, mothers would have delayed weaning and weaned/weaning subadults would have experienced caloric/nutritional stress; metabolic diseases such as scurvy, anemia and/or rickets could be attributed to any of these scenarios. Dietary stress that affected infant feeding practices and subadult diet could have produced a frail subadult cohort that was susceptible to morbidity and mortality; this is consistent with the large number of infant interments and the high frequency of pathological lesions in subadults relative to adults at Huaquerones.

Table 1: Nitrogen isotope data for all tissues. The subadults are grouped by age category with the sample size listed in brackets. The female mean is listed at the bottom of the table for comparison.

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Bone</th>
<th>Hair</th>
<th>Nail</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants (Newborn-24 months)</td>
<td>( \delta^{15}N ) ‰</td>
<td>( \delta^{15}N ) ‰</td>
<td>( \delta^{15}N ) ‰</td>
<td>( \delta^{15}N ) ‰</td>
</tr>
<tr>
<td>Average</td>
<td>13.0 (9)</td>
<td>11.9 (10)</td>
<td>n/a</td>
<td>12.9 (5)</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.8</td>
<td>1.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Young subadults (3-7 years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>10.3 (5)</td>
<td>10.7 (4)</td>
<td>9.6 (2)</td>
<td>14.1 (5)</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.8</td>
<td>1.3</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Older subadults (7-18 years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>11.5 (5)</td>
<td>11.1 (5)</td>
<td>13.2 (2)</td>
<td>14.4 (3)</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.5</td>
<td>1.7</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Adult females (20-50 years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>10.4 (19)</td>
<td>9.9 (17)</td>
<td>11.4 (4)</td>
<td>14.4 (9)</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.3</td>
<td>1.1</td>
<td>3.4</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Figure 1: Images of infant (12-24 months, Sample ID 43) demonstrating extensive porosity of the frontal, parietal, temporal, sphenoid and maxilla. These images also show developmental defects of the dental enamel including hypoplasia and discolorated enamel with concomitant carious lesions of the incisors. The nitrogen isotope ratios in this infant’s hair (see Table 2) is consistent with weaning in the six months before death.
<table>
<thead>
<tr>
<th>Age</th>
<th>Sample ID</th>
<th>0-1cm</th>
<th>1-2cm</th>
<th>2-3cm</th>
<th>3-4cm</th>
<th>4-5cm</th>
<th>5-6cm</th>
<th>6-7cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB - 8m</td>
<td>30</td>
<td>□13 C</td>
<td>-11.7</td>
<td>-12.2</td>
<td>-13.0</td>
<td>-13.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□15 N</td>
<td>12.8</td>
<td>12.2</td>
<td>11.7</td>
<td>11.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NB - 24m</td>
<td>64</td>
<td>□13 C</td>
<td>-14.8</td>
<td>-14.9</td>
<td>-15.0</td>
<td>-14.6</td>
<td>-14.1</td>
<td>-14.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>□15 N</td>
<td>12.7</td>
<td>12.4</td>
<td>12.4</td>
<td>12.7</td>
<td>13.2</td>
<td>13.1</td>
</tr>
<tr>
<td>6-18m</td>
<td>4</td>
<td>□13 C</td>
<td>-15.7</td>
<td>-14.7</td>
<td>-13.9</td>
<td>-14.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□15 N</td>
<td>9.5</td>
<td>8.9</td>
<td>8.7</td>
<td>9.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-18m</td>
<td>8</td>
<td>□13 C</td>
<td>-13.1</td>
<td>-13.1</td>
<td>-12.8</td>
<td>-12.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□15 N</td>
<td>11.7</td>
<td>11.4</td>
<td>11.4</td>
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<td>-9.8</td>
<td>-9.9</td>
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<td>-11.1</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>□15 N</td>
<td>14.4</td>
<td>14.3</td>
<td>13.5</td>
<td>13.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-18m</td>
<td>60</td>
<td>□13 C</td>
<td>-13.9</td>
<td>-13.7</td>
<td>-11.8</td>
<td>-12.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□15 N</td>
<td>11.0</td>
<td>10.9</td>
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<td>11.2</td>
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Table 2: Incremental stable isotope data for the infant hair (n = 10) beginning at the scalp end (i.e., 0-1cm; coincides with diet in the month before death) and moving distally in 1cm increments (1cm hair growth = 1 month of diet). All isotope data presented in per mil. The nitrogen isotope data for Sample 43 is consistent with weaning in the 6 months before death.

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4.5 Diet, stress, and lifeways at the pre-Columbian Nasca site of La Marcha, Peru using biochemical methods

Corina M. Kellner¹, Verity Whalen², Alejandra Figueroa Flores³

Using a variety of biochemical methods on well-preserved human remains, including stable isotope and cortisol analysis, along with standard bioarchaeological techniques, enriches our interpretations of past lifeways. Occupied and used during the first millennium B.C.E., the site of La Marcha in south coastal Peru was a central part of the Nasca culture during times of environmental, political, and social challenges. La Marcha was first scientifically excavated by Dr. Julio C. Tello in 1927 and the remains were kept in the Museo de Arqueología, Antropología, e Historia del Perú in Lima. The author studied a portion of Tello’s collection in the early 2000s, and marries these previous data to data gathered in 2014 by new excavations of the site. Located across the valley from the large site of Huaca del Loro, La Marcha may have been used as an important burial and ceremonial site for those living in the southern Nasca region. Overall demographic information as well as health, trauma, and cranial vault modification patterns are discussed on human remains analyzed from La Marcha. Biochemical analysis of a sampling of human bone and teeth elucidates dietary and migration patterns through time at La Marcha in different sectors of the site. Additionally, a personal biohistory relating to diet and stress from cortisol in hair is presented for one young woman, found in a looted grave and exceptionally well preserved.

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4.6 Making enemies, making places: geographic origins of mummified trophy heads from Uraca in the Majes Valley, Arequipa, Peru

Beth Koontz Scaffidi¹, George Kamenov², Tiffiny A. Tung¹, Mirza del Castillo Salazar³, John Krigbaum⁴

Excavations at Uraca, a Wari-era (AD 600 - 1000) cemetery in the Majes Valley, recovered evidence of human trophy-taking rituals which are also depicted in the nearby Toro Muerto petroglyphs. Some adult males were transformed into trophy heads (n=12), manufactured in three distinct styles: Nasca, Wari, and a local “horizontal half-mask.” Isolated mandibles were also recovered with cutmarks evincing violent defleshing (n=8). Trophy head processing methods varied by sector: those from sector I were completely defleshed; those from sector IIC were naturally mummified after removing only the eye and endocranial tissues. The mummified head of an indigenous pampas cat was also recovered from Sector IIC, buried with the three mummified human trophy heads. Were the trophy head “victims” revered ancestors or punished criminals who grew up in the Majes, or were they foreign enemies from outside the region? Are there differences in geographic origins among the trophy heads according to their sector of interment, or according to manufacturing style?

In order to understand the social contexts of this violent dismemberment at Uraca, lead, strontium, and oxygen isotope analyses of tooth enamel (apatite) are used to examine the geographic origins of the trophy head victims compared to the rest of the population. Biogeochemical signatures from the trophy and non-trophy head subsamples are compared to Andean baseline data (Knudson et al. 2014) and the Majes site of Beringa (Knudson and Tung 2011). Analysis of cutmarks shows how the trophy heads were manufactured, while childhood geographic origins will show whether the beheaded individuals grew up outside of the Majes. This combined isotopic approach will help us understand the contexts of trophy head processing in the mortuary, political, and religious rituals at Uraca, and clarify whether individuals with foreign childhoods had a greater risk for violence and dismemberment than locals.

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4.7 Using incremental isotopic analysis to analyse weaning behaviour and female fertility during the agricultural transition in the Atacama desert, Chile

Charlotte L. King\textsuperscript{1}, Siân Halcrow\textsuperscript{2}, Andrew Millard\textsuperscript{3}, Darren Grocke\textsuperscript{4}, Vivien Standen\textsuperscript{5}, Bernardo Arriaza\textsuperscript{6}

The transition to an agricultural economy is often assumed to be associated with an increase in female fertility and large-scale population growth. This idea has been popularised as the Neolithic demographic transition model, and is applied worldwide to explain changes to human health and behaviour. The Atacama desert, however, is unlikely to follow the same trajectory as other areas, it being a far more marginal environment with sedentary hunter-gatherers present prior to the advent of agriculture. It is difficult to test female fertility archaeologically, but weaning behaviour may be used as a proxy. Breastfeeding confers an immunological advantage on both mother and child, and also has contraceptive effects for the mother. As such its duration significantly impacts maternal and infant survival, and the interval between potential births. In this study we take advantage of the exceptional preservation of collagen in mummified tissues to undertake incremental isotopic analysis of human dentine. The data gleaned from this analysis has allowed the development of weaning profiles for 35 individuals from the pre-agricultural Archaic (8,000BC-1,500BC) and the later agricultural periods (1,500BC-1,500AD). Comparison of these profiles has shown considerable variability in weaning age and isotopic ratios in general. This has allowed assessment of human behavioural, and by implication female fertility, changes with increased reliance on agricultural resources.

\textbf{Incremental sampling method}

\textbf{Az6 T105 weaning curve}

\textbf{Coastal outline}
4.8 Pilgrimage to death: isotopic dietary short-term change evidence (δ13C and δ15N on hair) in Capacochas Cerro Esmeralda and Cerro El Plomo, Chile.

Verónica Silva-Pinto¹,², Andrew S. Wilson³, Pablo Mendez-Quiros A.⁴, Mario Castro⁵, Rubén Stehberg⁶, Domingo C. Salazar-García²,⁷,⁸

The Capacocha is one of the most important ceremonies from the Inca period. Children and young women were offered in sacrifice to the high peaks of the Andes and other important mountains during this ritual. For the ceremony sons and daughters of local chiefs from throughout the territory dominated by the Incan Empire were chosen. After the selection, they had to walk to Cuzco, where the pilgrimage to sacrifice began to any of the four suyus (Ceruti 2003, 2004, Vitry 2008). We have studied the male child of Cerro El Plomo (8 years old) and the maidens of Cerro Esmeralda (9 and 18 years old), who are Capacochas from Tawantinsuyu in Chile. Through carbon and nitrogen stable isotopes analysis on hair and bone collagen, we report the change in diet during their pilgrimage from Cuzco to Cerro Esmeralda (northern Chile) and Cerro El Plomo (central Chile) respectively.

The Capacocha Cerro Esmeralda is located in the coastal mountain range of the Atacama Desert, 905 masl, while the Capacocha Cerro El Plomo is located in the central Andes at 5400 masl. This important difference in the environment certainly influenced the diet of the local populations, who most likely gave food to the offered-in-sacrifice children during the pilgrimage and could thus explain the differences observed in the three cases. The results on bone collagen from Cerro Esmeralda show the prevalence of maize and camelid meat consumption. The results from hair sections of these three different individuals show that values change during the different months before death. For example, in this analysis we can see similarities between the child of Cerro El Plomo and the young females of Cerro Esmeralda several months prior to death. However, during the last months it can be observed how the values of Nitrogen start differing between both Capacochas (Fig. 1).

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4.9 Sir Henry Wellcome’s legacy to mummy studies: seven mummies with South American attributes from the Wellcome Collection

Andrew S. Wilson1, Virginie Cerdeira2, Ruth Horry3, Sonia Guillen3, Karin Frei4, Robert C Janaway5, Ian Barnes6

This paper will present initial findings on a landmark project involving the study and potential permanent display of two mummies from the Wellcome Collection. The mummies were bought together in 1924 by auction, with documentation suggesting that they came from Peru. A further five mummies where bought in 1931 by the same auction house and also share the same cultural resemblance and their study will constitute the second phase of this project. This study will discuss the arrival of these mummies in London in the early twentieth century and review their curation, together with ethical issues concerning their display. The project is seeking a greater understanding of the cultural affiliation of this assemblage by drawing on documentary sources from the Wellcome Trust’s own archives, combined with the application of biochemical methods.

Molecular and isotopic studies are underway to start to look at the nature of preservation and to help to piece together a comprehensive picture on lifeways information. By exploiting the incremental nature of hair growth we are examining evidence for dietary variation and presence of metabolites in hair. Radiogenic isotopes are being used in conjunction with other evidence to exclude geographic regions and try to narrow down where these mummies might have originated from. Molecular analyses are being used to explore the phenotypes of these individuals – their ability to digest certain foods, aspects of appearance, propensity to disease and their genetic history. CT and surface imaging are being used to help provide information on age and health status, whilst helping to reconstruct the nature of the funerary context alongside the small number of textiles and artefacts accompanying them.

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Symposium 5. Host-parasite relationships and diseases: lessons from the past. Session dedicated to Adauto Araújo†

Chairs: Raffaella Bianucci, University of Turin, Italy, Karl Reinhard, University of Nebraska, USA, Dong Hoon Shin, Seoul National University, South Korea

5.1 Archaeological parasitology based on mummy diagnosis: a new approach

Karl Reinhard¹, Isabel Teixeira-Santos¹, Elisa Pucu de Araújo²

The discovery of a mummy with the gross pathology of megacolon in the Lower Pecos Canyonlands showed that Trypanosoma cruzi transmission was present 1,000 years ago. By itself, this discovery was interesting, but just an isolated case. However, in context of subsistence strategy for the region, it provided a basis for generating hypotheses that could be tested by archaeological research. In 2014, Araújo and Reinhard published a research strategy for field recovery of evidence of T. cruzi transmission, both sylvatic and domiciled. They propose a three-pronged approach of sampling archaeological middens for triatomines, sampling woodrat middens, and testing human coprolites for T. cruzi DNA. They suggested that bulk samples, especially from rockshelters, be recovered from stratigraphic deposits to examine for insects. It is probable that rockshelter deposits will preserve intact or partially fragmented insects.

They also suggested that woodrat bones be carefully recovered and retained for molecular analysis. Woodrats are the common definitive host for T. cruzi and were a major part of the hunter-gatherer diet. Finally, they suggested that human corporeal remains, and coprolites, be tested for T. cruzi via ELISA and molecular means. Our analysis of the first season of excavations began in January of 2016. The excavations focused on Eagle Nest Cave, near Langtry, Texas. This presentation reports the results of preliminary investigations.

Parasitología arqueológica basada en el diagnóstico en momias: una nueva aproximación.

El descubrimiento de una momia con lesiones macroscópicas de megacolon, procedente de los cañones del Bajo Pecos, demostró que Trypanosoma cruzi ya se encontraba en la región hace 1,000 años. Aunque aislado, este hallazgo fue interesante por sí mismo. Sin embargo, en el contexto de la estrategia de subsistencia de esta región, propició hipótesis que pueden ser puestas a prueba por la investigación arqueológica. En 2014, Araújo y Reinhard publicaron una estrategia para la recuperación de evidencias de la transmisión de T. cruzi, tanto silvestre como urbana. Propusieron una estrategia triple para el muestreo de triatomíneos en deshechos arqueológicos, en los nidos de ratas silvestres y de ADN de T. cruzi en coprolitos humanos. Sugirieron que muestras en bloque, tomadas de depósitos estratigráficos de abrigos rocosos, fuesen examinadas para hallar a los insectos; en consideración que éstos podrían conservar sus cuerpos enteros o fragmentados.

También sugirieron que se recuperen restos óseos de las ratas silvestres para someterlas a análisis moleculares. Estos roedores son los hospederos definitivos de T. cruzi y fueron también un componente importante de la dieta de los cazadores-recolectores. Finalmente, sugirieron que se busque, mediante ELISA y pruebas moleculares, evidencia de T. cruzi en restos humanos y coprolitos asociados. Nuestros análisis de la primera temporada de excavación, principalmente en la cueva Eagle Nest, cerca de Langtry, Texas, se iniciaron en enero de 2016. Presentamos aquí los resultados preliminares.

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5.2 Sensibility and specificity of primers designed long before new sequences were deposited: a critical approach applied to the archaeological context

Elisa Pucu1, Paula Cascardo1, Marcia Chame1, Gisele Daltrini Felice2, Niède Guidon3,4, Maria Cleonice Vergne5, Daniela Leles1

The recovery of ancient DNA opens the possibility of studying human-parasite relationships. Not only we still need to deal with the general issues of preservation, contamination and decay of samples, but whether the parasite DNA is still in the archaeological sample. Some primers specificity might be put to a test due to the universe of new information and the daily sequencing of organisms.

In 1996, Souto and colleagues defined two lineages of Trypanosoma cruzi amplified of part of the intergenic region of the mini exon genes. These primers were deposited before other organisms had their DNA sequenced. In 2008, two papers were published using these primers in human remains with successful results. We will describe the results of using T. cruzi primers with archaeological samples and discuss the possibility of updating primers regularly as more organisms are being sequenced.

Twelve bones from Sítio Justino, Sergipe were analyzed: one amplified Propionibacterium acnes, and one amplified Agrobacterium tumefaciens. P. acnes is a bacterium found in the human skin known to maintain the inflammatory phase of acne, and also cause infection. Its genome sequence was published in 2004. A. tumefaciens occurs in the soil and it is a plant pathogen. Also, five bone samples of the extinct ground sloth from Lagoa dos Porcos, Piauí were tested. We found similarity with Pseudomonas putida, a non-pathogenic bacteria that can degrade synthetic materials. Few studies reported cases when primers amplify different organisms. However, even though the results are different from expected they should not be discarded as they might reveal unexpected results endogenous to the archaeological sample.

Sensibilidad y especificidad de primers diseñados mucho antes que nuevas secuencias fueran depositadas: una aproximación crítica al contexto arqueológico.

La recuperación de ADN antiguo abre la posibilidad de estudiar las relaciones entre los humanos y sus parásitos. No sólo necesitamos enfrentar los problemas generales de la preservación, contaminación, y deterioro de las muestras; pero si el ADN parasitario se encuentra aún en la muestra arqueológica. La especificidad de algunos primers podría ser puesta a prueba debido al universo de nueva información y el secuenciamiento diario de nuevos organismos. En 1996, Souto y colegas definieron dos linajes de Trypanosoma cruzi, a partir de amplificar la región intergenómica de los genes en los mini exones. Estos primers fueron depositados antes que el ADN de otros organismos fuese secuenciado. En 2008, dos artículos fueron publicados usando estos primers en restos humanos con resultados exitosos. Describimos los resultados de usar primers de T. cruzi en muestras arqueológicas y discutimos la posibilidad de poner al día nuestros primers regularmente, ya que nuevos organismos son secuenciados constantemente.

Se analizaron doce huesos procedentes de Sítio Justino, Sergipe: uno amplificó Propionibacterium acnes y otro amplificó Agrobacterium tumefaciens. P. Acnes, una bacteria encontrada en la piel humana, donde mantiene la fase inflamatoria del acné y también causa infección. La secuencia de su genoma fue publicada en 2004. A. tumefaciens ocurre en la tierra y es un patógeno de los vegetales. También, cinco muestras de hueso del extinto perezoso terrestre de Laguna dos Porcos, Piauí. Encontramos similaridad con Pseudomonas putida, una bacteria no patógena que puede degradar materiales sintéticos. Algunos reportes cuentan de casos en los que los primers amplifican organismos diferentes. Sin embargo, aun cuando los resultados son diferentes de lo esperado, no deben ser descartados ya que podrían revelar resultados inesperados, endógenos a la muestra arqueológica.

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5.3 Paleoparasitology in Brazil: status and perspectives

Alena Mayo Iñiguez¹, Mônica Veira¹, Lucélia Guedes¹, Morgana Camacho¹, Victor Hugo Borba¹, Alexandre Fernandes¹, Sergio Miranda¹, Karl Reinhard², Adauto Araújo†¹

Paleoparasitology, the study of parasites found in archaeological materials, is a term originated in Brazil by Dr. Luiz Fernando Ferreira, in the Oswaldo Cruz Foundation-Fiocruz. As a branch of Parasitology, and of Paleopathology, was created with the main objective of studying the origin and evolution of parasitic infections, based on a broad concept of parasites including viruses, bacteria, protozoa, helminths, and other forms of life with ecological niche in a host. Paleoparasitological findings have changed the previously accepted conceptions about the origin of infectious diseases in the New World. Our research group has demonstrated that the presence of geohelminths in pre-Columbian populations could be considered an evidence of alternative routes of the peopling of America. And also that American Trypanosomiases and Chagas disease, was present before the arrival of Europeans, for example.

The group is establishing methods and techniques to study human and animal parasites from both archaeological and paleontological remains. Especially in material from the littoral as Brazilian sambaquis (shell mounds), where parasites are rare. Paleoparasitological analysis have been conducted in archaeological sites from Brazil and worldwide. New records of parasites from pre-Columbian archaeological sites from Chile and ancient populations of Pueblos, USA, will be presented. The understanding of the introduction/spread of new parasites and/or new lineages with the arrival of European and African slaves in America is an important topic in our research. In this regard, we have evaluated the presence of intestinal parasites in human remains from archaeological sites of the colonial period in Brazil. Historical sites, with different cultural and epidemiological contexts, showing similar parasite diversity in spite of divergence in prevalence. We have worked on integrating paleoparasitological, and paleogenetic analysis, not only with basic information from parasites but also from their hosts, and now including palynology and geoprocessing data, for a more comprehensive paleoepidemiological scenery.

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Paleoparasitología en Brasil: su estado y perspectivas.

El término paleoparasitología, estudio de parásitos en materiales arqueológicos, fue creado en Brasil por el Dr. Luiz Fernando Ferreira, de la Fundación Oswaldo Cruz - Fiocruz. Como rama de la parasitología y de la paleopatología, su objetivo principal es estudiar el origen y evolución de las infecciones parasitarias, las que, en sentido amplio, incluye a virus, bacterias, protozoos, helmintos y otras formas de vida con nicho ecológico en un hospedero. Sus hallazgos han cambiado conceptos previamente aceptados sobre el origen de enfermedades infecciosas en el Nuevo Mundo. Nuestro grupo de investigación, por ejemplo, ha demostrado que la presencia de geohelmintos en poblaciones precolombinas puede considerarse como evidencia de rutas alternas para el poblamiento de las Américas; y también que la Tripanosomiasis Americana (Mal de Chagas) estuvo presente antes de la llegada de los europeos.

El grupo desarrolla métodos y técnicas para estudiar parásitos de humanos y animales, tanto de restos arqueológicos como paleontológicos; por ejemplo, de material del litoral brasileño (sambaquis o conchales), donde los parásitos son raros. Análisis semejantes han sido hechos también fuera de Brasil. Se presentan nuevos registros de parásitos de sitios arqueológicos precolombinos de Chile y de poblaciones antiguas Pueblo, de los Estados Unidos. Entender el arribo/difusión de nuevos parásitos y/o cepas con la llegada de europeos y esclavos africanos a las Américas es un tópico importante de nuestra investigación. Así, hemos evaluado la presencia de parásitos intestinales en restos humanos de sitios arqueológicos coloniales de Brasil. En ellos, lugares con diferentes contextos culturales y epidemiológicos, presentan diversidad de parásitos semejantes, pero difieren en prevalencia. Hemos trabajado integrando análisis paleoparasitológicos y paleogenéticos, no sólo con información básica de los parásitos, pero también con la de los hospederos, ahora incluyendo la palinología y el geoprocesamiento de información, lo que permite recrear un escenario paleoepidemiológico más completo.
5.4 Current trends of paleoparasitology in Korean mummy studies

Chang Seok Oh¹, Min Seo², Ho Chul Ki³, Jong-Yil Chai⁴, Dong Hoon Shin³

Paleoparasitology reveals the prevalence of each parasite infection of the past, by examination on the samples from archaeological sites. Especially as for coprolites obtained from Korean mummy, as its preservation status was quite good for parasitological analysis, invaluable information about the parasitism in history could be accumulated. Briefly, microscopic examination confirmed the presence of parasite eggs in Korean mummy’s coprolites, by which we estimate the infection prevalence of specific parasitism among pre-modern Korean people. Using ancient DNA technique, we can reconstruct each parasite’s phylogenetic trees from a historical perspective.

The sociocultural background of the parasitism in pre-modern Korean society was also studied lately. By intense collaboration with historians who know much about what was going on the health and disease status in pre-modern society, we tried to make a hypothesis about the presumptive route of ancient parasite infection in Korea, especially on Ascaris, Trichuris, Clonorchis, Metagonimus, Paragonimus, and Taenia spp. By such interdisciplinary collaboration between different research fields, we can get invaluable academic clues for comprehending ancient parasitism in pre-modern Korean history.

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Tendencias actuales en paleoparasitología a partir del estudio de momias coreanas.

La paleoparasitología revela la presencia de cada infección parasitaria del pasado mediante el examen de muestras de sitios arqueológicos. Los coprolitos obtenidos en momias coreanas, debido a su preservación muy buena, proporcionan valiosa información paleoparasitológica. El examen microscópico confirmó la presencia de huevos de parásitos en los coprolitos de una momia coreana, a partir de lo cual podemos estimar la prevalencia de parasitosis específicas en la población coreana pre – moderna. Usando técnicas de estudio de ADN antiguo, podemos reconstruir los árboles filogenéticos de cada parásito desde una perspectiva histórica.

El contexto sociocultural de las parasitosis en la sociedad coreana pre – moderna también fue estudiado, gracias a la colaboración intensa con historiadores expertos en el estado de la salud y enfermedad de la sociedad coreana pre – moderna. Así, intentamos desarrollar una hipótesis acerca de rutas presuntas para la difusión de las parasitosis antiguas en Corea, particularmente para Ascaris, Trichuris, Clonorchis, Metagonimus, Paragonimus y Taenia spp. A través de esta colaboración interdisciplinaria, podemos obtener información académica valiosa que permite comprender las parasitosis en la historia de Corea pre – moderna.
5.5 Guanche mummies: integrating paleoparasitological and paleogenetic investigations

Alena Mayo Iñiguez1, Herminia Gijón-Botella2, María del Carmen del Arco - Aguilar3, Mercedes Martín - Oval4, Conrado Rodríguez – Martín4, Mercedes del Arco-Aguilar4, Adauto Araújo†1

The Guanches, ancient inhabitants of the Canary Islands, Spain, practiced mummification of their dead. A paleoparasitological and paleogenetic analysis was conducted on mummified bodies (n=6) (AD 1200, Cal BP 750) belonging to the Guanche culture from Gran Canaria Island (Figure 1). Coprolite and sediment samples (n=19) were removed from below the abdominal region or sacral foramina. The samples were rehydrated in 0.5% trisodium phosphate solution for 72 hrs. at 4°C, and the paleoparasitological investigation was conducted by spontaneous sedimentation method and microscopic examination. The results revealed the presence of well-preserved eggs of Ascaris sp., Trichuris trichiura, Enterobius vermicularis, and hookworms.

Ancient DNA was extracted from sediment samples to elucidate the ancestry of the mummies and for molecular detection of Ascaris sp. infection. Results of paleogenetic analysis demonstrated Ascaris sp. infection using 2 molecular targets, cytb and nad1. mtDNA haplotypes U6b, U6b1, and HV were identified that confirmed records of Guanche ancestry. The excellent preservation of Guanche mummies facilitated the paleoparasitological and paleogenetic study, the results of which contribute to our knowledge of Guanche culture and their health status.

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Momias Guanche: investigaciones integradas en paleoparasitología y paleogenética.

Los Guanches, antiguos pobladores de las Islas Canarias, España, practicaron la momificación de sus muertos. Se realizó análisis paleoparasitológico y paleogenético en cuerpos momificados (n=6) (AD 1200, Cal BP 750) pertenecientes a la cultura Guanche de la Isla Gran Canaria (Figura 1). Coprolitos y muestras de sedimento (n=19) fueron removidos de la parte inferior de la cavidad abdominal o de los forámenes sacros. Las muestras fueron rehidratadas en solución de fosfato trisódico al 0.5% por 72 hs a 4°C. Luego, la investigación paleoparasitológica fue realizada por el método de sedimentación espontánea y examen microscópico. Los resultados revelaron la presencia de huevos bien preservados de Ascaris sp., Trichuris trichiura, Enterobius vermicularis y de uncinarias.

Se extrajo ADN antiguo de muestras de sedimento para dilucidar la filiación de las momias y para detectar la infección por Ascaris sp. Los resultados de los análisis paleogenéticos demostraron la infección por Ascaris sp. utilizando dos blancos moleculares, cytb y nad1. Haplotipos mitocondriales U6b, U6b1 y HV fueron identificados, lo cual confirma los registros de filiación Guanche. La excelente preservación de las momias Guanche facilitó los estudios paleoparasitológicos y paleogenéticos, cuyos resultados contribuyen a nuestro entendimiento de la cultura Guanche y su estado de salud.
5.6 Identification of *Leishmania tarentolae* signature in a post-Colonial Brazilian human Mummy reopens questions on its ability to survive and spread systematically in human hosts.

Shênia P. C. Novo, Daniela Leles, Adauto Aráujo, Raffaella Bianucci

Leishmaniasis are a complex of diseases with a broad clinical spectrum and epidemiological diversity. Caused by different species of the genus *Leishmania*, they represent a major threat to public health in different areas of the world. Advances in paleoparasitology allowed scholars to recover remnants of ancient *Leishmania* parasites and to identify biological signatures in various hosts. Here we report on the identification of *L. tarentolae* signatures in soft and hard tissues of a Brazilian male dating to the post-colonial period (18th-19th c A.D.) from Minas Gerais.

*L. tarentolae* is a *Sauroleishmania* that originates from the Old World and is currently not pathogenic to humans. Used in vaccines, *L. tarentolae* is apparently unable to complete its life cycle within the human host. Our findings contradict the previous statement and re-open the discussion concerning the survival potential of a *L. tarentolae* ancient strains in human macrophages, their ability to spread systematically and cause a disease. These data, in turn, raise a series of questions concerning the parasite’s way of transmission from lizards to humans, its presence in the Brazilian paleoenvironment and in the ancient lizard population.

Identificación de *Leishmania tarentolae* en una momia post-colonial retoma las preguntas sobre su capacidad para sobrevivir y propagarse sistémicamente en huéspedes humanos.

Las leishmaniasis son un complejo de enfermedades con un amplio espectro clínico y diversidad epidemiológica. Causadas por diferentes especies del género *Leishmania*, representan una gran amenaza a la salud pública en diversas áreas del mundo. Los avances de la paleoparasitología han permitido a los investigadores a recuperar restos de antiguas Leishmania e identificar firmas biológicas en varias hospederos. Aquí reportamos la identificación de firmas biológicas de *L. tarentolae* en tejidos blandos y óseos de un varón brasileño del periodo post-colonial (Siglos 18 – 19 D.C.) procedente de Minas Gerais.

*L. tarentolae* es una *Sauroleishmania* que se originó en el Viejo Mundo y es actualmente no patogénica en humanos. Usada en vacunas, *L. tarentolae* es aparentemente incapaz de completar su ciclo vital en el hospedero humano. Nuestro hallazgo contradice afirmaciones anteriores y reabre la discusión respecto al potencial de supervivencia de antiguas cepas de *L. tarentolae* en los macrófagos humanos y su capacidad de diseminación sistémática hasta causar enfermedad. Estos datos, a la vez, nos plantean nuevas interrogantes referentes al modo de transmisión de este parásito de las lagartijas a los humanos, su presencia en el paleoambiente brasileño y en la antigua población de lagartijas.
The trypanosomatid parasites are an ancient group of organisms responsible for devastating human disease worldwide. In the Americas, *Trypanosoma cruzi* is the causative agent of Chagas Disease (CD), the most epidemic zoonosis in Latin America today. The clinical manifestations of CD, however, have been recognized in archaeological human remains from South America as early as 9,000 years ago. Here we present the preliminary results of a new project that applies paleogenomic methods, including targeted enrichment and next-generation sequencing (NGS), to capture *T. cruzi* in human remains found in pre-Columbian South America, incorporating material with and without signs of infection throughout regions thought to be endemic.

To date, the molecular detection of *T. cruzi* via PCR has been reported for a small number of cases, but these PCR products have limited power to address evolutionary questions. If successful, reconstructed NGS data from the ancient parasites will be used to test hypotheses regarding the origins, timing and dispersal of human-adapted lineages in ways that PCR product cannot. NGS methods, however must contend with their own challenges, namely false-positives and the difficulty of determining a ‘presence/absence’ threshold for sequence reads that match the organism of interest. We will report the initial NGS results for over 70 individuals from mostly Peru and Chile and discuss the major challenges and pitfalls in interpreting and authenticating these data.

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Retos en la aplicación de NGS para detectar *T. cruzi* en restos humanos prehispánicos de América del Sur.

Los parásitos tripanosomátidos son un antiguo grupo de organismos responsables de devastadoras enfermedades humanas en todo el mundo. En las Américas, *Trypanosoma cruzi* es el agente causal de la enfermedad de Chagas (CD), la zoonosis más epidémica en Latinoamérica en la actualidad. Las manifestaciones clínicas de CD, sin embargo, han sido reconocidas en restos humanos arqueológicos de Sudamérica desde tan temprano como hace 9.000 años. Aquí presentamos los resultados preliminares de un nuevo proyecto que aplica métodos paleogenómicos, incluyendo enriquecimiento dirigido y secuenciamiento de la siguiente generación (NGS), para capturar *T. cruzi* en restos humanos de Sudamérica precolombina, incorporando material con y sin signos de infección a través de regiones consideradas como endémicas.

Hasta esta fecha, la detección molecular de *T. cruzi* vía PCR ha sido reportada en un pequeño número de casos, lo cual tiene un poder limitado para responder preguntas evolutivas. De ser exitoso, el análisis de la información obtenida a partir de NGS de los antiguos parásitos, podrá utilizarse para poner a prueba hipótesis acerca de los orígenes, tiempo y dispersión de las cepas adaptadas a los humanos, en maneras que el PCR no puede. Los métodos NGS, sin embargo, deben enfrentarse a sus propios retos, particularmente a los falsos positivos y la dificultad para determinar el umbral presencia/ausencia para lecturas de las secuencias que correspondan a los organismos de interés. Reportaremos los resultados iniciales de usar NGS en más de 70 individuos mayormente de Perú y Chile, y discutiremos los principales retos y errores al interpretar y autenticar estos datos.
Symposium 6. Bioarcheology of war

Chairs:
Patricia Maita, Museo Nacional de Arqueología, Antropología e Historia del Perú, Peru
Tiffiny A. Tung, Department of Anthropology, Vanderbilt University, USA

6.1 Women Warriors among Central California Hunter-Gatherers: Egalitarianism or Institutionalized Inequality?

Al W. Schwitalla1, Marin A. Pilloud2

This paper explores the complex theme of social inequality among sedentary, semi-sedentary, and seasonally mobile hunter-gatherers whose political structure is characterized by anthropologists working in the region as that of complex triblets and triblets. This topic is well-attested to in the historic, ethnographic and archaeological record of central California foraging societies. In previously published research (Schwitalla et al. 2014) we evaluated spatial and temporal patterns in physical evidence for violence from a bioarchaeological database of 16,820 individual skeletons that represent people that lived in central California from 3050 B.C. to A.D. 1899. We demonstrated that sharp-force trauma wounds were more common among males (273/2553 or 10.7%) than females (118/2594 or 4.5%). Blunt force trauma wounds (Pilloud et al. 2014) indicative of violence were also more common among males (141/2,557 or 5.5%) relative to females (103/2,580 or 4.0%). While some of these wounds are likely the result of domestic violence rather than warfare for both sexes, eyewitness accounts of women combatants in the historic era (A.D. 1720 – 1899) clearly indicate indigenous females were active participants during colonial conflicts.

First, we consider possible correlations between frequencies and types of sharp-force trauma to sociopolitical complexity and relative mobility. Second, we present the diachronic patterns of ante and peri-mortem sharp-force trauma among adult males and females and the data patterns that are observed with respect to wound type, location, trajectory, and number of instances per individual skeleton. Finally, we take a critical look at the temporal and spatial distribution of female combatants during times of trouble and advance the notion that inequality may simply be a by-product of societal luxury among these diverse hunter-gatherer groups.

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6.2 Warfare and Foodways: Violence, Dismemberment, and Dietary Reconstruction at Wari-era Uraca (600 – 1000 AD) in the Lower Majes Valley, Arequipa, Peru

Beth Koontz Scaffidi¹, Tiffiny A. Tung¹

Excavations at Uraca, a Wari-era (600 – 1000 AD) cemetery in the Majes Valley, uncovered incomplete human skeletons (MNI = 157), many with cranial trauma. These skeletons were analyzed to investigate whether diet varied within the population, what that variation might suggest about the presence of different social segments at Uraca, and whether inter-life differences in diet are correlated with violence-related trauma.

Of the 100 adults observable for cranial trauma, a proxy for malevolent attack, 67 presented wounds: 62/67=ante-mortem; 1/67=peri-mortem; 4/67=both. Most of the injured (n=41) suffered multiple injuries. Draft-age males were the only victims of perimortem injury (n=7), and exhibited the highest frequency of cranial trauma and multiple injuries. Males had a significantly higher head trauma rate than females, but the locational distribution of head wounds was similar. Twelve additional individuals (adult males) were transformed into trophy heads, and eight unarticulated mandibles show evidence of defleshing. The locational distribution and demographic patterns of injury are consistent with those expected in warfare. But, it is also possible that some these injuries were obtained in ritual battle or festive combat, in community brawls, or in domestic contexts.

Dietary reconstruction can help to clarify the larger context in which violence emerges. For example, food scarcity may be a motive for violent inter-group competition and intra-group hostility (see Keeley 2016: 292). To evaluate if those with trauma, without trauma, and trophy head victims consumed different foods in childhood, we compare stable carbon isotope ratios from dental enamel from those two groups. We also examine dietary differences in those groups of adults through analysis of stable carbon and nitrogen isotopes from bone collagen. If dietary differences from childhood and adulthood correlate with cranial injuries, then food inequality or food insecurity may help to explain why there was an intense outbreak of violence-related trauma at Uraca.

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6.3 Indiscriminant Violence in Times of War: A Bioarchaeological Study of Terminal and Post-Wari Skeletal Populations from Huari, Ayacucho, Peru

Tiffiny A. Tung

This study explores the effects of Wari imperial collapse ca. AD 1000-1100 and the effects of a drought in the ancient Peruvian Andes AD 1250 – 1350. I document ante- and post-mortem cranial trauma among a skeletal population (N=37) from the Cheqo Wasi sector at Huari that dates to Wari imperial decline (Terminal Wari, ca. AD1050). The Cheqo Wasi sample was excavated by Mario Benavides in the 1970s. Violence-related cranial trauma is also documented on 69 adults and 18 juveniles that date to the subsequent drought era. Those post-Wari crania come from Enrique Gonzalez’s excavations at Vegachayoq Moqo in the 1980s and from Francisco Solano’s excavations at Monqachayoq in the 1980s. Those two contexts yielded thousands of commingled, post-cranial elements representing at least 200 individuals. Those elements were analyzed to document post-mortem violence against the body, showing how times of violent conflict include not only violent acts against the living, but also destructive acts against the corpse. Radiocarbon dates also clarify chronology.

Results show that violence significantly increases through time. In the heartland of the Wari Empire, Wari era cranial trauma is 20% (Tung 2012), and it increases to 60% in Terminal Wari, and again increases to 74% in post-Wari. Moreover, nearly all of the 200 post-Wari individuals exhibit cut marks, indicating that they had been de-fleshed, de-muscled, and dismembered, a highly unusual treatment of the dead relative to mortuary practices in the preceding eras. The high levels of trauma and the desecration of bodies in the post-Wari drought era suggest that it was a time of intense indiscriminate violence that resulted in trauma (which was often lethal) among males, females, and children. More broadly, these trauma data are used to speak to anthropological issues regarding the community health impact of two distinct processes: state collapse and climate change.

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6.4 Deeper than Bone: Assessing the Epigenetic Effects of Violence among Wari and Post-Wari Populations in the Ayacucho Basin, Peru

Rick W. A. Smith¹, Tiffiny A. Tung², Amy L. Non³, Ripan S. Malhi⁴, Deborah A. Bolnick⁵

Bioarchaeological studies of ancient populations have provided valuable insights into past experiences of violence because these events often leave permanent marks on human skeletal remains. In addition to the visible effects that violence can leave on bone, traumatic experiences can also have effects at the DNA level. A growing body of research in the field of epigenetics has linked violence with chemical modifications to the genome (i.e., DNA methylation), where tags are added to DNA that alter the expression of genes in response to social and environmental contexts. This shows that certain lived experiences have effects that go deeper than bone, and reconstructing epigenetic patterns in ancient DNA may shed new light on violence in the ancient world.

In this study, we are investigating the DNA-level effects of violence during the reign and subsequent decline of the Wari state. At the Wari site of Conchopata, archaeologists suggest that differences in exposure to violence were influenced by status, gender, and ethnic differences. In particular, low-status, foreign women were subjected to extreme brutality throughout their lives relative to other members of Wari society. In the post-Wari era (1250-1350 CE), exposure to violence was no longer clearly structured by social hierarchies. Rather, violence greatly intensified across all demographic categories in the former Wari imperial heartland.

Using ancient DNA obtained from Wari and post-Wari bone, we have sequenced a portion of the mitochondrial DNA. For a subset of the samples with preserved DNA, we have determined genomic methylation levels by bisulfite sequencing repetitive elements (LINEs). Finally, to assess the epigenetic effects of violence, we are reconstructing methylation of stress-related loci (i.e., NR3C1) that are known to be affected by traumatic experiences. Combining emerging paleoepigenetic methods with bioarchaeology, we are investigating the DNA-level effects of violence, social inequalities, and social change in the Andes.

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6.5 Dietary Inequality in Times of War: An Isotopic Study of post-Wari Foodways, Ayacucho, Peru

Tiffiny A. Tung¹, Natasha Vang¹, Theresa Miller¹,

Theories about state “collapse” often highlight the role of climatic stress in the deterioration of state power, and climate stress is often cited to explain resource scarcity and subsequent outbreaks of war. However, while climate change (droughts, in particular) can significantly hinder food production, social and political decisions about food (re)distribution become paramount. Will dietary resources be equitably distributed, or will some groups, whether structured by age, gender, or social class, have less access to certain foods? These issues are particularly poignant during times of war.

These questions are explored through a case study of two skeletal populations from the site of Huari: one from Cheqo Wasi and which corresponds to the Terminal Wari (AD 1000-1100) when state power was on the decline and violence was pervasive (as indicated by cranial trauma), and another that dates to the post-Wari era (AD 1250 – 1350), during which time there was a long-term drought and pervasive and indiscriminate violence. Twenty radiocarbon dates affirm those chronological associations. Stable carbon and nitrogen isotope ratios from bone collagen are compared to previous studies on Middle Horizon Wari heartland groups; those comparisons help to clarify effects of state decline, climate change, and warfare, as well as reveal insights into human agency as communities adjusted to changing socio-political and ecological conditions.

Results show that adult diets become increasingly heterogeneous during the post-Wari era that was plagued by violent conflict. The greatest differences are between males and females, but not in childhood; those gender-based dietary differences are only observed in adulthood when it appears that gender identities are more socially identifiable and embodied. These dramatic shifts in adult diet, which co-occur with high levels of sublethal and lethal violence, suggest the development of marked inequalities in society and a significant decline in well-being for all community members.

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6.6 Warfare and Violence in the Peruvian Central Coast

Maricarmen Vega

From the well-known mass-sacrifices of the Moche culture to the most recent crimes against humanity that occurred during the internal conflict between terrorists and government forces (1980-2000), Peru offers the ideal research environment to test hypotheses about the cultural context of violence, about its patterning, and about its effects on individual people. The research herein will focus on the Peruvian central coast, (one of the less studied regions in the country but an area with a complex socio-political development), in order to reconstruct a 3000+ year “history of violence”, covering from the Formative to the Early Colonial periods.

This study included 736 individuals from 14 different samples. Violence was assessed by the interpretation of the prevalence of malintent trauma combined with other variables such as cohort, lethality, minimum number of events, and social status. An analysis of the environmental, cultural, and archaeological contexts, as well of comparisons with published samples of the same area was also included.

The results showed that the pattern of trauma was not the same through time. These differences correspond to specific socio-political events and processes that triggered violent outbursts. In general terms, males (especially those related to military duties) and low status individuals were more exposed to violent episodes. Warfare appeared in the region for the first time during the beginnings of the Early Intermediate Period. After this time, the lesser rates of violence-related trauma was found in the first part of the Middle Horizon and during the Late Horizon, the two time periods in which a strong state (the Wari and the Inca Empire) were present. The prevalence of both lethal and non-lethal lesions rose in the periods that immediately followed the fall of these Empires, phenomena that was also documented in other Andean regions.

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6.7 Digging up the history of war: Soldiers of the Battle Alto de la Alianza, Pacific War (1880)

Milena Vega-Centeno A.¹, Patricia Maita²

The Battle of Alto de la Alianza was a historic armed conflict between Peru - Bolivia coalition against the army of Chile. The confrontation took place into Peruvian territory on May 26, 1880 as part of the Pacific War also known as the War of Guano and Salitre from 1879 to 1883. Recent excavations in the battlefield conducted by Alto de la Alianza research project allowed the recovery of four individuals dressed with historical military uniforms, deposited in disarray with the face on the floor and with a common cause of death. Three bodies are complete and just one are represented by few bones due to the removal of a section of the deposit by looters. All the individuals are men, according the military garment two are Bolivian, one is Peruvian, and the last one still with unknown nationality.

Five traumatic wounds by firearm were recorded in the three completed bodies, all the lesions are penetrating injuries located in head, thorax and less prevalent in leg. Due to localization and lethality, 60% of the injuries have been received when they were fighting, while the 40% suggest executions. The review of historical sources about the Pacific War allowed the confirmation of nationalities of the soldiers by the recognition of their battalion’s uniforms, identifying two of them as members of the 2nd Infantry Regiment of Sucre, which allowed the return of soldiers to their original community in Bolivia, where they rest now.

The study of human remains of historical wars is a valuable archaeological resource for understanding the context in which the events developed, without forgetting the respect that every human deserves and taking account the right to repatriation to their communities of origin. The sample analyzed is small, however has great meaning for being physical witness of one of the most important historical conflicts inside Peruvian territory and whose remembrance remains in the collective memory of the countries that participated in this armed conflict.

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6.8 Warfare in the Chachapoya territory: bioarchaeological interpretation of violence in Kuelap

Patricia Maita¹, Marcela Urizar²

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This study examines the evidence for bone trauma related violence of the skeletal remains of Kuelap, the most monumental Chachapoya settlement located in the Utcubamba Basin, traditionally classified as a fortress due to its location on top of a mountain and its high enclosed walls. The skeletal sample consists of 90 individuals, mainly represented by skulls, related to the occupation of the settlement during the Late Intermediate Period, around the second half of the 15th century AD. Forty individuals exhibited a total of 47 traumatic injuries. Twenty-one of these injuries (45%) showed evidence of bony remodeling and twenty-five injuries (53%) were morphologically compatible with a perimortem trauma. More males (n=33) are affected by trauma than females (n=13). Five subadults, between child and adolescents, exhibited evidence of violent death, including extreme blunt-force trauma. Furthermore, one adult crania exhibited cutmarks and the occipital base was removed, indicative of the elaboration of a trophy head.

Cranial injuries are consistent with wounds from blunt implements. The location of the perimortem injuries and extensive cranial damage allows us to hypothesize that they were due in the course of a violent confrontation where the intention of the attackers was to cause death. The relatively high proportion of adult men and the trophy-taking of human remains suggest an attack related to warfare. The Chachapoya have been catalogued as a rebellious population by European chroniclers who visited the region in the 16th century, ethnohistoric literature points out the existence of brave warriors and their strong resistance against the establishment of the Inca domination in their territory. One of the functions of Kuelap during the Inca invasion would have been to confront aggressions and protect the local elite. The pattern of lethal head wounds on adults and subadults suggest a raid as the most probable scenario, perhaps the attack was stimulated by revenge, punishment or intimidation against constant Chachapoya rebellions in the context of violent social control of the territory.
6.9 In war fathers bury their sons: Violence against the subadult population in Lucanamarca and Umasi during the Peruvian internal armed conflict

Flavio Estrada Moreno

Mortality profiles of prehistoric societies usually show an important number of sub adult deaths, immature skeletal remains in archaeological contexts reflect failed adaptive processes and diseases, although a number of these remains could be human sacrifices, victims of domestic violence or population control. In the forensic context, sub adult remains may appear as a result of homicides, accidents, suicides and wars. Armed conflicts dramatically modify the normal mortality rates respecting young individuals, especially children and adolescents who die as a result of massacres, devastations and razzings of their communities.

The Commission of Truth and National Reconciliation in Peru (2003) reported that among the war-related deaths produced by the internal armed conflict (1980 -2000), it was a significant number of non-combatant sub adult individuals whose bodies were least probable to be identified by survivors and informants, due to the fact that they were less know in their communities and also because their identities were not formally registered by any governmental institution.

This paper presents the review of two violence cases that involve the deaths of sub adult population in Peru’s recent history as a result of the internal armed conflict: Lucanamarca (April 1983) and Umasi (October 1983) both are rural communities located in the highlands of Ayacucho, in the Central Andes of Peru. In both cases sub adult individuals ranging in age from infancy to adolescence (Lucanamarca n=28, Umasi n=25) were tortured and killed during army attacks carried out by the terrorism organization Shining Path (SL) and military troops of the Peruvian Army on civilian population. The amount of human lives lost represented a significant demographic impact of the war in the Andean communities, approached them to extinction.
Symposium 7. Ancient bodies: the interplay between ancient culture, spiritual beliefs and mummification

Chairs:
Raffaella Bianucci, University of Turin, Italy
Despina Moissidou, National Kapodistrian University of Athens, Greece
Dong Hoon Shin, Seoul National University, South Korea

7.1 Experiences from the Greenland mummies

Niels Lynnerup

Eight mummified bodies were discovered in a natural tomb formed by a rock covered ledge in 1972 at Qilakitsoq, Greenland. Radiocarbon dating showed that they dated to approximately 1460 AD. The soft tissues of mummies, including internal organs, were very well preserved, not least due to the mummification process, which was essentially freeze-drying. The mummies were sheltered in the rocky tomb, but the tomb allowed for exposure to the dry, cold arctic winds. Garments and animal hides were also excellently preserved. The mummies had been placed in two stacks within the natural tomb. The Qilakitsoq mummy find is still the largest single find of mummies from the Arctic.

Due to their intactness, the investigations of the Greenlandic mummies from Qilakitsoq in the 1980’s were instrumental in pointing the field of mummy study in a more systematic direction, not least because the investigations had such a wide scope and brought many medical and natural scientific methods to bear. The medical and natural scientific investigations were able to shed light on many aspects of Thule culture conditions and habits of life. A salient point is here that mummies not only speak to us of the individuals own life history, but also in a much wider context, providing data on daily life in pre-historic times, where no written sources exist.

This presentation will focus on the organization of the Qilakitsoq investigations, some of the results, as well as how continuing analyses beget new interpretations. Especially, the find situation and the natural mummification method is analyzed in the cultural, historical context.

Experiencias con las momias de Groenlandia.

En 1972, ocho cuerpos momificados fueron descubiertos en una tumba en un abrigo rocoso en Qilakitsoq, Groenlandia. El fechado radiocarbónico mostró que databan de aproximadamente 1460 N.E. Los tejidos blandos de las momias, incluyendo los órganos internos, estuvieron muy bien preservados, principalmente debido al proceso de momificación, que básicamente fue por liofilización. Las momias fueron protegidas en la tumba rocosa, pero estuvieron expuestas a los vientos árticos frios y secos. Las vestimentas y las pieles de animales también estuvieron excelentemente preservadas. Las momias habían sido apiladas en dos grupos dentro de la tumba natural. El descubrimiento de las momias de Qilakitsoq aún permanece como el hallazgo más grande de esta naturaleza en el Ártico.

Debido a su condición intacta, las investigaciones de las momias groenlandesas de Qilakitsoq en los 80s fueron instrumentales en dirigir el campo de los estudios en momias en una forma más sistemática, particularmente porque éstas tuvieron una visión muy amplia y agrupó muchos métodos científicos y médicos, Las investigaciones médicas y de las ciencias naturales fueron capaces de iluminar aspectos de las condiciones de vida y costumbres de la cultura Thule. Un aspecto saltante es que las momias no sólo nos hablan acerca de vidas individuales sino, visto en un contexto más amplio, proporcionan datos acerca de la vida diaria en tiempos prehistóricos, de los cuales no existen fuentes escritas.

Esta presentación se centra en la organización de las investigaciones del hallazgo de Qilakitsoq, ningunos de los resultados, así como en qué manera la continuidad de los estudios proporcionan nuevas interpretaciones. Se analiza especialmente la situación del hallazgo y el método de la momificación natural dentro de un contexto cultural e histórico.

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7.2 What do Peruvian mummies tell us about our ancestors' spiritual beliefs? a chronological overview

Guido P. Lombardi

One of the common elements that unite human cultures is death. All cultures have honored their deceased ones with ceremonies and rites, sometimes extremely complicated and enduring. The Andes has been no exception. Andean South America shows extraordinarily preserved bioarchaeological remains, mostly due to natural conditions. Nevertheless, the reasons for the rise of mummification practices and their background is basically unknown due to the lack of any written records to back the evolution of the natives' treatment of the dead and their religious beliefs.

South American archaeology, axis of any approach to local past, meeting the challenge, has devised several contrasting 'cultural horizons' that show material evidence of ideological changes in specific moments of local prehistory. The significance and origin of these changes, at the center of Andean archaeological theory, provide a framework to organize an evolution of the cultural treatment of the dead over the millennia in this region.

This paper synthesizes information gathered from different sources aiming at presenting a model to show the chronological evolution of local belief systems upon which mummies and mummy-making played, almost constantly, a central role.

The author also presents the hypothetical ways of body disposal, including mummy cremation on specialized structures, as transient practices in the late preceramic period, which could explain the lack of formal cemeteries and human remains in or around their known settlements.

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¿Qué nos dicen las momias peruanas acerca de las creencias espirituales de nuestros antepasados? Una visión cronológica en conjunto.

Unos de los elementos comunes que une a las culturas humanas es la muerte. Todas las culturas han honrado a sus muertos con ceremonias y ritos, algunos extremadamente complicados y duraderos. Los Andes no han sido la excepción. Sudamérica Andina muestra restos bioarqueológicos extraordinariamente preservados, en mayor parte debido a condiciones naturales. Sin embargo, las razones por las cuales las prácticas de momificación aparecieron y su contexto son básicamente desconocidos debido a la ausencia de registros escritos que respalden la evolución del tratamiento de los muertos por los nativos y sus creencias religiosas.

La arqueología sudamericana, eje de cualquier aproximación al pasado, enfrentando este reto, ha propuesto diferentes 'horizontes culturales' contrastantes que muestran evidencia material de cambios ideológicos en específicos momentos de la prehistoria local. El significado y origen de estos cambios, centrales a la teoría arqueológica andina, proporcionan el marco para organizar una evolución del tratamiento de los muertos a lo largo de los milenios en esta región.

Este artículo sintetiza información de diferentes fuentes e intenta presentar un modelo cronológico de evolución local de los sistemas de creencia locales en los cuales las momias y su elaboración jugaron, casi siempre, un rol central.

El autor también presenta formas hipotéticas de disposición de los cadáveres, incluyendo la cremación de momias en estructuras especializadas, como práctica transitoria en el Periodo Pecrerímico Tardío, lo cual podría explicar la ausencia de cementerios formales y restos humanos en y alrededor de sus asentamientos conocidos.
7.3 Naming the dead: An interdisciplinary study on human mummified remains from 17th to 19th century crypts in Germany

Amelie Alterauge1, 2, Peter Weber1, Matthias Friske4, Manfred Baron von Crailsheim5 Wilfried Rosendahl6, Natalia Shved7, Sandra Lösch7, 8

Church vaults were used as burial places by local noble families or tenants in rural areas between the 16th and the 19th century AD in Central Europe. Due to environmental conditions, the inventory is often preserved, including coffins, fabrics, botanical and human remains. The large number of mummies stored in these crypts represents a unique opportunity to investigate the living conditions, diseases and funeral customs of this period.

In this study, four crypts from Germany dating to the 17th to 19th century AD are investigated: St. Nicolaus Church in Nedlitz, St. Catherine’s Church in Salzwedel, Sommersdorf Castle, and the Church of the Assumption in Illereichen. In total, 36 coffins and 28 mummies in different preservation states can be analyzed.

The first aim is to identify the entombed persons by evaluating the historical, archaeological and anthropological records. The second aim is to evaluate the influence of funeral customs on the preservation of the bodies.

Archival records were studied to detect name, ancestry, occupation, date of birth and death and burial site of the individuals. The coffins were inspected and dated by typo-chronological comparisons. The clothes were examined regarding style, sex specificity and chronological era.

Anthropological data for 21 individuals had to rely on in situ examinations or on photographs. A profound scientific examination, including molecular analyses and computed tomography, was performed on seven mummies. Age, sex, body height and pathological alterations were determined.

All investigated individuals are naturally mummified. Most of them were entombed within three days after death. Constant dry airflow was the main factor for mummification through desiccation. However, absorbent materials and plants played an important role in delaying the decomposition and in covering decay scent.

At the current state of research it seems unclear to what extent such preservative conditions were intentionally produced or developed as an unintended (though accepted) consequence of crypt-burial.

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The island of Sicily is home to a large number of mummified remains, dating from the 16th-20th centuries of the current era, most of which are located in the renowned Capuchin Catacombs of Palermo. There, the oldest mummy is that of Brother Silvestro da Gubbio, who died in 1599, but recent 20th century examples, including the popular ‘sleeping beauty’ Rosalia Lombardo, are present. Beyond the Palermo Catacombs, other important mummy collections include those at Savoca, Piraino, Gangi, Santa Lucia del Mela, Novara and Burgio. Since 2007, the author of this paper has headed the “Sicily Mummy Project”, aimed at scientifically investigating this important bio-cultural heritage and understanding local mummification practices. In this context, historical sources were also collected in order to gain a deeper view on the mummification phenomenon, its roots, and its significance. This overview will summarize the techniques of bodily preservation employed to obtain mummies, together with the related architectural structures in crypts and subterranean chapels. Findings will be supported by radiological and computer tomographic data which enabled direct inspection and gathering of an amount of bio-anthropological data; and will be additionally supplemented by archival sources and hitherto unpublished evidence describing in detail how cadavers were treated in order to be preserved. This study will shed new light on mortuary practices and funeral variability in the region, as well as provide examples on the excellent embalming skills achieved in the 19th and 20th centuries. An interpretative pattern will be provided, through comparison with the anthropological and sociological literature.

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Métodos de momificación espontánea y antropogénica en Sicilia (1600-1900).

La isla de Sicilia es hogar de un gran número de restos mummificados, que datan desde el siglo XVI hasta el siglo XX de nuestra era, la mayoría de las cuales se encuentran en la célebre Catacumbas Capuchinas de Palermo. Allí, la más antigua momia es la del Hermano Silvèstro da Gubbio, quien murió en 1599, pero más recientes ejemplos del siglo XX, incluyendo la popular “bella durmiente”, Rosalía Lombardo, también están presentes. Más allá de las catacumbas de Palermo, otras importantes colecciones de momias incluyen aquéllas de Savoca, Piraino, Gangi, Santa Lucia del Mela, Novara y Burgio. Desde 2007, el autor ha dirigido el “Proyecto de Momias de Sicilia”, dirigido a investigar científicamente esta importante herencia bio-cultural y entender las prácticas locales de momificación. En este contexto, las fuentes históricas fueron también colectadas para obtener una visión más profunda acerca del fenómeno de la momificación, sus orígenes y su significado.

Esta revisión resume las técnicas para la preservación corporal empleadas para obtener momias, junto con las estructuras arquitectónicas relacionadas a ellas en criptas y capillas subterráneas. Los hallazgos son acompañados por datos radiológicos y tomográficos, los que permitieron inspeccionar y obtener directamente una cantidad de datos bio-anterológicos, y serán adicionalmente suplementados por fuentes de archivos con evidencia inédita que describe en detalle cómo los cadáveres fueron tratados para ser preservados. Este estudio proporciona nueva información acerca de las prácticas mortuorias y variabilidad funeraria en la región, así como proporciona ejemplos de las excelentes habilidades para embalsamar obtenidos en los siglos XIX y XX. Un patrón interpretativo será proporcionado, a través de la comparación con la literatura antropológica y sociológica.
7.5 Predynastic Egyptian Religious Practice: A Case Study in Early Mummification

Jane A. Hill, Ph.D.¹

As part of a detailed study of the University of Pennsylvania Museum’s Predynastic Egyptian collection, an unprovenanced flexed bundle burial (E 16229) has been analyzed and conserved (Hill & Rosado, forthcoming). The initial study, as well as revealing osteological and paleopathological information about the deceased male, uncovered some of the most complete evidence to date of artificial mummification procedures developed in Egypt’s prehistory.

Radiocarbon dating and linen weaving techniques indicate this mummy dates to the Naqada IA to Naqada IIB periods (Dee et al., Table 1; Hendrickx 2006: 92, Table 2; Jones 2008) or 3760-3640 BC. While some of the burial practices recorded with this body are well documented from earlier studies of Predynastic cemeteries – the use of multiple types of linen wrappings, basketry, woven matting and animal skin coverings – other features are indicative of a more complex ritual treatment of the body, perhaps indicative of rituals meant to effect a spiritual transformation as well as bodily preservation. These features include removal of the internal organs to be replaced with padding in the abdominal cavity, the insertion of vertebral column supports, and special treatment of linen wrappings with resins and pigment. Also, there is evidence of the body being packaged in a manner that would make its transportation possible.

Practices encoded in the mummy reveal interesting parallels with Egypt’s first preserved descriptions of mortuary ritual found in the Pyramid Texts. Taken with the growing evidence of ritualized treatment and mummification of the dead in the early Naqada period in Upper Egypt (Jones, et al 2014; Friedman & Maish 1999; Friedman, et al 2002) the implications for the study of the development of Upper Egyptian religion and ritual practice are discussed.

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E16229 wooden support

Cemetery location

Penn Museum E16229
7.6 Looks can be deceiving: fake and composite mummies from a Ptolemaic Period cemetery at Saqqara

Iwona Kozieradzka-Ogunmakin¹

Disposing of the dead in ancient Egypt was a highly ritualized and complex process instigated by religious beliefs that promised eternal life to those who could satisfy a number of specific requirements. The most important of these requirements was the preservation of the body. But what if there was no body to bury or the body itself was, for some reason, incomplete?

A Ptolemaic Period cemetery extending westwards to the Step Pyramid enclosure at Saqqara has yielded more than five hundred burials since excavations began in 1996, among which were four suspicious-looking mummies. Detailed examination of these inhumations delivered surprising findings: the wrappings of one of the mummies (B. 519) contained no more than a few bone fragments commingled with scraps of textile and other materials associated with the mummification process, whereas the other three mummies (B. 415, B. 627 and B. 639) were composed of skeletal elements that belonged to more than one individual.

The finding of composite mummies at Saqqara is not unique to ancient Egypt; evidence of this practice has been reported from other burial sites of the Greco-Roman Period, including Hawara in the Fayum Oasis and Ismant el-Kharab in the Dakhla Oasis.

In this presentation I will explore the purposes and circumstances for making fake and composite mummies at Saqqara.

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Las apariencias engañan: momias falsas y compuestas en un cementerio del periodo Ptolemaico en Saqqara.

La disposición de los muertos en el antiguo Egipto fue un proceso altamente ritualizado y complejo, instigado por creencias religiosas que prometían una vida eterna para aquellos que podían satisfacer una serie de requerimientos específicos. El más importante de éstos fue la preservación del cuerpo. Pero, ¿qué pasaba si no había cuerpo para enterrar, o si el cuerpo por alguna razón estaba incompleto?

Un cementerio del periodo Ptolemáico que se extiende al oeste de la Pirámide Escalonada en Saqqara ha proporcionado más de 500 entierros desde que las excavaciones se iniciaron en 1996, entre los cuales se encontraron cuatro momias de aspecto sospechoso. El examen detallado de éstas proporcionó hallazgos sorprendentes: las envolturas de una de ellas (B. 519) contenía sólo algunos fragmentos óseos mezclados con retazos de textiles y otros materiales asociados con el proceso de momificación; mientras que las otras tres momias (B. 415, B. 627 y B. 639) estaban compuestas por elementos esqueléticos que pertenecían a más de un individuo.

El hallazgo de momias compuestas en Saqqara no es único en el antiguo Egipto; evidencia de esta práctica ha sido reportada en otros lugares de entierro del Periodo Greco – Romano, incluyendo Hawara en el Oasis Fayum e Ismant el – Kharib en el Oasis Dakhla.

En esta presentación exploraré los propósitos y circunstancias para el que se hayan elaborado momias falsas y compuestas en Saqqara.
7.7 A neo-Confucian concept for world after death and accidental mummification in east Asia

Dong Hoon Shin¹, Mi Kyung Song², Ho Chul Ki¹

Studies on Joseon mummies have provided researchers with invaluable scientific data about Korean people and society in history. In fact, amazingly well preserved mummies became one of the best subjects from which we could obtain the information of health and disease status of Joseon people. However, as for the exact mechanism of mummification, Joseon mummies are quite different from other naturally or artificially mummified ones. Rather, Korean mummies are formed by a unique sociocultural factor: the formation of Joseon tombs with lime-soil mixture barrier. Recent reports about mummies in China, those of Song, Yuan, Ming and Qing dynasties, might also be of similar origin from a cultural perspective. Constructing the tombs in accordance with neo-confucianist axioms might have been the socio-cultural background of mummification commonly shared by Korea and China in history.

Actually, the people of both countries did not hope to make their ancestors mummified at all. Constructing the lime-soil mixture barrier around the coffin was to protect the infiltration of insects, plant roots or robbery into the tombs. However, unexpectedly enough, their ancestors were mummified in the tombs by so far unknown mechanism and thus discovered by archaeologists after several hundred years of burial. Natural mummification due to a sociocultural factor: this was the possible cause of mummification observed accidently in some of the pre-modern tombs of East Asian countries.

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El concepto neo-Confuciano del universo después de la muerte y la momificación accidental en el este de Asia

Los estudios realizados en las momias de Joseon han proporcionado a los investigadores datos científicos valiosos acerca de la historia del pueblo y la sociedad coreana. De hecho, estas sorprendentemente bien conservadas momias se convirtieron en los mejores sujetos de los que se podía obtener información acerca del estado de salud y enfermedad de los Joseón. Sin embargo, respecto al mecanismo exacto de momificación, las momias Joseón son muy diferentes de otras ya sea naturales o artificiales. Las momias coreanas fueron formadas por un factor sociocultural único: la formación de las tumbas Joseón con barreras hechas con una mezcla de cal y tierra. Reportes recientes acerca de momias de China, como aquellas de las dinastías Song, Yuan, Ming y Qing, podrían también ser de origen similar desde una perspectiva cultural. La construcción de tumbas de acuerdo a axiomas concordantes con el neo–confucianismo podría haber sido el marco socio–cultural común, compartido por la historia de Corea y China.

En realidad, la gente de ambos países no deseaba momificar a sus ancestros para nada. La construcción de barreras con mezcla de cal y tierra alrededor del ataúd se usaron para protegerlo de la infiltración de insectos, raíces de plantas y robos. Sin embargo, inesperadamente, sus ancestros se momificaron por mecanismos desconocidos y así fueron descubiertos por arqueólogos luego de algunos siglos después de su entierro. La momificación natural causada por un factor sociocultural: ésta puede ser a causa posible de la momificación accidental observada en algunas tumbas pre–modernas de países del este asiático.
There have been limited studies on the bodies of the Aleutian mummies, but little research has been conducted on the cultural context of this practice. I propose that the mummies represent whalers and their lineage members who were affiliated with a clandestine whaling cult. Evidence of such cults can be found in contiguous regions. It is suggested that mummification was reserved for the whaling elite. The Unangax believed in the power that existed in the human body. Mummification preserved that power. Additionally, literature pertaining to the passage between life and death focuses on the liminality of the soul.

This concept is presented as another important element in understanding Aleutian mummification. My research suggests that individuals were deliberately mummified so they could remain in a state of persistent liminality in order to be preserved for their power. Mummification, therefore was a key aspect to whaling. Whalers needed courage and power to hunt whales from a kayak, and this was accomplished through the use of mummified body parts as magical talismans. Hunting with the mummified bodies of their comrades was only one of the secrets of this cult. In my presentation I will reveal the others.

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Las momias Unangax como balleneros: una contextualización multidisciplinaria de la momificación humana en las islas Aleutianas, Alaska.

Ha habido un número limitado de estudios en cuerpos de momias aleutianas, y escasa investigación ha sido realizada en los contextos culturales de esta práctica. Propongo que las momias representan a balleneros y miembros de sus linajes quienes estuvieron afiliados a un culto ballenero clandestino. Evidencias de tales cultos pueden ser encontradas en regiones vecinas. Se sugiere que la momificación fue reservada para la élite ballenera. Los unangax creían en un poder que existía dentro del cuerpo humano. La momificación preservaba este poder. Adicionalmente, la literatura que se ocupa del paso entre la vida y la muerte se concentra en la liminalidad del alma.

Este concepto se presenta como otro elemento importante para entender la momificación aleutiana. Mi investigación sugiere que los individuos fueron deliberadamente momificados de modo que pudieran permanecer en un estado de liminalidad persistente que preservase su poder. La momificación, por lo tanto, fue un elemento clave para la caza de ballenas. Los balleneros necesitan coraje y poder para cazar ballenas desde un kayak, y esto fue logrado a través del uso de fragmentos de cuerpos momificados como talismanes. Cazar con los cuerpos de sus camaradas fue solo uno de los secretos de este culto. En mi presentación revelaré otros.
7.9 See the face: a living history of the cultural/spiritual implications of mummification practices among the Ibaloy of the Kabayan region of the Philippines and the Anga of Papua New Guinea

Ulla Lohmann¹, Ronald Beckett¹, Andrew Nelson², Dario Piombino-Mascali³

The Anga of Papua New Guinea have practiced smoked body mummification for as long as collective memories can recall. Mummification is reserved for those individuals and families who have distinguished themselves in life. In the traditional view, the smoked body practice allows the living to remain connected to their dead. In the past, there has been no after-life construct associated with the dead. However, it is still believed that without the physical connection spirits may ‘circulate’ and become mischievous. An element in this connection appears to be the ability to ‘see the face’. The smoked bodies protect the village by marking territories. Western missionaries have assimilated many Anga into Western after-life belief systems that challenge the traditional practice of mummification. Burials in coffins are now common, yet due to cultural myths associated with ground burials, some elders hope to reestablish the smoked-body tradition. In August of 2015, clan leader of Koke village in the Aseki region, Gemtasu, got his final wish and was mummified according to the smoked-body tradition representing the first known cultural mummification in modern times. The smoked-body tradition currently has several cultural implications on a continuum ranging from traditional constructs to one of mummy tourism.

The Ibaloy of the Kabayan Region of Luzon, Philippines mummified their respected deceased with elaborate ritual and method. Once completed, the mummies were placed within caves in sacred mountains where they are respected as if living. Rituals surround visits to the caves suggesting ancestral respect and a demonstration of the traditional views of the Ibaloy. The ‘spirits’ can become displeased if rituals are not followed causing calamities that afflict a village. The mummified remains provide a cultural identity for the Ibaloy as well as a means of providing income through mummy tourism.

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8.1 Peruvian pre-Hispanic mummy bundles from the central coast: specialization in production techniques with naturally pigmented native cotton

James M. Vreeland, Jr.

The peculiar characteristics of the Peruvian central coast desert ensure an ideal environment for conserving both naturally and artificially mummified bodies. This paper summarizes for the first time research conducted in the 1970s at the Peruvian National Museum of Anthropology and Archaeology, on a half dozen prehispanic mummy bundles recovered from looted cemeteries along the central coast, between the Huaura Valley to the north and the Ica Valley to the south of Lima.

Initial direct and microscopic observations revealed unique information on the fibers employed, bundle construction methods, spinning and weaving techniques used. The unadorned, plain weave shrouds woven from naturally pigmented cotton fibers, required hundreds of kilometers of hand spun yarn. Special looms of an upright configuration of a very robust nature appear to have been used, very different from those associated with fine woven and decorative textiles, employing dyed yarns usually spun from of camelid fibers.

Ethnohistoric and ethnographic investigation of traditional textile manufacture in the Andes conducted by the author and an interdisciplinary team during the following decades, provides new information on which to propose reasonable reconstructions of the textile techniques and production methods presumably employed centuries earlier when the bundles were created and interred. The survival of naturally pigmented native cotton among hand spinners and weavers today may be associated with the ritual uses of the fiber in prehispanic times.

The unique nature of the plain weave mortuary shrouds implies the use of craft technologies of a very complex nature, resembling a kind of pre-industrial craft specialization in mortuary textile production. The hygroscopic properties of the native cotton fibers, loosely spun, suggest intentional fabric constructions to wick away the autolytic body decomposition fluids, propitiating a rapid intentional desiccation in an anaerobic environment not conducive to the reproduction of insect pests usually investing the bodies during the interment process. The scientific opening of additional bundles is needed to further elucidate the nature of specializations in the manufacture of mortuary shrouds not found in any other prehispanic context.
8.2 Good things in small packages: differential inclusions and cloth replicas in Egyptian Mummies

Carter Lupton¹, Jonathan Elias², Sabina Malgora³

In a series of CT projects on Egyptian mummies of several different periods, medium density inclusions of textile matter have been identified. Differential inclusion (DI) is proposed as an analytical term to describe these objects to distinguish them from the wrappings which surround them. Their presence reflects behavior which is deliberate, patterned, and ritually expressive. Despite their rather clear boundaries, such inclusions are frequently overlooked.

Some differential inclusions have distinctive globular shapes found individually or in groups within the bandages, and sometimes within visceral packets. Other DIs belong to rather elaborate constructions of fabric and fibrous cordage. In many cases, they are detectable in axial, sagittal and coronal CT image aspects as if they were carefully positioned. In some cases, they can be characterized as ritual accoutrements (amuletic wrapping features) placed on the body at a critical point in the wrapping process. In this way they are sandwiched within the textile layers comprising the mummy bundle. The existence of such accoutrements (and their relationship to amulets) was noted by Andrzej Niwinski during the disassembly of a damaged mummy from the northern Middle Egypt site of el-Gamhud, (Archeological Museum in Cracow). He felt that these objects, which he termed “cloth replicas” in a 1998 article, were rather atypical. Here we present CT evidence of similar objects on the legs of the Saite Period mummy of Djed-hor (Milwaukee Public Museum 10264). We examine the occurrence of other inclusions in mummies of different periods from the Fayum, Akhmim, and Thebes. We further suggest that the frequency of cloth replicas, amuletic wrapping features, and other differential inclusions is greater than Niwinski originally suspected, and propose a methodology to aid in their identification.

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8.3 Two Byzantine period mummies from Egypt in French museums

Roberta Cortopassi

The French archaeologist Albert Gayet excavated the Roman-Byzantine city of Antinoopolis in Middle Egypt from 1895 to 1911. He sent back to France a huge amount of artefacts, ceramics, woods, textiles and some burials. The material was first presented to the public in temporary exhibitions in Paris and then dispersed among French and European museums or private collections.

Approximately thirty complete mummies are still kept in museum collections in France. Those dating to the Roman period were prepared according to Pharaonic tradition. Some are wrapped in painted shrouds typical of the production of the city; others have a painted portrait on a wooden panel laid over the face, the so-called ‘Fayum portraits’.

The mummies that date to the Byzantine period are fully dressed in everyday clothes and have undergone mummification by natural means, without any human intervention. A team of specialists studied two of these female burials in detail. Analyses included radiocarbon dating (giving a date of 6th-7th century AD) and CT scanning. This paper will focus on the study of clothing and other textiles from the burials.

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8.4 A lady from Deir el-Medina: a case study of multidisciplinary conservation program

Cinzia Oliva¹, Laure Cadot², Rosa Boano³, Matilde Borla⁴

The conservation treatment carried out on the mummy and coffin S. 7715 (XXI Dynasty 990-970 BC) is part of the conservation program launched by the Fondazione Museo delle Antichità Egizie di Torino for the new Museo Egizio. According to ICOM code of ethics all the conservation treatments were based on the “minimal treatment” principle.

The mummy was in a very advanced state of decay, of both the fibers in the bandages and shrouds and in the anatomical structure of the body. The weakening of the fibers allowed the partial protrusion of bones and organic material, which in turn compromised the general structure of the mummy. A hole in the front of the head exposed the skull. X-rays showed a very dismantled skeleton, especially in the thoracic area.

In order to check the back of the mummy, the body was turned over using a special tailor-made shell (made by Marco Samadelli, European Academy/Bolzano). Cadot then proceeded with the conservation of human remains: all the bones of the skull, thoracic cavity and pelvis were removed and documented. Then the reconstruction of the skull as well as the thoracic bones was carried out. These were reorganized into their anatomical position on a conservation support and replaced in the cavity. Internal supports were built to fill gaps and reconstruct the original shape of the body. Once the textile wrappings on the back were replaced, the mummy was turned over to the front. It was then wrapped in a net that had been dyed to match the color underneath, and attached with linen ribbons.

Anthropological examination was carried out in order to assess age at death and sex. Direct observations, supported by radiological images, showed that the body belonged to a young woman aged 20 to 30 years.

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8.5 Reconstructing mortuary traditions at the necropolis of Wari Kayan in early Nasca times: Established ritual and new practices
Ann H. Peters

A cemetery area can include more than one mortuary tradition, as well as tombs from different historic periods. Comparisons in the structure and content of mortuary bundles in the Paracas Necropolis assemblage from the Wari Kayan cemetery areas indicates changes over time associated with different artifact styles. Burials associated with artifact assemblages related in style, technique and imagery to early Nasca are interspersed with earlier mortuary assemblages in both sectors A and B. While most burials share key features of mortuary practice, significant changes in the artifact types included and in mortuary bundle construction are associated with the changes in artifact style.

Comparisons among mortuary contexts associated with artifacts in Nasca-related styles demonstrate regularities in practices of bundle construction as well as unusual forms and changes over time. Body arrangement and certain types of evidence for body preparation are also considered. Comparisons among textiles and other artifacts demonstrate several style groups, some of which appear to characterize polities on the northern margin of Nasca influence while others are closely linked to the core region.

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8.6 Wari imperial funerary customs and rituals: pre-Hispanic necropolis at Castillo de Huarmey

Milosz Giersz¹, Patrycja Przadka Giersz¹, Wieslaw Wieckowski¹, Krzysztof Makowski²

The recent discovery of the Wari royal mausoleum with the first untouched Wari elite women’s tomb at the Peruvian site of Castillo de Huarmey located on the desert coast some 300 kms north of Lima and 4 kms east of the Pacific Ocean, and renowned for the findings of fine tapestries, sheds new light on imperial funerary customs and mortuary architecture during the second part of the first millennium AD. The main chamber concealed 64 individuals accompanied by the most intimate and valuable personal effects: gold and silver jewelry, polychrome ceramics, tools representing each step of the textile technological process and remains of fine textiles. Each elite individual was buried wrapped in a bundle, parts of which were occasionally preserved. Remains of additional multiple naturally mummified individuals were found within the mausoleum perimeter.

The preservation varies due to the postdepositional processes. The chamber was a first stage in the construction of an architectonical complex of the royal mausoleum, which later became a center of the necropolis, consisting of chullpas mausoleums, platforms, passages between them, and stairways. The purpose of this paper is to describe the context of this unique discovery, with the special attention to the role of textiles, and explain sophisticated funerary customs, and rituals in relation to the funerary architecture that served as the physical focus of Wari’s ancestor worship. Using a broad methodological spectrum, including bioarchaeological and biogeochemical analyses, archaeometry, 3D HDS scanning and architectural analysis, the Authors show how the new pan-Andean Wari funerary paradigm helped to facilitate inter-group relationships and new identities established and negotiated by imperial elites.

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8.7 Types of textiles found in the late funerary bundles of the Peruvian central coast

Patricia Landa Cragg

Textiles in ancient Peru were specially valued; used as symbol of power they kept their importance even after the death of the individuals that owned them. They are especially important in the construction of funerary bundles as they constitute more than 80% of the elements that form the funerary package.

Textiles of 29 funerary bundles (20 adults and 9 children) from five sites of the Peruvian Central Coast (especially from the Late Periods of the Rimac and Lurin Valleys) were analyzed and compared. The variables used included position relative to the body, fibers (type, twist, width), textile techniques and evidence of use.

From our analysis we can distinguish three groups of textiles:
- Funerary textiles, specially made to be part of the bundle layers
- Reused textiles, textiles that show evidence of previous use and that have been transformed to be part of the bundle
- Textiles specially made to be part of the funerary offerings of the individual

This study shows that funerary contexts (besides helping us to determine identity) give information about the recurrence in the use of certain textiles. The identification of these recurring textiles can help us to understand funerary contexts even if we deal with groups of disturbed textiles.

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8.8 Gender, social status and power seen through the textiles of the bundle of the Lady of Cao

Gioconda Arabel Fernández López

After the discovery of a very important Moche culture funerary bundle on the upper platform of “Huaca Cao Viejo” in “El Brujo” archaeological complex and due to the exceptional condition in which it was found, a detailed record was possible of its conformation through their respective opening. The funerary bundle was wrapped with several layers of textiles, including many emblematic objects. Inside, the body of a young woman was found with extremely well preserved symbolic tattoos on her face, arms and feet. Both the place in which she was buried as the symbols of power and social status associated with her body, allowed us to propose that she was a woman with a crucial political, social and religious role in Moche society. Today she is known as “The Lady of Cao”

According to our investigation, the textiles of the “The Lady of Cao” bundle were manufactured specifically for mortuary purposes, others were part of the dress and others had symbolic purposes. I will describe the funerary bundle opening, especially the technical and structural characteristics of the textiles with its economic and social implications. Furthermore, I will describe funerary offerings such as textile instruments and raw materials. Finally, with the supporting evidence we are going to develop the relationship between the textile occupation, gender and power.

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8.9 The textiles of the mummy bundles in the Ethnological Museum in Berlin

Lena Bjerregaard

Around 1900 the Ethnological Museum in Berlin build up an extensive collection of Southamerican pre-Columbian artifacts, collected mainly by the German textile merchant Wilhelm Gretzer. During the Second World War the collections were stored in containers around the country and not all the artifacts came back to Berlin after the war. The mummy bundles that did come back, were infested with pests, and some consequently were lost. Today 57 mummy bundles and/or mummies remain. Some were unwrapped in the Museum, and the textiles and other artifacts are now stored separately, but are registered and accessible. The mummies were mainly collected by Baessler, Gretzer and Reiss & Stübel, and are supposed to be mainly from the Central Coast.

All the mummy bundles were x-rayed, and a book about these x-ray analyses was published by the Museum in 1993. A second part containing the analyses of the rest of the mummy bundle materials was proposed (textiles, offerings etc.), but the book was never published.

I was employed in the Ethnological Museum as conservator, responsible for the pre-Columbian textiles from 2000 – 2014. During this time, I analyzed all the textiles on the Museum’s mummies. This included a definition of fibers, techniques and patterns, which can help confirm or deny proveniences and determine cultures of the mummy bundles.

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8.10 ‘Re-rolling’ a mummy: an experimental spectacle

Lidija M. McKnight

The use of textiles as wrapping materials in ancient Egypt was a fundamental element in the ritual transformation of preserved human and animal bodies. Textiles, namely linen, effectively concealed the contents of mummy bundles and disguised the nature of bronze and stone statuettes, making them capable of crossing the boundary between earthly life and the divine. Many artefacts received a complex wrapping treatment with elaborate decoration visible by eye. The application of CT (computed tomography) to wrapped mummy bundles has yielded a wealth of information on the internal construction methods employed.

Due to the nature of early excavation and recording techniques, many artefacts were unwrapped on site, losing much of their original context. In addition, the unwrapping of human mummies became a popular pastime for socialites and philanthropists during the nineteenth-century when numerous reported mummy ‘un-rollings’ were performed.

Current research conducted for the Ancient Egyptian Animal Bio Bank project sought to address the question ‘how easy (or difficult) is it to wrap a mummy?’ The project combines experimental mummification of bird cadavers with evidence obtained from the radiographic study of ancient mummies to suggest how the ancient embalmers might have operated. Attempts at corporeal preservation continue to be largely successful despite the climatic variations between Egypt and Manchester and efforts have now been directed towards the replication of wrapping techniques. Combining the expertise of textile specialists, conservators and artists, a public mummy ‘re-rolling’ was held at Manchester Museum marking the anniversary of the unwrapping of Mummy 1770 some forty years earlier.

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8.11 Joseon textiles from Korean mummies

Dong Hoon Shin¹, Mi Kyung Song²

Mummies from the Joseon Dynasty (AD 1392-1910) are an invaluable subject for scientific studies on the health and diseases of pre-modern Korean people. However, for the past several decades textile investigation has also become an important part of mummy studies in South Korea, as both clothing and mummies are discovered simultaneously in the same Joseon tombs. Whenever archaeologists examined the Korean mummies, they discovered perfectly preserved, magnificent centuries-old textiles and garments. Since the first archaeological report on the clothing from the Joseon tomb discovered in 1964, the documentation produced has grown into one of the most impressive academic collections in the cultural heritage of South Korea.

Removal of the clothing was undertaken under strict, sterile laboratory conditions and each step documented since 2006. By studying these cases, scholars can trace detailed changes in the fashion of Joseon clothing that otherwise might not have been revealed to modern observers. Based upon the acquired data, the clothing currently displayed in museums and institutes could be repaired successfully and maintained meticulously. In this paper, we will present a scholarly reconstruction of a vivid glimpse into the lives and funerary rites of the Joseon Dynasty elite, based on examination of the academic works of the textile historians.

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**8.12 Ritual, religion, function? Multi-disciplinary analysis of funerary wrappings of Egyptian mummies from the prehistoric period, circa 4300-3300 BC.**

Jana Jones¹, Stephen Buckley², Thomas P. G. Higham³, David Chivall³, Raffaella Bianucci⁴, Federica Ugliani⁴, Ron J. Oldfield¹, Gemma L. Kay⁵, Mark Pallen⁵

Belief in perpetual life and preservation of the body was the motivation for continuing attempts by the ancient Egyptians to improve scientific techniques in mummification. A well-preserved, recognizable body was crucial for the deceased to pass successfully into the afterlife. The vast mummification ‘industry’ entailed anatomy, chemistry, pharmacology, manufacture of grave goods and enormous quantities of textiles.

Despite advances in modern scientific analysis, disagreement exists among scholars regarding the development of mummification. Recent biochemical analysis of embalming substances on funerary wrappings dated 4316–3906 calBC in the Bolton Museum, UK has radically revised understanding of the beginnings of Egyptian mummification (Evidence for Prehistoric Origins of Egyptian Mummification in Late Neolithic Burials). Gas chromatography-mass spectrometry (GC- MS) and thermal desorption/pyrolysis (TD/Py)-GC-MS identified complex mixtures of oils, resin and fats. Moreover, these embalming agents constitute complex, processed recipes of similar natural products as those utilized at the zenith of mummification some 3,000 years later.

Subsequently, Mummy S.293 (RCGE 16550), the earliest intact so-called ‘natural’ mummy in the Egyptian Museum (Turin), was – for the first time – subjected to a suite of scientific analyses, including, biochemistry, textile analysis, radiocarbon dating, and metagenomics. Compounds with antibacterial and preservative properties similar to those used at the Neolithic sites some 700 years previously were identified on the wrappings.

This paper will discuss the significance of these findings in the context of ‘natural’ v. ‘artificial’ mummification by deliberate physico-chemical intervention in preservation of the body, and evidence for the ritual that took place before burial in this pre-literate society.

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9.1 The Home of Truth” Commune 1930s Utah, USA: results of experimental application of milk/egg enemas in mummification process.

Gwyn Madden¹, Emma Kemp²

In the mid-1930s spiritualism was all the rave in the eastern United States. Marie Ogden, a wealthy New Jersey widow, traveled west to Southeast Utah to establish The Home of Truth, attracting approximately 100 spiritual followers at its height. When Idahoan Edith Peshak was diagnosed with cancer, she and her husband joined Marie’s band of followers with hope of spiritual healing and moved into a wooden cabin on the commune.

As Edith grew sicker, Marie promised to cure her using her healing powers gifted from the “higher plane”. After months of treatment, including positive mental thinking and the “laying of hands”, Edith died. Marie believed that Edith was not deceased but visiting another astral plane, and so the body was in need of daily feeding and maintenance. Edith was “fed” through egg and milk (protein) enemas 2-3 times a day. Her body was kept in her drafty log cabin, washed with salt water 3-4 times a day, and her bedding changed 2-3 times a day. It is said that during this time Edith looked “normal” with little external alteration. Interestingly, Marie owned the local newspaper and kept a running column of Edith’s status. Locals were concerned by Marie’s column and sent the police to collect Edith’s body. Upon viewing the body, the medical examiner stated that it “posed no public health concern” to the community as it was completely mummified.

While the salt water baths, drafty dry cabin environment, and frequently changed linens speak to a common understanding of mummification, addition of the protein enemas are not understood in regard to the process of mummification. Pig remains were used as a proxy for human remains, following the care and feeding provided for Edith to test the process of mummification with special focus on the changes associated with the protein enemas.

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9.2 The mummies of the “Cervantes Project”, Convent of the Trinitarias Descalzas of Madrid

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During the search for the human remains of the Spanish writer, Miguel de Cervantes in the Convent of the Trinitarias Descalzas of Madrid (Spain), 36 mummified bodies were exhumed from the crypt of the convent. The mummification is natural by dehydration, favored by the environmental conditions of the crypt, except in the case of saponification of a child who was buried in a wooden coffin lined internally with zinc. Another interesting case is a child mummy with her right arm covered by a bandage. Between bands, a sheet copper had been placed, maybe for therapeutic purposes.

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This study demonstrates the difficulties in radiological anthropological studies of mummified remains by focusing on a case of spinal pathology in an ancient Egyptian mummy at the Museo di Anatomia Umana in Pisa. The mummy was CT scanned in 2011 and the scans contributed to the IMPACT Radiological Mummy Database. In reviewing the scans for another study, several spinal abnormalities, unreported in previous studies of the mummy (Caramella et al., 2007; Giuffra et al., 2009; Caramella et al., 2010) were noted. The challenges in the diagnosis of conditions from mummified remains are demonstrated particularly well here, as some of the same conditions in this mummy were correctly diagnosed by the original researchers in other dry bone materials (Giuffra et al., 2010a, b). The goal of this study is not to critique the work of previous researchers, but to demonstrate the need for interdisciplinary consensus and the inclusion of mummy radiology specialists in the analysis of mummified remains and in the differential diagnosis of the pathological conditions within them. This process of diagnosis by consensus is essential to the analysis of these remains, complexly altered through natural and anthropogenic processes in the millennia subsequent to the individual’s death.

We will discuss the challenges that radiography of mummified soft tissues pose in anthropological analysis and review the osteobiographical and diagnostic aspects of the radiological findings in this mummy. The authors propose a diagnosis of DISH, additional signs of undifferentiated spondyloarthropathy, and lumbarisation of S1.

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9.4 Growth and development during the agricultural transition in pre-Hispanic northern Chile

Gail Elliott¹, Siân Halcrow¹, Hallie Buckley¹, Vivien Standen², Bernardo Arriaza²

The bioarchaeological model of health change posits that health deteriorated with the development of agriculture. This model is predominantly based on findings from North American and European populations, reporting that with the advent of agriculture there was an increase in population sizes, unsanitary conditions, and the spread of diseases due to close living conditions and proximity to domesticated animals, all of which had a detrimental effect on physical health. Dependence on plant-based subsistence may have also lowered immune responses, making populations more susceptible to infection and disease. However, some recent work in South America and Asia is challenging this model, suggesting that region-specific factors may influence physiological stress levels.

This paper presents a research proposal on current work that will further test this model. We will assess growth disruption as an indicator for physiological stress in prehistoric infants and children from the Azapa, Camarones, and Lluta coastal valleys of northern Chile. This skeletal sample is perfectly placed to test the model using growth because it contains high numbers of well-preserved infants and children (N=246), representing well-documented pre and post-agricultural cultures that occupied these valleys between ca. 10,000 to 500 B.P. Dental mineralization progress will be evaluated to estimate biological age (because it is fairly resilient to environmental conditions, while long bone growth and dental crown measurements are more sensitive to environmental influences) and will be studied to investigate the effects of the agricultural transition on stress levels.

This research project is funded by a New Zealand Marsden Grant (UOO1413) awarded to Sian Halcrow, and the Ruggles-Gates Fund from the Royal Anthropological Institute in the United Kingdom.

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9.5 The bioarcheome in the anthropocene. A proposal

Otto Appenzeller\(^1\)

Here I advocate the sharing of accumulated bioarchaeological materials and pooling of all relevant data banks. Bioarcheome is a collective term for all bioarchaeological materials and Bioarcheomics is the study of these materials. The Anthropocene is the geological period in which we now live in. The hallmark of this period is the emission of toxins into the biosphere (global air, soil and water). Because the Bioarcheome generally predates the onset of global pollution (Anthropocene), the Bioarcheome provides opportunities for the analyses of human and animal tissues relatively free of large toxic loads.

Modern techniques now widely employed for the analyses of bioarcheological materials, such as DNA analyses and statistical modeling, provide new opportunities to derive useful information for survival of biota including human evolution and health in the Anthropocene. Free sharing of all Bioarcheome data in the Anthropocene, will benefit Bioarcheology and both human and animal well-being. The best use of such data is the establishment of several central repositories that will freely distribute appropriate archived tissue for further study to qualified investigators. Once sufficient data become available bioinformatics, using “dragnet searches”, that is the accumulation of data without prior hypotheses on their eventual use, will allow the formulation of hypotheses about the impact of toxins in the biosphere on human and animal health. Such data will also allow the repurposing of the data in light of current and future needs.

There are several models for scientific data pooling. Such models have benefits and costs but intermediate models between centralized and non-commons exist, and these could be adjusted to fit the need of Bioarcheomics in the Anthropocene. Thus, the clinical power of bioarcheology will affect life in the Anthropocene and contribute to human and animal survival and health in this new geological epoch.

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El bioarqueomo en el antropoceno. Una propuesta.

Aquí abogo por el intercambio de materiales bioarqueológicos acumulados y el uso común de todos los bancos de datos relevantes. Bioarqueomo es un término colectivo para todos los materiales bioarqueológicos, y bioarcheomica es el estudio de estos materiales. El antropoceno es el periodo geológico que ahora vivimos. La característica distintiva de este periodo es la emisión de toxinas en la biosfera (aire global, suelo y agua). En tanto el bioarqueomo generalmente precede a la aparición de contaminación global, el bioarqueomo ofrece oportunidades para el análisis de los tejidos humanos y animales relativamente libres de grandes cargas tóxicas.

Técnicas modernas que se emplean ampliamente para el análisis de materiales bioarqueológicos, tales como análisis de ADN y modelación estadística, ofrecen nuevas oportunidades para derivar información útil para la supervivencia de la biota, incluyendo la evolución humana y la salud en el antropoceno. El intercambio libre de todos los datos del bioarqueomo en el antropoceno, beneficiará tanto a la bioarcheologia como al bienestar humano y animal. El mejor uso de dichos datos es el establecimiento de varios repositorios centrales que distribuirán libremente tejidos archivados adecuados para realizar estudios por los investigadores calificados. Una vez que se acumulen suficientes datos, la bioinformática, usando búsquedas de rastreo, que es la acumulación de datos sin hipótesis previas sobre su eventual uso, permitirá la formulación de hipótesis sobre el impacto de toxinas en la biosfera sobre la salud humana y animal. Tales datos también permitirán la reutilización de los datos a la luz de las necesidades actuales y futuras.

Hay varios modelos para el agrupamiento de datos científicos. Tales modelos tienen costos y beneficios, pero existen modelos intermedios entre el centralizado y no comunes, y estos pueden ajustarse a la necesidad de la bioarcheomica en el antropoceno. Así, el poder clínico de la bioarcheología afectará la vida en el antropoceno y contribuirá a la supervivencia humana y animal y la salud en esta nueva época geológica.
9.6 Metabolism, function and biologic rhythms in feathered dinosaurs

Otto Appenzeller¹, Clifford Qualls², Spencer Lucas³

The energy necessary for life is provided by metabolism, which, in turn, is tied to the rotation of the Earth around the Sun. The rhythmic changes induced by the Sun are circadian (approximately every 24 hours). These have been widely studied. But, additional biologic rhythms exist that extend over several days; they are termed multidien. We measured biologic rhythms (circadian and multidien) of dinosaur’s fossilized feather imprints (~body mass 210-620 grams) from various geological periods. We compared feather growth in one dinosaur glider (~428 grams) to that of dinosaur flyers. We validated our measurements in a contemporaneous wild turkey tail-feather (body mass 5-11 kilograms). Daily growth lines were measured in 9 feather-figures published in the literature. They were: from an enantiornithine bird from China (Mesozoic 245-265 million years), a Sinosauropteryx (Early Cretaceous; ~ 125 million years) and a troodontid theropod (Late Cretaceous ~160 million years). We then measured the growth intervals of the feather rachis imprints and compared all our measurements to the modern feather.

We found measures of daily growth rhythms (circadian rhythms) and multidien rhythms in all feathers. The presumed glider had large feathers, which grew by 18.9 mm/day with a multidien rhythm (36 hours) of 28.5 mm growth. In contrast, all other feathered dinosaurs had a daily feather growth of ~5 mm and a 36-hour growth rate of ~7.5 mm. Wild turkey feathers grew 6.5 mm/day and 9.7 mm in 36 hours. We based our conclusions on statistically identified spectral peaks in feather and rachis growth. We discovered both circadian and multidien rhythms in the fossilized feather imprints of ancient dinosaurs and in extant birds similar to those found in mammals. Therefore, feather growth is related to metabolism during life, to function and to body mass as well, and this suggests a similar metabolism in feathered dinosaurs and modern birds.

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9.7 The “Free Limb Mummies” - are they from the Roman period?

Robert Loynes

A small group of eight mummies with particular external characteristics has been identified by authors such as Raven and Taconis (Raven and Taconis, 2005: 195). The particular characteristics are that all four limbs in the finished artifact are wrapped separately; the facial features are sketched in over the facial region and there are adornments some of which are decorated with patterns including rosettes. Furthermore, in most cases, the wrapping ends at the brow leaving the scalp exposed. It is for the facial appearance and the use of these particular rosette patterns that the mummies have been attributed to the Roman Period.

Examination of CT scans of these mummies reveals that the techniques used in embalming do not conform to those used in many other mummies from this period. This comment applies to the techniques of excerebration, the preparation of other features of the head and to evisceration and the materials used to pack the cranial and trunk cavities. All aspects of mummification have been examined through the medium of the CT scans – by personal analysis in most cases otherwise from the literature where available. Illustrations of these characteristics of embalming will be shown in order to differentiate them from other Roman Period examples. The implications of these variations will be discussed, as will the possible explanations for this phenomenon.

¿Las “Momias de Extremidades Libres” son del periodo Romano?

Un pequeño grupo de ocho momias con características externas particulares ha sido identificado por autores como Raven y Taconis (Raven y Taconis, 2005:195). Las características particulares son que las cuatro extremidades en el objeto terminado se envuelven por separado; las características faciales se bosquejan sobre la región facial y hay adornos, algunos de las cuales están decoradas con motivos como rosetas. Además, en la mayoría de los casos, la envoltura se termina en la frente, dejando el cuero cabelludo expuesto. Es por la apariencia facial y el uso de estos patrones particulares de roseta que las momias se han atribuido al periodo romano.

El examen de las momias mediante escaneo de tomografía computarizada (CT) revela que las técnicas de embalsamamiento no se ajustan a las utilizadas en muchas otras momias de este periodo. Este comentario se aplica a las técnicas de descerebración, la preparación de otras características de la cabeza y la evisceración, así como otros materiales utilizados para envolver el cráneo y las cavidades del tronco. Todos los aspectos de la momificación han sido examinados a través de exploraciones con CT, mediante un análisis personal en la mayoría de los casos, o a partir de la literatura donde era posible. Se mostrarán las ilustraciones de estas características de embalsamamiento a fin de diferenciarlas de otros ejemplos del periodo romano. Se discuten las implicaciones de estas variaciones, así como las posibles explicaciones de este fenómeno.

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9.8 Mortui viventes docent: A novel workshop format to teach young scientists on best practice in ancient Egyptian human remains research

Frank Rühli¹, Salima Ikram², Khaled El-Enany³

A lot of researchers deal with ancient Egyptian human remains, both in Egypt and abroad. However, hitherto there is no an established format on how to train young scientists about the best way to work with ancient mummies. The aim of this presentation is to outline the novel format of a four-day training workshop specific for this, which took place in February 2016 in Cairo, Egypt. Being organized jointly by the American University Cairo, Institute of Evolutionary Medicine University of Zurich, the Egyptian National Research Center and the National Museum of Egyptian Civilization as host institution, this initiative aimed to introduce curators to the issues surrounding handling mummies and bones.

The workshop consisted of lectures on topics such as handling and storage of human remains, mummification types, ethics of mummy research, imaging pitfalls, histology and state of-the-art in ancient DNA applications. Additionally, hands-on sessions included topics such as packing and moving these artifacts, and the use of a portable digital x-ray unit for in situ diagnostic imaging. A particular focus is laid on the exposure of the participants to typical examination methods and its eventual best practice in real situations. Participants were mainly archeologists/scientists at master level. The international and national faculty members are all senior mummy researchers with a wide variety of professional background (MSc, MD, PhD). It is planned to run such a workshop in the future as needed. This novel initiative shall represent a sincere approach of sustainable knowledge transfer to a most promising new generation of local researchers.

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9.9 Third Intermediate to Roman Period heads from Abusir El Meleq: a glimpse at mummification in Middle Egypt

Raffaella Bianucci¹, Jana Jones², Dong Hoon Shin³, Carl Heron⁴, Do Seon Lim⁵, Ron Oldfield⁶, Michael Francken⁷, Katerina Harvati⁸, Johannes Krause⁹

Mummification is the process by which the post-mortem decomposition of soft tissue is significantly arrested. Multiple investigations were carried out on Third Intermediate to Roman Period mummified heads from Abusir el-Meleq, a site located at the mouth of the Fayum Depression. The objectives were to ascertain: i. their degree of preservation; ii. the presence of falciparum malaria histidine-rich protein type II (PfHRP-2); iii. the type of funerary treatment (e.g. embalming recipes, wrappings). Apart from sample #1622, morphological investigations showed that the heads had a moderately good state of preservation of collagen. Specific structures such as adipocytes (#1564, #1608) and blood vessels (#1585, #1543), whose lumen is filled with debris, could be identified. From a pathological perspective, an attempt at identifying the Pf HRP-2 was performed and failed.

In situ hybridization of P. falciparum ancient DNA from the lumen of blood vessels is on-going. With reference to the funerary treatments, macro and micro observation showed that the accessible textile wrappings were flax, the majority in tabby (plain) weave, ranging from fine to medium-coarse density. The yarns were spun in the ‘S’ direction, consistent with Egyptian Dynastic technology. Sample #1544 was a ‘basket’ weave, typically found in Roman Period contexts. Sample #1564 showed residue of gilding. Close similarities between the substances associated with each head - plant oil or a mixture of plant oils in some cases associated with animal fat, lower levels of highly oxidized conifer resin, phenolic acids and sugar- were identified, showing a certain degree of continuity in the embalming practices in this region over more than nine hundred years.

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Cabezas del Tercer Periodo Intermedio al Periodo Romano de Abusir El Meleq: un vistazo a la momificación en el Egipto Medio

La momificación es el proceso por el cual se detiene significativamente la descomposición post-mortem de tejidos blandos. Se llevaron a cabo múltiples investigaciones en cabezas momificadas del Tercer Periodo Intermedio al Periodo Romano, procedentes de Abusir el-Meleq, un sitio ubicado en la desembocadura de la depresión de Fayum. Los objetivos fueron determinar: i. su grado de conservación; ii. la presencia de proteína tipo II rica en histidina de falciparum malaria (PfHRP-2); iii. el tipo de tratamiento funerario (por ejemplo, métodos de embalsamiento, tipos de envolturas). Aparte de la muestra #1622, las investigaciones morfológicas demostraron que las cabezas tenían un estado relativamente bueno de conservación del colágeno. Se pudieron identificar estructuras específicas como adipocitos (#1564, #1608) y vasos sanguíneos (#1585, #1543), cuyo contenido está lleno de desechos. Desde una perspectiva patológica, se realizó un intento de identificar el Pf HRP-2 y no se pudo.

Está en curso la hibridación in situ del ADN antiguo de P. falciparum del lumen de los vasos sanguíneos. Con referencia a los tratamientos funerarios, las observaciones a nivel macro y micro demostraron que las envolturas textiles accesibles fueron de lino, mayormente en tejido lino, con densidades desde fina hasta medianamente gruesa. Los hilos estaban torcidos en dirección S, lo cual es compatible con tecnología egipcia dinástica. La muestra #1544 fue un tejido de “canasta”, encontrado típicamente en los contextos del Periodo Romano. La Muestra #1564 muestra restos de material dorado. Se evidenció una estrecha semejanza entre las sustancias asociadas con cada cabeza, como aceite vegetal o una mezcla de aceites vegetales en algunos casos asociados a grasa animal, niveles bajos de resina de coníferas muy oxidada, ácidos fenólicos y azúcar, mostrando un cierto grado de continuidad en las prácticas de embalsamamiento en esta región por más de novecientos años.

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9.9 Third Intermediate to Roman Period heads from Abusir El Meleq: a glimpse at mummification in Middle Egypt

Raffaella Bianucci¹, Jana Jones², Dong Hoon Shin³, Carl Heron⁴, Do Seon Lim⁵, Ron Oldfield⁶, Michael Francken⁷, Katerina Harvati⁸, Johannes Krause⁹

Mummification is the process by which the post-mortem decomposition of soft tissue is significantly arrested. Multiple investigations were carried out on Third Intermediate to Roman Period mummified heads from Abusir el-Meleq, a site located at the mouth of the Fayum Depression. The objectives were to ascertain: i. their degree of preservation; ii. the presence of falciparum malaria histidine-rich protein type II (PfHRP-2); iii. the type of funerary treatment (e.g. embalming recipes, wrappings). Apart from sample #1622, morphological investigations showed that the heads had a moderately good state of preservation of collagen. Specific structures such as adipocytes (#1564, #1608) and blood vessels (#1585, #1543), whose lumen is filled with debris, could be identified. From a pathological perspective, an attempt at identifying the Pf HRP-2 was performed and failed.

In situ hybridization of P. falciparum ancient DNA from the lumen of blood vessels is on-going. With reference to the funerary treatments, macro and micro observation showed that the accessible textile wrappings were flax, the majority in tabby (plain) weave, ranging from fine to medium-coarse density. The yarns were spun in the ‘S’ direction, consistent with Egyptian Dynastic technology. Sample #1544 was a ‘basket’ weave, typically found in Roman Period contexts. Sample #1564 showed residue of gilding. Close similarities between the substances associated with each head - plant oil or a mixture of plant oils in some cases associated with animal fat, lower levels of highly oxidized conifer resin, phenolic acids and sugar- were identified, showing a certain degree of continuity in the embalming practices in this region over more than nine hundred years.

In situ hybridization of P. falciparum ancient DNA from the lumen of blood vessels is on-going. With reference to the funerary treatments, macro and micro observation showed that the accessible textile wrappings were flax, the majority in tabby (plain) weave, ranging from fine to medium-coarse density. The yarns were spun in the ‘S’ direction, consistent with Egyptian Dynastic technology. Sample #1544 was a ‘basket’ weave, typically found in Roman Period contexts. Sample #1564 showed residue of gilding. Close similarities between the substances associated with each head - plant oil or a mixture of plant oils in some cases associated with animal fat, lower levels of highly oxidized conifer resin, phenolic acids and sugar- were identified, showing a certain degree of continuity in the embalming practices in this region over more than nine hundred years.
9.10 Mummified remains from tomb K93.12 at Dra’ Abu el-Naga, Thebes, Egypt

Sandra Lösch¹, Ute Rummel², Albert Zink³

Human remains from tomb K93.12 in the ancient Egyptian necropolis of Dra’ Abu el-Naga were analyzed. It is located opposite to the modern city of Luxor in Upper Egypt on the western bank of the Nile. Archaeological findings indicate that the rock tomb was originally built in the early 18th dynasty. Remains of two tomb-temples of the 20th dynasty and the looted burial of the High Priest of Amun Amenhotep have been identified. After the New Kingdom the tomb was reused as a burial place until the 26th dynasty. The skeletal and mummified material of the different tomb areas underwent a detailed anthropological and paleopathological analysis. The human remains were mostly damaged and scattered due to extensive grave robberies.

In total, 79 individuals could be partly reconstructed and investigated. The age and sex distribution revealed a male predominance and a high percentage of young children (< 6 years) and adults in the range of 20 to 40 years. The paleopathological analysis showed a high prevalence of stress markers such as cribra orbitalia in the younger individuals, and other pathological conditions such as dental diseases, degenerative diseases and a possible case of ankylosing spondylitis. Additionally, 13 mummies of an intrusive waste pit could be attributed to three different groups belonging to earlier time periods based on their style of mummification and materials used. The study revealed important information on the age and sex distribution and diseases of the individuals buried in tomb K93.12.

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9.11 His Flesh is Slain’: fear of decay as the origin of Egyptian mummification

Jasmine Day

New discoveries have recently been made about the materials and procedures associated with ancient Egyptian mummification and the antiquity of the process. Less research has been conducted into the reasons for its development, direct evidence for which is lacking. Inferences have been drawn that mummification originated as an imitation of the natural dehydration of bodies buried in sand or as a means to preserve the bodies of elite persons during prolonged funerary rituals prior to burial. However, ethnographic analogy could lend greater insight into the sociocultural and emotional motivations for Egyptian mummification.

A seminal anthropological theory developed through companions between the mortuary rituals of various traditional cultures suggests that death is often conceived as being “outside of nature” rather than part of it, an aberration to be symbolically defeated by funerary rituals (M. Bloch and J. Parry, “Introduction” in M. Bloch and J. Parry eds 1982, Death and the Regeneration of Life). Through comparative eschatology using evidence from funerary spells and mythology, it will be suggested that the Egyptians likewise regarded decay of the body as not merely abhorrent, but abnormal, an insidious force to be suppressed through preservative technology.

Su carne está muerta: el miedo a la decadencia como el origen de la momificación egipcia.

Recentemente se han hecho nuevos descubrimientos sobre los materiales y procedimientos asociados con la antigu.a momificación egipcia y la antigüedad del proceso. Menos investigación se ha realizado sobre las razones de su desarrollo, sobre lo cual se carece de evidencia directa. Se han formulado inferencias acerca de que la momificación se originó como una imitación a la deshidratación natural de cadáveres enterrados en arena o como un medio para preservar los cuerpos de personas de élite durante rituales funerarios prolongadas antes del entierro. Sin embargo, la analogía etnográfica podría prestar una mayor visión de las motivaciones socioculturales y emocionales de la momificación egipcia.

Una teoría antropológica fundamental desarrollada a través de acompañantes entre los ritos mortuorios de varias culturas tradicionales sugiere que la muerte es a menudo concebida como “fuera de la naturaleza” en lugar de parte de ella, una aberración que debe ser derrotada simbólicamente por los rituales funerarios (M. Bloch y Parry J., “Introducción” en M. Bloch y Parry J. eds 1982, La muerte y la regeneración de la vida). A través de la eschatología comparativa, utilizando evidencias de ensalmos funerarios y de la mitología, se sugiere que los egipcios también miraron la descomposición del cuerpo no solo como meramente abominable, sino anormal, una fuerza malévola que debía ser suprimida mediante tecnología de preservación.

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10.1 A paleogenomic perspective on the population history of the central Andes and the peopling of South America

Lars Fehren-Schmitz¹, Kelly M. Harkins¹

Recent technological advance in molecular genetics opened up new and exciting opportunities for paleogeneticists to gain insights into prehistoric population dynamics and the evolutionary adaptability of our species inconceivable just a few years ago. However, ancient DNA research in South America so far has been mostly restricted to the analysis of the mitochondrial control region and samples 5000 years old and younger. While these studies have increased our understanding of the pre-Columbian population history, inferences have been restricted to female population dynamics and have not allowed us to address relevant aspects like admixture and selection properly. Here, we present genome wide data from over 100 pre-Columbian South American individuals and complete mitochondrial genomes from over 200 individuals deriving from different archaeological sites dating from 9000 BC to the late pre-Colonial period. Ancient DNA genomic libraries were analyzed employing both shotgun sequencing and targeted hybridization capture approaches. We compare this data with genome-wide data from ancient and modern Native American populations and relate our results to previous ancient DNA studies to evaluate in how far the new data resolution positively contributes to our understanding of South American population history. We report new insights into the ancestry of early Andean highlanders, population relationships, and admixture events that help us to better understand the interaction of Central Andean groups with other regional populations of South America. Furthermore, we identify that selection must be considered as one of the driving factors of the adaptation to hypoxia in the Central Andean highlands.

All presented research projects are cooperative efforts between the UCSC Paleogenomics Lab (Fehren-Schmitz), the Harvard Medical School (D. Reich), the MPI for the Science of Human History (J. Krause, W. Haak), and the Australian Centre for Ancient DNA (A. Cooper, B. Llamas).

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10.2 Ancient Mycobacterium tuberculosis genomes suggest re-adaptation to pre-Columbian human populations

Johannes Krause1, Kirsten Bos1, Alexander Herbig1, Sebastien Gagneux2, Jane Buikstra3, Anne C. Stone3

Tuberculosis had a significant impact on the cause of Human History in the Old as well as the New World. Here we discuss the evolutionary history of the causative agent of the disease, Mycobacterium tuberculosis, by exploring the distribution and phylogenetic relationship of the bacterial strains today and in the past. We focus in particular on ancient mycobacterial genomes isolated and reconstructed using hybridization capture of DNA from 1000-year-old human remains found in the Americas. We find them most closely related to M. pinnipedii, the causative agent of tuberculosis in seals and sea lions and a member of the mycobacterium tuberculosis complex (MTBC).

This finding emphasizes the potentially important role of sea mammals disseminating disease across the ocean. We discuss various hypotheses about the potential zoonotic transmission, re-adaptation as well as replacement of ancient pre-Columbian mycobacterial strains in the New World. Using ancient mycobacterial genomes as tip-calibration points for the molecular clock we calculate in at least two independent dating analyses a most recent common ancestor of all MTBC strains less than 6000 years old, implying a Holocene dispersal of the pathogen and a rapid host adaption to various mammalian species including humans.

Genomas antiguos de Mycobacterium tuberculosis sugieren una re-adaptación de las poblaciones humanas pre-Colombinas

La tuberculosis ha tenido un impacto significativo tanto en la historia del Viejo Mundo, así como del Nuevo Mundo. En este estudio, discutimos la historia evolutiva del agente causal de esta enfermedad, Mycobacterium tuberculosis, al explorar la distribución y relaciones filogenéticas de las cepas bacteriales modernas y antiguas. Nos enfocamos específicamente en genomas antiguos de Mycobacterium aislados y reconstruidos usando captura por hibridación de ADN en restos humanos de 1000 años de antigüedad hallados en las Américas. Encontramos que estos, se encuentran relacionados más próximamente a M. pinnipedii, el agente causal de tuberculosis en focas y leones marinos y miembro del complejo Mycobacterium tuberculosis (MTBC).

Este hallazgo enfatiza el importante rol potencial de los mamíferos marinos en la disseminación de la enfermedad a través del océano. Discutimos varias hipótesis a cerca de las potenciales transmisiones zoonóticas, la re-adaptación, al igual que el reemplazo de cepas precolumbias antiguas en el Nuevo Mundo. Usando genomas mycobacteriales antiguos como puntos de calibración terminales para el reloj molecular, calculamos, en al menos dos análisis de datación independientes, que el ancestro común más reciente de todas las cepas de MTBC es menor a 6000 años de antigüedad, lo que implica una dispersión Holocénica del patógeno y una rápida adaptación del huésped a varias especies de mamíferos incluyendo los humanos.

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10.3 Reconstruction of a 5300-year-old Helicobacter pylori genome from the Iceman’s stomach

Albert Zink1, Frank Maixner1, Ben Krause-Kyora2, Dmitrij Turaev3, Alexander Herbig4, 5, Michael R. Hoopmann6, Janice L. Hallows6, Ulrike Kusebauch6, Eduard Egarter-Vigl6, 7, Peter Malfertheiner6, 7, 8, Francis Megraud8 Niall O’Sullivan10, Giovanna Cipollini10, Valentina Coia10, Marco Samadelli10, Lars Engstrand11, Bodo Linz12, Robert L. Moritz6, Rudolf Grimm13, Johannes Krause4, 5, Almut Nebel14, Yoshan Moodley15, Thomas Rattei9, 16

The stomach bacterium Helicobacter pylori is one of the most prevalent human pathogens. It has dispersed globally with its human host resulting in a distinct phylogeographic pattern that can be used to reconstruct both recent and ancient human migrations. The modern H. pylori strain found in most Europeans (hpEurope) is thought to have originated from recombination of the two ancestral populations Ancestral Europe 1 and 2 (AE1 and AE2).

In this study, we analyzed biopsy samples from the gastrointestinal tract of the mummy of the 5300-year-old South Tyrolean Iceman. By using metagenomic diagnostics and targeted genome capture, we determined the presence of H. pylori and reconstructed its complete genome. Retrieved unambiguous reads mapped to 92.2% of the reference genome with an 18.9-fold average coverage. Subsequent sequence analysis classified the ancient H. pylori as a virulent strain that is now associated with inflammation of the gastric mucosa. Using a proteomics approach, we identified the two subunits of calprotectin that were probably released as a result of host inflammatory immune responses.

Comparative analysis of ancient housekeeping gene fragments with a global multilocus sequence typing (MLST) database and comparative whole-genome analyses assigned the 5,300-year-old bacterium to the modern population hpAsia2 commonly found in Central and South Asia. A high-resolution analysis of ancestral motifs in the Iceman H. pylori strain showed low levels of ancestry with AE2, which suggests that most of the AE2 ancestry observed in hpEurope today is a result of AE2 introgression into Europe after the Copper Age, which is later than previously proposed. Taken together, we suggest that the Iceman H. pylori strain belonged to a population that was present in Copper Age Europe that was different to hpEurope today. Moreover, our analyses indicate a co-ancestry of the ancient and most European hpEurope strains, despite millennia of AE2 introgression.

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Symposium 11. Animal mummies

Chair:
Salima Ikram, American University in Cairo, Egypt.

11.1 Burials of dogs and humans in Huaca 33, Complejo Maranga, Lima, Peru

Karina Venegas Gutiérrez¹, Lucenida Carrión Sotelo¹

For the Late Intermediate Period (1000 – 1400 a.C.) Huaca 33, a building modeled adobes, built during the Early Intermediate Period (300 - 600 a.C.) and would have been public functions; It was abandoned and used as a burial place of humans and dogs. During the years 2012 - 2013, the División de Arqueología del Parque de las Leyendas; under the direction of Licensed Lucenida Carrion Sotelo, conducted excavations in the Huaca 33, recovering more than one hundred remains of burials of humans and a similar number of dogs, found in a layer of boulders over a meter thick covering the building. Most of the dogs were found as to rest, lying on his belly or any of its sides and were buried with objects associated as canes, cotton or vegetable fiber ropes. Physical analyzes on a sample, it was determined that are dogs with hair, of different ages and both sexes.

Some of the dogs were found mummified, apparently naturally; to be wrapped in cotton textiles. In the case of humans, some have been found wrapped in textiles, others using loincloth or robes. Bioanthropological analyzes on a sample, showed that most were between 20 and 30 years old and peri-mortem trauma injuries, mainly in the head or chest. These results lead us to propose a shared human cemetery with the burial of dogs; another possibility is that dogs are been left as offerings to humans; which, peri-mortem trauma injuries, have died violently.

The investigations are still continuing, so more questions and answers await us.

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Radiographic imaging is the go-to technique for the study of mummified remains, providing the ability to see inside wrapped mummy bundles non-invasively. Visualising the contents of animal mummy bundles using radiography alone can be problematic. Desiccation, level of preservation and their wrapped presentation, coupled with the limitations of clinical imaging techniques and the wide range of species represented, all exacerbate this issue. However, this can be further complicated if the animal mummy being studied is presented inside a container or coffin.

Votive animal mummies, those created in huge numbers as gifts for the gods, were interred in a range of materials, yet retain their portability due to their small size. This differs from human mummies, where size and weight restrictions only allow cartonnage and wooden containers to be imaged successfully using clinical equipment. This variety presented some challenges for researchers at the University of Manchester: the nature of the materials (both the container and its contents), particularly their proximity to the elements under investigation, prevented ease of visualisation. The placement of animal remains within bronze, ceramic, wood, cartonnage and stone containers, as well as the Victorian penchant for placing curios within glassware for display, will be explored, highlighting the strengths and limitations of clinical imaging and visualisation techniques.

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11.3 The Great Ape Wet Collection at the Smithsonian Institution

Bruno Frohlich1,2, Darrin Lunde1, Christine France1, Christina Wurst3, David Hunt1, Samuel Wann4, Randall Thompson5

Of the more than 140 million objects curated by the Smithsonian’s 16 museums, one zoological garden, and several research stations, the items at the Museum Support Center in Maryland are the most diverse and hold the greatest research potential. One such fascinating collection is the Great Ape ‘Wet’ Collection curated by the National Museum of Natural History’s Mammal Division. More than 40 gorillas (Gorilla), Chimpanzees (Pan), and orangutans (Pongo) are preserved in alcohol and stored in large stainless steel tanks. Over the more than 100 years of collecting, these specimens have been utilized for numerous studies, and most recently a systematic survey with the research being conducted by the Horus team (atherosclerosis).

As would be expected, a collection used this extensively by scientists for decades will have been compromised in their pristine form by removal of internal organs, dissection, and the mixture of several specimens stored in the same containers. Presently we have CT scan data for 38 of these great apes: thirteen chimpanzees, ten gorilla, fourteen orangutans and one unknown - representing twenty-one males, eight females and nine with unknown sex. The age distribution is: eighteen adults, twelve sub-adults, and eight with unknown age. Tissue samples have been collected for aDNA, stable isotopes, histological studies and hair analyses. Based on available, but tentative records - two are zoological garden specimens, eight from the ‘wilds’, and twenty-eight with tentatively unidentified places of origin. The study of provenance and origin for each of the animals is essential to our research, thus additional exploration of archival data is needed.

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11.4 Application of high resolution CT scanning in the nondestructive study of Egyptian animal mummies and wet preserved great apes

M Linda Sutherland MD1, Bruno Frohlich PhD2, James D Sutherland MD MS3, Samantha L Cox PhD4, L Samuel Wann MD5, Gregory S Thomas MD MPH6, Randall C Thompson MD7, Adel Allam MD8, Caleb E Finch PhD9

High resolution CT scanning has been used successfully in the past decade to nondestructively evaluate ancient human remains.

In June 2011, the New York Animal Medical Hospital in NYC, CT scanned 33 animal mummies from the Egyptian collection housed at the Brooklyn Museum. In January 2014, the Horus Research Group applied the same high resolution CT scanning technique in the nondestructive assessment of 28 wet preserved Great Apes housed at the museum support center of the National Museum of Natural History at the Smithsonian Institute as part of an atherosclerosis study in great apes.

The CT scans of the Egyptian animal mummies were reviewed by a team of human and animal radiologists and museum curators from the Brooklyn Museum. The CT scans of the wet preserved great apes were reviewed by a multidisciplinary team of cardiologists, radiologists, biologists, archaeologists, and anthropologists from the Horus Study Group.

3D multiplane and 3D volume reconstruction of the CT scans will be presented to demonstrate some of the unusual and/or unexpected results found within the Egyptian animal mummies and the wet preserved great apes.

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Symposium 12. Radiography in bioarcheology

Tribute to Marvin Allison†

Chairs:
James N. Skufis, Washtenaw Community College, USA
Sonia Guillén, Centro Mallqui, Peru

12.1 Autopsy of a tuberculoid Chachapoya-Inca mummy: implications for differential diagnosis

Andrew Nelson¹, Sonia Guillén², Gerald C. Conlogue³, Ramona González³, Peter Zadori³, Anthony Bravo

The diagnosis of tuberculosis in human remains from PreColumbian contexts in the Andes continues to be the object of debate. It is clear that TB was present in at least late PreColumbian times, possibly derived from a pinniped reservoir (Bos et al 2014). The initial differential diagnosis often focuses on the presence of vertebral lesions. We present the results of the radiological survey and subsequent autopsy of an incomplete Chachapoya-Inca mummy (CMA 218) who we believe suffered from TB. The mummy dates to the Inca conquest of the Chachapoya territory, a female probably 40+ years of age. The remains of this funerary bundle and mummy were partially destroyed by looters, only the head, the trunk and the right arm and leg remained attached, while the wrappings were affected by machete cuts and mud. The unsatisfactory conservation conditions led to the separation of materials after x-rays were taken.

This individual was flagged on a radiographic survey (Guillen et al 2004) as having calcified nodes in her chest, neck and pelvis, which correspond to locations of “popcorn lesions” pathognomonic of tuberculosis. However, this individual does not demonstrate any vertebral lesions – indeed her spine suggests a much younger age than her teeth and pubic symphyses.

In this paper, we review the bioarchaeological differential diagnosis of TB in a mummified individual. In particular, we focus on the radiological component of the diagnosis, supplemented by the evidence yielded by autopsy of the mummy.

In conclusion, we recommend that semi-standardized radiographic projections (allowing for body position) be captured of any PreColumbian whole mummy. Such systematic collection of radiographic data will allow for a more objective discussion of the presence of TB in PreColumbian individuals.

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12.2 X-raying mummies for registry, conservation and education. Fifteen years of collaboration between Washtenaw Community College and Centro Mallqui in Ilo, Peru

James Skufis¹, Sonia Guillén²

Conventional radiography has been widely employed in the field of bioarcheology because of what it can help to reveal. Unfortunately, radiographic imaging of cultural remains at the point of excavation or study can be logistically challenging, so the timely information which could be yielded from it may be missing when decisions are made concerning the study, cataloging, storage, conservation, and/or display of a specimen. The immediate availability and use of screen-film radiography during excavations at Centro Mallqui-Ilo, Peru has altered the processing, study, and eventual disposition of the mummified remains of the Chiribaya and other cultures developed in the lower Osmore River Valley.

This paper details the unique conditions in the Atacama desert and specifically in the Osmore valley which result in a wealth of biocultural remains, as well as the relationship between the researcher, the radiographer and the equipment used, including the benefits of quick access to radiography and how this early imaging can impact the study of an individual mummy or collection. A pivotal case study of a mummy bundle recovered in 2008 will be discussed to illustrate the advantages of early imaging for these studies.

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2. Centro Mallqui
12.3 Experimental Mummification Project: CT analysis of cancer in mummified material

Jennifer Willoughby¹, Casey Kirkpatrick¹, Jim Koropatnick¹,², Andrew Nelson¹

Cancers and neoplastic diseases are highly present in our world today, and according to an increasing volume of bioarchaeological and historical research, it is probable that cancer also affected many people in the past. Most published case studies of ancient cancer record tumors or neoplastic disease in skeletal remains. However, mummified human remains have the potential to preserve soft tissue tumors, thus providing a more complete picture of the presence of cancer in the ancient world. Non-invasive methods such as CT imaging provide information on the internal structures of mummies, but identifying cancer in mummified human remains can be difficult for several reasons, one of them being that cancerous tissues likely undergo changes during and long after the mummification process. The effects of natural and anthropogenic mummification on soft tissue tumors are unknown and could affect the appearance of tumors in mummies examined through CT imaging analysis.

An experimental mummification project was undertaken by the authors in order to understand how cancerous tissues change in different mummification scenarios. Mice (provided by a cancer research laboratory) that contained human tumors were mummified in four different cultural and environmental conditions: 1) anthropogenic mummification in the ancient Egyptian style, 2) natural desiccation using a controlled heat source, 3) frozen at a static temperature, and 4) naturally preserved in an anaerobic bog environment. Prior to mummification, the mice were documented using a microCT scanner, and they were scanned again at intervals after the mummification process was complete. The size and shape of the tumors were documented in each scan, along with changes in the radiological appearance of different tissues. This research demonstrates the value of experimental mummification projects to paleopathological research, especially regarding the study of cancer in the ancient world.

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12.4 Mineral inclusions in a corpse frozen long ago in a Canadian glacier: X-ray spectrometry of the lung tissue

Maria Victoria Monsalve¹, Yueyang Shen, David Walker, Elaine Humphrey

In August 1999, hunters found the frozen remains of an approximately 18-year-old male melting out of a glacier in the northwest corner of British Columbia. His clothing and bone collagen were carbon dated 150-300 years old. Our objective was to use scanning electron microscopy combined with X-ray spectroscopy and elemental mapping to identify chemical composition of minerals found in the lung tissue of the remains. Raman spectroscopy had already indicated the presence of minerals (likely conglomerates). We were able to determine the composition of the inclusions (carbon particles, calcium, iron, gold, and magnesium).

Presence of elements such as carbon and oxygen was expected, as they are part of the normal composition of a human body. Silicon and aluminum were found but not embedded the tissue and may indicate contamination. Our findings gave us clues to the chemical elements that comprise the minerals previously found with Raman spectroscopy. Presence of gold and lead may suggest particles inhaled to his lungs. Minfiles for locations near the discovery site report existence of minerals containing the chemical elements that we found in the lung tissue and could explain the origin of some of our findings.

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12.5 A modern cultural mummification. Gemtasu’s final wish and the smoked body tradition of the Anga of Papua New Guinea

Ulla Lohmann1, Ronald Beckett1, Andrew Nelson2

Papua New Guinea is one of the nations of the world where Western influences have been slow to permeate traditional cultures. The remoteness of villages along with the geographic and linguistic barriers, and fierce traditions are responsible for slowing the encroachment of Western ideals. The smoked body mummification practice has been the tradition for preserving the dead for as long as the collective Anga can remember. Western missionaries discouraged the practice and substituted in-ground burials as conversion efforts progressed. However, there are those among the Anga who wish to maintain the traditional ways. Gemtasu, clan leader of Koke Village in the Aseki region, expressed his desire to become a smoked body to sit alongside his father and other ancestors on the cliff niche 1000 feet above their village.

Gemtasu was told by the missionaries that this was against the law. One of the authors (UL) facilitated legal arrangements that allowed Gemtasu to be mummified according to tradition upon his death. Gemtasu made sure his family and clan members understood the process by creating smoked bodies from forest pigs so that when the time came he could be mummified. In previous expeditions the authors were able to witness, study and record these smoked body procedures. In August of 2015, Gemtasu died, and his family carried out his wishes.

One of the authors (UL) was an eye-witness to the smoked body procedure of Gemtasu who now sits with his father on the cliff niche. Local oral reports suggest that other clans in remote PNG continue the tradition of smoked body mummification.

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13.1 Age and sex: their relationship in the funerary treatment as a feature of identity in a sample from the Necropolis of Ancon, Peru

Gonzalo Irureta Salvatierra

The objective of this research is to identify whether the relationship between age, sex and burial offerings contributes to distinguish the funeral treatment of 15 individuals from Chancay funeral bundles (1100 AD – 1532 AD).

The selection criteria for the sample was guided by the level of preservation and integrity of the individuals and their burial offerings. In order to analyze the relationship individual-offerings I established the following categories: a) Subadult b) Young adult, c) Middle Adult, and d) Old Adult.

The sample consists of five males, six females, and four subadults with certain peculiarities in their funerary treatment such as the variety of the burial offerings, which can be linked to the concept of identity. Furthermore, the funerary offerings tend to increase in quantity and quality in older individuals. Moreover, females present more textile instruments, unlike males. Only one male presents a small quantity of spindles.

It is suggested that the age of the individuals would be linked to fulfilling a role that took greater significance as they approached the life expectancy in their society. Thus, age was perhaps one of the assessment criteria in shaping the burial treatment observed in this sample. Moreover, the relationship between females and textile instruments would probably reflect the notion of a female identity linked to textile activities in their community.

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13.2 From a code number to the reconstruction of identity: the case of mummy 7C from Villar Córdova-Cajamarquilla (Lima, Peru)

Maricarmen Vega¹, Sergio Barraza²

In 2000 and 2001, a number of funerary contexts were recovered from the monumental site of Cajamarquilla, situated east of Lima. From this group of tombs, Funerary Context 7, composed by a large bundle accompanied by two smaller funerary packages, attracted the attention of investigators and the media. Sixteen years after this discovery, what is known about the identity of the main individual buried in this context?

This investigation combines archaeological, bioarchaeological, and ethnohistorical data to reconstruct the identity of one important individual that was buried in Lima 500 years ago during Inca occupation of the region. The arid climate of Cajamarquilla and the eleven layers of textiles that wrapped the corpse resulted in the natural mummification of the body. The preservation of skin provided invaluable information that otherwise would be lost.

The osteological study revealed that the individual was an old male. The number and quality of the textiles and offerings inside the bundle (including slings and a sling stone), and the placement of the burial in an important place in the landscape (the highest part of the site, within the Huaca or sacred site) indicate that this man enjoyed high status, possibly obtained by his military achievements. He also possessed certain badges of authority (i.e. cropped hair and silver bracelets) that were strictly regulated by the Inca State. According to ethnohistorical sources, silver bracelets was reserved for the Inca nobility and for the most prominent warriors. Shorn hair was an attribute of Inca nobility and people that gained the status of “Inca by privilege” for their service to the state. Alternatively, the absence of elongated earlobes (mandatory for all the “new nobles”) could also imply that this individual was an indigenous authority from the Early Colonial times, shaved as a punishment by the Catholic church for supporting idolatry.

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13.3 Physical activity and violence: gender differences in Pueblo Viejo-Pucara, an Inca site at the Lurin Valley, Peru

Krzysztof Makowski¹, Lucía Watson², Maricarmen Vega³

The objective of this study is to examine the possible differentiation of physical activity and violent events of the residents from the main Carina of Huarochiri settlement, Pueblo Viejo-Pucara, through bone indicators of Muscular Stress Marks (MSM) and trauma observed in selected adult individuals from the herders area (sector I), the palatial area (sector II), the conglomerate domestic settlements (sector III), and the military settlement (sector IV).

MSM analysis clearly shows that the sequences of muscle movements repeated by certain groups of individuals in their daily lives were different. The difference is noticeable between males and females, and there is a higher prevalence of MSM among males linked to pastoral activities and craftswomen, however high-status individuals do not register MSM in severe or moderate levels.

The trauma analysis also shows gender and intra-site differences. Although males and females show similar prevalence of malintent trauma, the location of these lesions is different: mostly focused in the facial area in females and the back of the skull in males. Moreover, while females from the different sectors present similar prevalence of malintent and rib trauma, males of the military sector have higher prevalence of both kinds of trauma than the males of the other sectors.

Our results suggest a division of labor related to the sex and status of the individuals, with a privileged group of inhabitants of the palace who were not exposed to physical labor. Likewise, males and females experimented different kinds of violence, being males from the military sector more exposed to it. Our results confirm the hypothesis that the inhabitants of this urban settlement were charged with a differentiated work linked to herding and the defense of the valley and the sanctuary during the Inca administration.

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13.4 Blond barbarians along the Silk Road: migration, admixture, and identity

Christine Lee¹, Jennifer M. Mantie¹

The western boundary of China and Mongolia has been populated by non-Asians for at least 3000 years. The arid climate of this region has produced naturally desiccated mummies. Biological and cultural aspects of their lives have been preserved which corroborate contemporary written descriptions. Many of these individuals have blonde hair and blue eyes attesting to the easternmost migration of non-Asians into the Asian continent. Who were these people and how many different migrations were there? This study looks at four different sites (Nileke, Yanghai, Yingpan, and Chandman) from western China and Mongolia, dating between 700 BCE-420 CE, with a sample size of 283 individuals. Previous research in this region using craniometrics and DNA showed evidence of at least three distinct non-Asian populations. New data was collected on dental nonmetric traits, body modification, unique dental wear patterns, and trauma to determine how many different populations could be detected.

Dental nonmetric trait analysis showed three distinct population samples (Nileke, Yanghai/Yingpan, Chandman). Nileke was not related to the other three sites. Yanghai was closely related to Chandman and Yingpan. However, Yingpan and Chandman were not related. Trauma to the head and face were recorded. The highest rates of trauma were at the centrally located Yanghai (17%) and Yingpan (18%) sites and not at the frontier sites of Nileke (13%) and Chandman (12%). Cranial deformation was found at two sites, Nileke (30%) and Yingpan (49%). The population pattern of cranial deformation at these two sites differed, Nileke had an almost equal number of males to females with deformation, while Yingpan had twice as many females than males with deformation. Finally, Yingpan had a unique dental wear pattern probably related to their diet.

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13.5 Modern investigation of the Two Brothers mummies at the Manchester Museum, UK

Kathryn Reusch

The 12th Dynasty mummies of the Two Brothers, Nekht-Ankh and Khnum-Nekht, at the Manchester Museum, were re-investigated using modern osteoarchaeological techniques. The mostly skeletonized mummies appear to be in stable condition, but some discrepancies with the original 1910 report were noticed. Nekht-Ankh appears to be younger than the 60+ years given in the initial report, which may change his designation as the elder of the brothers, and, if he was ever castrated, it was post-pubertally. The mummies do appear to be from different ancestry groups. Both, unusually, have only a woman, Khnum-Aa, named as a parent, though both are identified as descending from local princes. However, Khnum-Nekht has two generations of princes listed on his coffin and Nekht-Ankh does not. The difference in ancestry of both the skeletons and the inscriptions has led scholars to believe that the two individuals are maternal half-brothers.

Interesting questions are raised from the inscriptive and osteological data. Currently, at least three situations could be postulated from the available evidence. Nekht-Ankh could have been castrated and publicly disgraced, or Nekht-Ankh could have had a congenital condition that made him infertile. If Nekht-Ankh was the elder of the two, both of these situations would have required the birth of a new heir, Khnum-Nekht. In either of these cases, the mummies’ burial in a single tomb and their association with the maternal line may indicate that the primary identity espoused by these individuals was fraternal and maternal rather than paternal. Alternately, Nekht-Ankh could be Khnum-Nekht’s father. Each of these possibilities has a different impact on our understanding of the politics, social life, and identities of an elite family in Middle Kingdom Egypt. Radiographic and genetic evidence would help to clarify which of these situations is most likely.

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14.1 From first to latest imaging technology - Revisiting the first mummy investigated with X-rays in 1896 by using dual-energy computed tomography

Stephanie Zesch¹, Stephanie Panzer²,³,⁴, Thomas Henzler⁵, Stefan O. Schoenberg⁵, Wilfried Rosendahl¹

A few months after the discovery of X-rays in 1895, the physicist Walter Koenig conducted the first radiographic investigation of mummified remains at Physikalischer Verein in Frankfurt am Main (Germany). One of the X-rayed objects was an ancient Egyptian child mummy of unknown archaeological provenience from Senckenberg Museum Frankfurt (Inv. no. ÄS 18).

In the recent study, the mummy was re-examined in an interdisciplinary approach comprising radiocarbon dating, radiology, paleoimaging and anthropology. Radiocarbon dating for determination of the mummy’s age was conducted at Curt Engelhorn Centre Archaeometry gGmbH in Mannheim (Germany). The mummy was scanned by a 2x64 slice computed tomography (CT) scanner operating in dual-energy mode for advanced spectral tissue characterization at Medical Faculty Mannheim of Heidelberg University (Germany).

The primary aim was to recapitulate the earliest X-ray technique compared to latest CT scanning technology. The CT images were further used for assessing bone and soft tissue preservation, wrappings, embalming technique, determining age at death and sex, dentition, pathologies, traumata and stress markers of the child.

Radiocarbon analysis yielded a calibrated age between 378 and 235 cal BC (1SD) - the beginning of Ptolemaic period in Egypt. Dental status revealed a child aged between 4 and 5 years. Remains of the desiccated brain are preserved on the skull base and within the cervical spine. Intestines are located inside the chest and abdominal cavity. The liver seems to be enlarged. Analysis of the thorax revealed a pectus excavatum deformity. Both femora show a longitudinal cleft in the ventral part of the diaphysis. Harris lines as indicators for metabolic stress during growth are visible on the long bones of the lower limbs.

The recent CT scanning not only shows the potential of dual-energy CT technique, but furthermore revealed comprehensive anthropological results about the first-ever X-rayed human mummy.
14.2 Diagnostic imaging of ancient human mummies: Experiences at the Swiss Mummy Project

Frank Rühli¹, Francesco Galassi¹, Lena Oehrstroem¹

Diagnostic imaging of ancient human mummies has had a long tradition since its very first successful attempt by Walter König in 1896. Since then, with the introduction of novel methods, the range of research hypotheses has expanded enormously. Yet, there exists still many technological challenges and diagnostic pitfalls. Based on the ca. 20 years of experience at the Swiss Mummy Project (www.swissmummyproject.uzh.ch) we hereby intend to report, both, the state-of-the-art applications of major imaging technologies (such as CT and MRI) as well as some restrictions of medically-oriented investigations of ancient mummies. These shortcomings include e.g. limitations in tissue differentiation, particularly soft tissues (subcutaneous vs. muscular), as well as the issue of taphonomy-related artefacts (e.g. embalming-liquids penetrating into deeper tissue layers). Finally, the obvious differences between clinical and paleopathological diagnostic imaging is addressed, thus leading to guidelines of best practice in diagnostic imaging of ancient mummies. The range of mummies reported by us includes a.o. ancient Egyptians, ancient Peruvians, ancient Iranian salt mummies and a natural mummy from nowadays Botswana.

Imágenes diagnósticas en antiguas momias humanas: experiencias en el Proyecto Suizo de Momias.

La imagenología diagnóstica en restos humanos ha sido una larga tradición desde el primer intento exitoso pro Walter König en 1896. Desde entonces, con la introducción de métodos novedosos, el rango de hipótesis investigadas se ha expandido enormemente. Sin embargo, aún persisten muchos retos tecnológicos y errores diagnósticos. Basados en los cerca de 20 años de experiencia del Proyecto Suizo de Momias (www.swissmummyproject.uzh.ch) hemos intentado aquí reportar, tanto la aplicación de equipos de última generación en imagenología (tales como TAC y RMN), así como algunas restricciones de investigaciones de orientación médica para las momias. Estas limitaciones incluyen la diferenciación tisular, particularmente en los tejidos blandos (subcutáneo vs. muscular), así como el problema de los artefactos de rigen tafonómico (por ej., penetración de líquidos de embalsamamiento en capas de tejidos profundos). Finalmente, se discute las obvias diferencias entre el diagnóstico imagenológico en la clínica y la paleopatología, dirigiéndose así a guiar una mejor práctica en el diagnóstico en momias antiguas. El rango de momias reportado por nosotros incluye, entre otras, antiguos egipcios, antiguos peruanos, antiguas momias iraníes por sal y una momia natural de la actual Botswana.

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14.3 Evolution of methods: 30 years of researching the Greenland mummies

Niels Lynnerup¹, Chiara Villa²

The Greenland mummies are silent witnesses of the Thule Inuit culture. The Thule people arrived in the Greenland less than 700 years ago and rapidly spread around the island. The Thule culture was a technologically highly developed culture that could survive the harsh climate of Greenland. These mummies are among the finest and most comprehensive assemblages of natural mummies in the world. This unique cache of mummies has been extensively analyzed using medical imaging technologies and DNA techniques, this to shed new light to health conditions, disease and tradition of their way of life. Since the first studies were carried out, there have been several technological improvements and this had a direct reflection on the number of information gathered.

Progression from 2D X-ray to advanced 3D segmentation of CT images: with the use CT techniques and imaging software, the quality of the images is improved and 3D reconstructions of every area of interest within the body can be produced in a way not possible with X-rays film, e.g. bypassing the superimposition problem, particularly severe when dealing with bodies extensively wrapped as the Greenland mummies.

Progression from HLA tissue typing to whole genome sequencing: massively parallel sequencing decreased the cost of sequencing per base pair and importantly has allowed the recovery of sequence information from smaller DNA fragment sizes, such as present in mummified material and other degraded samples.

This presentation will reflect the evolution of methods, showing how levels of evidence have changed and how guidelines may be difficult to establish.

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14.4 Conventional radiography of ancient Egyptian mummy heads. 
A report of personal experiences

Roger Seiler¹, Frank Rühli¹

In the time of the CT scans with their outstanding imaging possibilities, one can forget that conventional radiography has its place in the study of Egyptian mummies. We will report our experiences in the application of a digital, portable X-ray unit in the field. For better understanding, background into the history and development of radiography in Mummy research will be presented, standard types of radiological projections used in skull investigations and how these protocols are modified to the special needs of mummy heads will be discussed.

Examples of X-ray images of Egyptian mummy heads will demonstrate the ongoing possibilities of conventional radiography, but also its limits. The two-dimensional imaging of the skull with its complex three-dimensional structures, through the so-called “anatomical noise”, offer particular interpretational difficulties. On the other hand, it must be remembered that under adverse conditions and in unusual places, such as burial chambers or in a museum, X-ray is the only possibility to obtain internal images and so to fully investigate mummies. Therefore, we will discuss the taking of conventional X-rays of dentitions, jaws and the temporomandibular joints and the skull base. Of special interest to us are the characteristic defects in the context of the excerebration or mumification. Comparisons with CT scans will allow us to reassess the conventional, two-dimensional X-ray images.

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14.5 Preliminary results from the Canopic Jar Project

Abigail Bouwman¹, Michael Habicht¹, Frank Rühli¹

The Canopic Jar Project is an SNSF funded project that is examining a large series of ancient Egyptian human soft tissues samples in a truly interdisciplinary research setting (medical, genetic, chemical and Egyptological) from canopic jars and bundles in European and American museum collections.

The project is macroscopically, radiographically, chemically and genetically studying canopics to investigate the contents. All canopic jars are studied with X-ray and, where possible, by CT-scan, in order to investigate the contents prior to sampling.

Samples which are extracted from the canopic jars undergo: 1) histological examination – to identify the organ interred, assess the preservation of the sample and identify any pathological tissue, 2) molecular examination – to assess DNA preservation, identify the individual, examine the genetic relationship between pathogens and hosts, assess co-infection and investigate ancient microbiomes, and 3) chemical analysis – to identify the components used in the embalming process.

This presentation will concentrate on the first genetic data from the study, both from conventional and HTS methods. Although the material is heavily degraded by both time and the chemical preservation of the organs, DNA can be extracted and subjected to analysis. We have recovered mitochondrial and autosomal DNA by traditional methods. More importantly, metagenomic High Throughput Sequencing data has shown a wealth of bacterial data. Some evidence of dietary or ritual plant remains are also present in the DNA data.

The initial genetic data will be discussed within the context of the radiological, morphological, and chemical data.

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Resultados preliminares del Proyecto de los Vasos Canópicos.

El Proyecto de los Vasos Canópicos, financiado por la SNSF (Fundación Nacional Suiza de las Ciencias), está examinando una gran serie de muestras de tejidos blandos humanos, en un verdadero enfoque interdisciplinario (médico, genético, químico y egiptológico), procedentes de vasos canópicos y paquetes funerarios de colecciones de museos europeos y norteamericanos.

El proyecto investiga el contenido de los vasos canópicos de forma macroscópica, radiográfica, química y genéticamente. Todos los vasos canópicos son radiografiados y, de ser posible, tomografiados, antes de muestreárselos.

Las muestras extraídas son examinadas: 1) histológicamente – para identificar el órgano sepultado, evaluar la preservación de la muestra e identificar cualquier tejido patológico, 2) molecularmente – para evaluar la preservación del ADN, identificar al individuo, examinar la relación genética entre patógenos y huéspedes, evaluar co-infecciones e investigar microbiomas antiguos, y 3) químicamente – para identificar a los componentes usados en el proceso de embalsamamiento.

Esta presentación se concentrará en los primeros datos genéticos del estudio, obtenido por los métodos convencional y HTS (Secuenciamento de Alto Rendimiento). Aunque el material está altamente degradado tanto por el tiempo y la preservación química de los órganos, el ADN puede ser extraído y sometido a análisis. Hemos recuperado ADN mitocondrial y autosómico por métodos tradicionales. Lo más importante es que los datos metagenómicos obtenidos con HTS han revelado una gran cantidad de información bacteriana. Algo de evidencia acerca de plantas dietarias y rituales son también presentadas en los datos de ADN.

Los datos genéticos iniciales serán discutidos dentro del contexto de los datos radiológicos, morfológicos y químicos.
14.6 Computed Tomography (CT) studies of the Royal Egyptian Mummies of the New Kingdom

Sahar N. Saleem¹, Zahi Hawass²

We performed a detailed analysis of CT images of 20 royal Egyptian mummies dating to the New Kingdom (1550-1070 BC). Sixteen of the studied mummies dated to the 18th Dynasty (Thutmoses and Tutankhamun’s family), and four mummies belong to the Ramesside Period including Seti I, Ramesses II, Merenptah, and Ramses III.

The CT results helped to estimate their age at death, enabled us to describe pathological conditions, and to exclude others. CT results cleared up a long-standing misdiagnosis ankylosing spondylitis and indicated that the ancient Egyptian royals suffered from a milder age-related spinal disease (DISH: Diffuse-Idiopathic-Skeletal-Hyperostosis).

A detailed analysis of the CT scans of the mummies enabled us to recognize new evidences regarding the technology of mummification. Subcutaneous packing procedure was used as part of mummification in New Kingdom earlier than what was believed. CT offers a detailed noninvasive analysis of amulets, jewelry, and foreign objects on/within the mummies.

The results of CT study of two mummified stillborn daughters of King Tutankhamun set a precedent for use of CT in ancient mummified fetuses. In addition, analysis of the CT images provided intriguing theories about the death of the famous pharaohs derived from scientific clues. We analyzed the CT images of mummified Ramesses III and identified new evidences of multiple body injuries that supported that Ramesses III was probably murdered by the hands of multiple attackers.

In conclusion, CT examination of the royal mummies helped to answer questions, and to provide insights into health conditions, causes of death, mummification techniques, and more.

Estudios de tomografía computarizada (TC) de las Momias Reales Egipcias del Nuevo Reino.

Realizamos un análisis detallado de las tomografías de 20 momias reales egipcias del Nuevo Reino (1550 – 1070 AC). 16 de ellas pertenecen a la 18ª dinastía (familia de Tutmosis y Tutankamón), y cuatro son pertenecientes al periodo ramésido, incluyendo a Seti I, Ramsés II, Merenptah y Ramsés III.

Los resultados nos ayudaron a estimar su edad al morir, describir patologías y excluir otras. Por ejemplo, se corrigió el mal diagnóstico anterior de espondilitis anquilosante al considerarse que los antiguos reyes egipcios sufrieron de una enfermedad degenerativa espinal más leve: hiperostosis esquelética idiopática difusa (DISH).

El análisis detallado de las tomografías nos permitió reconocer nuevas evidencias respecto de las técnicas de momificación. Procedimientos de relleno subcutáneo fue utilizado como parte de la momificación en el Nuevo Reino más temprano de lo que se había creído. La tomografía ofrece detallado análisis no invasivo de los amuletos, joyas y cuerpos extraños sobre y dentro de las momias.

Los resultados del estudio de dos hijas natimuertas del rey Tutankamón establecieron un precedente en el estudio de la tomografía en fetos antiguos momificados. Adicionalmente, el análisis de las tomografías proporcionó teorías interesantes para la muerte de faraones famosos a partir de información científica. Estudiamos las tomografías de Ramsés III e identificamos nuevas evidencias de múltiples lesiones corporales que apoyan que probablemente este faraón fue asesinado a manos de múltiples atacantes.

En conclusión, el examen tomográfico de las momias reales ayudó a responder preguntas y proporcionó información acerca de sus condiciones de salud, causas de muerte, técnicas de momificación y más.

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14.7 Forensic Egyptology in Lithuania

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Since 2011, ancient Egyptian mummified human remains from collections in Lithuania have been subjected to scientific analysis in an attempt to assess the live and death of the individuals, and how their bodies were treated after death in order to achieve body preservation. In total, six mummies were studied using computed tomography to obtain the maximum amount of useful data in a non-invasive manner. This paper outlines the aims of the research, what has been done to date and the plans for future work on this corpus of material.

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Egiptología forense en Lituania

Desde 2012, momias egipcias humanas de colecciones de Lituania han sido sujetas a análisis científicos en un intento de evaluar la vidas y muerte de estos individuos, y cómo sus cuerpos fueron tratados después de la muerte para alcanzar su preservación corporal. En total, seis momias fueron estudiadas usando tomografía computarizada para obtener la máxima cantidad de información útil de manera no invasiva. Este artículo delinea los objetivos de la investigación, lo que ha sido hecho hasta la fecha y los planes para el futuro en este corpus.
14.8 Mummification / embalming methods in the Roman period

Robert Loynes

Examination of the CT scans of thirty human mummies said to be from the Roman Period reveals that there are common features (indicating deliberate intent) distinguishing them from mummies of other eras. This is in contrast to the view taken by authors such as Ikram & Dodson, David and Aufderheide (Ikram S. & Dodson A., 1998:129; David A.R., 2002: 337; Aufderheide A.C., 2003:248) that mummification techniques in this era may have become more casual and random, accompanying the increase in the attention paid to and the sophistication of the external appearance of these artifacts.

There is a definite repetition of the techniques applied to the rib cage resulting in distortion and compression of this anatomical region in many cases accompanied by damage to the integrity of the costo-vertebral continuum. There are certain notable deviations from these observed techniques but these may well be explained when the external characteristics – that is the wrapping techniques – or age at death of the individual are taken into account. The cohort splits well into those with Red Shrouds, those with all four limbs wrapped separately and those with neither of these characteristics.

Although the rib cage distortion and costo-vertebral dislocation have been described previously (Loynes R, 2014: 231-3) the increased cohort size – to thirty – makes this observation and the identification of the outliers as members of wrapping style subgroups a more robust concept.

It is possible that the changes in mummification practice reflect the influence of the Roman culture upon the embalming workshops of Egypt.

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15.1 Evidence of atherosclerosis in 300 human mummies from around the world

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Background: Atherosclerosis is thought to be a disease of modernity and related to modern lifestyles. However, some bioarchaeologic evidence suggests it was present in ancient times. It is not known how prevalent atherosclerosis was before the modern era.

Methods: In order to search for atherosclerosis in pre-industrial people, we reviewed whole body CT scans on 300 mummies of individuals from 6 different geographic regions on 5 continents and spanning a time horizon of over 5000 years. The mummies came from ancient Egypt, ancient Peru, southwestern US, Aleutian Islands, the Gobi Desert, and a Bronze Age European. Atherosclerosis was considered definite if a calcified plaque was seen in the wall of an artery and probable if calcifications were seen along the expected course of an artery.

Results: Probable or definite atherosclerosis was seen frequently in all geographic populations and in all vascular beds. Over one third of the mummies examined had definite or probable atherosclerosis. Age at time of death was positively correlated with atherosclerosis and with the number of arterial beds involved.

Interpretation: Atherosclerosis was common among all of the pre-industrial populations studied, including pre-agricultural hunter-gatherers and was seen in the Bronze Age European. It was prevalent in ancient times across a very large span of the globe and dating back over 5000 years. While atherosclerosis is frequently assumed to be a disease of modernity, the wide variety of diets and lifestyles represented by the people in this study suggests that humans have a basic predisposition to the disease.

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15.2 Search for cardiovascular genetic risk factors in ancient DNA of Egyptian mummified human remains

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Cardiovascular diseases (CVD) are known to be caused by both, the contemporary lifestyle plus the genetic predisposition of affected individuals. Until some years ago atherosclerosis was considered as a modern disease. The prevalence of CVD in ancient populations was unknown. Calcified plaques have been detected in mummified human remains of diverse geographic origins and times which provide evidence that our ancient ancestors suffered from atherosclerosis. Despite the rising number of discovered calcified vascular beds in ancient human remains, almost no genetic data assessing atherosclerotic burden in ancient populations are yet available. This is partly due to the specific requirements of ancient DNA analysis of such remains.

This study aims to detect the genetic predisposition for CVD in the genomes of ancient Egyptian mummies sampled from a museum collection (Egyptian Museum and Papyrus collection Berlin, Germany). Those mummies are dated from the Predynastic to the Byzantine Period, covering a timespan of more than 4,500 years. Previously, in the glacial mummy “Ötzi” (3,500 BC) the phenotypic presence of atherosclerotic plaques could be linked to the detection of a few genetic atherosclerotic markers. In this study, the list of applied single nucleotide polymorphisms (SNPs) has been extended to 75 SNPs which are distributed over the genome and have been closely linked with CVD in genome-wide association studies. Next generation sequencing was employed to study the residual degraded DNA of these ancient remains. Further, a specific enrichment approach to capture CVD associated SNPs in ancient specimens was assembled and used. In parallel, the mummified human remains underwent a CT analysis to correlate the molecular data with the physical occurrence of calcified plaques.

Comparing the presence and effects of genetic risk factors in our ancestors with their ancient lifestyle this study will provide new aspects to improve the knowledge of the development of cardiovascular diseases.
15.3 Assessment of missing links in atherogenesis: Study of mummified great apes

Randall C Thompson MD¹, Bruno Frohlich PhD², David Hunt, PhD², L Samuel Wann MD³, Navneet Narula MD², Jagat Narula, MD, PhD², M Linda Sutherland MD³, James D Sutherland MD³, Adel Allam MD⁷, Gregory Thomas⁸, Christine France PhD²

Background: At least 30% of MI’s are not explained by traditional cardiac risk factors. The discovery of genetic or yet unknown other risk factors could offer improved treatment strategies. Methods: 32 mummified great apes stored in alcohol tanks at the Smithsonian Institution were studied with whole body CT scanning, arterial biopsies, stable isotope analysis, and DNA extraction. Results. Of 11 animals biopsied, 4 (1 wild gorilla, 2 zoo gorillas, 1 zoo other species) had atherosclerosis on microscopic analysis (pathologic intimal thickening, fibrous atheromas). Arterial calcifications or arterial thickening was seen on CT scan near each of the positive biopsy sites. DNA and stable isotope work is ongoing.

Conclusion: Great apes, both in captivity and in the wild have biopsy-confirmed atherosclerosis, identical to that seen in humans. Calcifications and/or arterial thickening is seen on CT scan in the involved arterial segments. Cross species work on atherosclerosis might offer insights into the fundamental mechanisms of this important human disease.

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16.1 Discovery of a Colonial mummy at Queretaro city

Elizabeth Mejía Pérez Campos¹, Guadalupe Zárate Miguel¹

During May of 1994, the INAH Queretaro center came to notice the discovery of the mummified remains of a female in the basement of the choir of the convent of Santa Clara in the city of Queretaro. Therefore, archaeologist Elizabeth Mejía was commissioned to visit the place to recommend treatment, research and the place to store the body. After two visits the news of the finding reached the Queretaro population, the information was spread by the person who found the body; that is the reason that the population of the city of Queretaro always believed that it was the body of an abbess of the convent of Santa Clara.

One of the most important elements in this context is the presence of a glass bottle adhered to the back of the body, this registers the name and the date of death of the woman. The recent work has been to search for the historical data that provides tracks to know how did it end inside the convent of Santa Clara. In this paper we present the results of our inquiries, to know the historical essentials of this mummified body called “Clara”.

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16.2 Conservation measures for the Colonial mummy at Queretaro city

Elizabeth Mejía Pérez Campos¹, Alberto Herrera Muñoz², Rubén López Martínez², Francisca Hernández Hernández², Marcela Ramírez³, Ximena Chávez Balderas³

After the discovery of a mummified body in the convent of Santa Clara in the city of Queretaro in 1994, the recommended treatment for the conservation for the remains was proposed as well as its transfer to the INAH Regional Museum in the same city. Therefore, the restoration team of the INAH Center developed the first treatment which due to lack of resources and a specific place in the museography, the piece remained forgotten in the corridors of the museum for more than 21 years. At present, the authorities of the museum were contacted to develop microbiological cultures and new measurements of conservation, as the first part of the investigation on this specimen. In this paper we present the detailed measurements of conservation taken in the past, and its present evaluation, as well as the new conservation measurements for this Colonial mummified body in Queretaro.

Resultados de cultivo

Medidas de conservación en una momia Colonial en la ciudad de Querétaro.

Después del hallazgo de un cuerpo momificado en el Convento de Santa Clara en la ciudad de Querétaro, durante 1994, se recomendó el tratamiento de conservación de los restos y su traslado al Museo Regional de INAH en la misma ciudad. Así, el equipo de restauración del Centro INAH realizó los primeros tratamientos pero debido a la carencia de recursos y de un lugar específico en la museografía, la pieza quedó olvidada en los pasillos del museo por más de 21 años. Actualmente se está en contacto con las autoridades del museo para realizar cultivos microbiológicos y nuevas medidas de conservación, como una primera parte de la investigación de esta pieza. En esta ponencia se detallan las medidas de conservación tomadas en el pasado, y su evaluación en la actualidad, así como las nuevas medidas de conservación para estos restos coloniales momificados en Querétaro.

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16.3 Virtual reality applied to the presentation of mummified remains in Queretaro, México

Alberto Herrera Muñoz¹, Vania Herrera Mejía¹, Elizabeth Mejia Pérez Campos¹, Ximena Chávez Balderas²

The advances in the research process on a mummy, and the lack of adequate museum space for its display, prompted the use of new information technologies to allow us to provide new alternatives to start the historical validation and promotion of Queretaro’s heritage. This paper presents theoretical considerations between virtual reality, augmented reality and virtualization for different levels of research and the targets of different audiences from a museological perspective.

The methodology applied in the case of the mummy Pepita involves interdisciplinary integration of: archaeology, biological anthropology, museology, information technology and cinematography, for the production of models of low cost products for digital platforms for wide distribution of the results of the research of the mummified remains in Queretaro, Mexico.

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16.4 Pepita through the monitor

Vania Herrera Mejía¹, Alberto Herrera Muñoz¹, Elizabeth Mejía Pérez Campos¹

One of the results of the research process of a mummy involves its broadcast, although given the fact that it is a very delicate heritage, its transfer and display is complex, therefore digital modeling is a better alternative. This presentation shows, in a practical way, the modeling process using a digital platform called “Autodesk Maya”, which uses 2D digital photographs as its material source. This presentation shows the case of the mummy Pepita, found in 2002 in the highlands of Queretaro in central Mexico, it ends with a video shown at the end of the presentation.

Pepita a través del monitor.

Uno de los resultados del proceso de investigación de una momia es su difusión, pero siendo un patrimonio tan delicado, su traslado y su exhibición son temas complejos, por ello una mejor alternativa es el modelado digital. En esta presentación se muestra de manera práctica el proceso de modelado usando una plataforma digital denominada “Autodesk Maya”, el cual toma como material de origen fotografías digitales 2D. En esta presentación se muestra el caso de la momia “Pepita” hallada en 2002 en la sierra de Querétaro, en la zona central de México, y culmina con un video mostrado al final de la ponencia.

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Symposium 17. Bioarcheology of care

Chairs:
Kenneth C. Nystrom, Anthropology Department, State University of New York, USA
Lorna Tilley, Australian National University, Australia

17.1 An introduction to the bioarchaeology of care and mummy studies

Kenneth C. Nystrom

The soft tissue preservation encountered in mum-mified remains is rightly considered a unique and signifi-
cant source of paleopathological data that can be used
to reconstruct paleoepidemiology and disease evolution.
Since the emergence of the modern field of mummy stud-
ies as a scientific discipline in 1970s, a dominant focus has
been soft tissue paleopathology. Despite this centrality,
the discussion of the human and cultural reaction to dis-
ease has to date been limited. The goal of this presen-
tation is therefore twofold. First, I will highlight research
areas where mummy researchers have most explicitly
considered aspects of treatment and other forms of care.
Secondly, and more broadly, I argue that the bioarchaeol-
gy of care framework represents a means through which
mummy studies can study paleopathology through a more
holistic, biocultural approach.

Mummy studies have always been deeply connected with
the biomedical and natural sciences and current publica-
tion trends suggest that this trend will continue. Alterna-
tively, research that explicitly engages with archaeological
data or social theory is less frequent. The investigation of
health care therefore represents an opportunity where the
connection between mummy studies and bioarchaeology
can be strengthened and elaborated upon. As advances
in medical imaging and molecular analyses improve our
ability to identify and diagnose disease in the past, the
reconstruction of health care can contribute to our under-
standing of the human and cultural response to disease.

Introducción a la bioarqueología del cuidado y los estudios
en momias.

La preservación de tejido blando en restos momificados
se considera una fuente única y significativa de datos pa-
leopatológicos que se puede utilizar para reconstruir la
evolución de las enfermedades y la paleoepidemiología.
Desde la aparición del moderno campo de los estudios en
momias como disciplina científica en 1970, un enfoque
dominante ha sido la paleopatología de los tejidos blandos.
A pesar de esta centralidad, la discusión acerca de la
reacción biológica y cultural del hombre hacia las en-
fermedades es limitada hasta la fecha. El objetivo de esta
presentación es, por tanto, de dos tipos. En primer lugar,
voy a destacar las áreas de investigación donde los inves-
tigadores en momias han considerado aspectos de trata-
miento y otras formas de cuidado. En segundo lugar, y en
términos más generales, argumento que la aproximación
de la Bioarqueología del cuidado representa un medio a
través del cual los estudios de momias pueden investigar
el aspecto paleopatológico a través de un enfoque más
integral y biocultural.

Los estudios en momias han tenido siempre profundas
conexiones con las ciencias biomédicas y naturales y las
tendencias de publicación actual sugieren que esta ten-
dencia continuará. Por otra parte, las investigaciones que
se relacionan explícitamente con los datos arqueológicos
o teorías sociales son menos frecuentes. La investigación
de la asistencia en salud, por tanto, representa una oportu-
nidad donde la conexión entre los estudios de momias y
la bioarqueología pueden fortalecerse. A medida que los
avances en imagenología médica y los análisis moleculares
mejoran nuestra habilidad para identificar y diagnosticar
las enfermedades en el pasado, la reconstrucción de la asis-
tencia en salud puede contribuir a nuestra comprensión de
la respuesta humana y cultural hacia la enfermedad.

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17.2 The nuts and bolts of a bioarchaeology of care: a user’s guide

Lorna Tilley

What are the basics - the nuts and bolts - of the bioarchaeology of care? In archaeology, the provision of health-related care is inferred from evidence in human remains indicating a person survived with, or recovered from, a disease that likely compromised their ability to function independently within their society. Because any group’s response to the health requirements of its members is shaped by beliefs, values, knowledge and skills, social and economic organization, and access to resources, where we can identify possible features of past caregiving these may suggest insights into contemporary community, culture, agency and identity which are otherwise inaccessible. The bioarchaeology of care is a case study-based approach for identifying and interpreting past experience of disability and associated care behaviors, and aims to elicit such insights in a way that is both rigorous and transparent.

The methodology, supported by the online ‘Index of Care’, comprises four sequential stages of analysis: (i) detailing the subject, diagnosis and lifeways context; (ii) assessing clinical and functional disability impacts and the consequent likelihood of care; (iii) building a model of the care likely provided; and (iv) interpreting the broader implications of the provision and receipt of this care (Figure 1). This presentation is a ‘user’s guide’ to applying the methodology, and to illustrate this process it firstly draws on case studies of two prehistoric individuals, represented by their skeletal remains, thought to have received quite different forms of care. It then uses a case study of a mumified individual to discuss the potential for preserved soft tissue evidence to enhance our understanding of disability and care in the past. The presentation outlines major theoretical principles shaping the bioarchaeology of care, explains the rationale for important elements of the methodology, and briefly considers the approach’s scope and limitations.

STAGE 1: Describe, diagnose, document
- Describe remains and evidence for pathology
- (Differential) diagnosis of disease
- Describe cultural, social, economic, physical, mortuary contexts

STAGE 2: Assess disability
i. Identify clinical characteristics / implications of disease.
ii. Based on (i) identify functional impacts within lifeways context.
iii. Assess whether impact on function required care
   - If YES, proceed to Stage 3 (disability identified).
   - If NO, end bioarchaeology of care analysis.

STAGE 3: Construct model of care
Identify characteristics of care likely required / provided in response to clinical / functional impacts (basic elements of care, length of care, resource requirements and availability, likely costs incurred, etc.)

STAGE 4: Interpretation
Explore implications of collective and individual agency in provision and receipt of care modeled in Stage 3 for insights into social relations, practice and organisation, and group / individual identity.

The four stages of the bioarchaeology of care.

M9 (male, 20-25yrs, ~2000BC, Vietnam), lived with quadriplegia for ~10 years, first bioarchaeology of care study (Tilley and Oxenham 2011)

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17.3 Functional limitations and pathophysiology: interdisciplinary diagnosis by consensus

Ronald G. Beckett¹, Gerald J. Conlogue¹

In the Bioarchaeology of care construct it is critical that the most informed discussions regarding differential diagnosis, clinical characteristics, and functional consequences be undertaken if an accurate determination is to be surmised regarding the probability of care received by an individual within their cultural and historical context.

Understanding the functional impact of the observed paleopathology requires a detailed understanding and description of the associated pathophysiology. Functional limitations imposed on an individual can be described by examining the care required in more recent cases with the same condition. Bioarchaeology of care requires rigorous examination of the available evidence using expert input from a variety of anthropological and medical professionals. Deriving an interdisciplinary diagnosis by consensus is at the heart of making meaning regarding the behavioral and cultural context of a disease or condition as it relates to the possibility and nature of health-related care.

Limitaciones funcionales y fisiopatología: diagnóstico interdisciplinario por consenso.

En la aproximación de la bioarqueología de los cuidados es fundamental contar con las discusiones más informadas con respecto al diagnóstico diferencial, las características-clínicas, y las consecuencias funcionales si se quiere contar con una determinación exacta con respecto a la probabilidad de la atención recibida por un individuo dentro de su contexto histórico y cultural. 

Comprender el impacto funcional de la lesión paleopatológica observada requiere una comprensión detallada y descripción de la fisiopatología asociada. Las limitaciones funcionales impuestas a un individuo en el pasado pueden ser descritas por medio de la evaluación de los cuidados necesarios en casos actuales que cuentan con la misma lesión. La bioarqueología de los cuidados requiere un examen riguroso de la evidencia disponible mediante la participación de expertos en una variedad de especialidades médicas y antropológicas. Llegar a un diagnóstico interdisciplinario por consenso es el objetivo central que busca contextualizar estos comportamientos de cuidados relacionados con la salud en el contexto cultural de una enfermedad o condición especial.

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17.4 Utilizing CT evidence to evaluate the presence of care

M Linda Sutherland¹, Guido Lombardi², Lucia Watson³, Kenneth C. Nystrom⁴, James Vreeland⁵, Randall Thompson⁶, Muhammad Al-Tohamy Soliman⁷

Utilization of CT imaging in mummy studies has assisted in the nondestructive identification of disease. Fifty wrapped mummy bundles housed at the Museo de Sitio Puruchuco-Arturo Jimenez Borja, south of Lima, Peru, underwent whole body CT scanning as part of an atherosclerosis study by the Horus Team in May 2012. From May 2014 thru May 2015 the bundles were reviewed for additional medical conditions and cultural artifacts by a multidisciplinary team of anthropologists, archaeologists, and physicians comprising the Andean Wing of the Horus Team. Discussions were developed online via a web-based application, GoToMeeting.

Results showed that specimen number FA 54, a Late Intermediate Period- Late Horizon, 1000-1534 CE bundle from Rinconada La Molina-Inca cultural affiliation, was a female with estimated age at death around mid-30s. Review of the CT scan showed clear evidence of chronic osteomyelitis of the right tibia and a large left parietal skull defect, both possible sequelae of tertiary syphilis. Her intact bundle contained a metal disc embossed with a 6-pointed star and, a newborn infant positioned upside-down, strapped to the diseased right tibia, possibly representing an offering. The bioarcheology of care provides a framework for reconstruction of health-care, evidence of accommodation and provisioning in mummy studies within a cultural and historical context.

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17.5 Evidence of physical impairment in a Chancay bundle from the necropolis of Ancon, Peru

Kenneth C. Nystrom1, Lucia Watson2, M. Linda Sutherland3, Guido Lombardi4, James Vreeland5, Muhammad Al-Tohamy Soliman6

The aim of this paper is to reflect on the social implications of the construction of a funerary bundle of an adult with osteological evidence of physical limitations. This bundle was buried between 1100AD to 1532AD in the Necropolis of Ancon located in the Central Coast of Peru. While the mortuary bundle was partially opened because of its poor conservation condition, the core of the bundle was intact and was subject to computed tomographic scanning and 3D reconstructions in the Osirix program. This data was complemented by information from direct observation of the material from the superficial layers of the bundle.

The main pathological evidence that suggests some degree of physical impairment during life is a well healed trauma of the left femur with the development of a pseudo-arthritis between the acetabulum and the femoral head. It is estimated that the injury must have occurred when the individual was an adult because the dimensions and characteristics of the bones of the right leg are normal. The osteological evidence indicates that this individual likely had limited mobility. Based on the inclusion of several offerings within the bundle, however, including shells, two needles made with organic material, and one unidentified high density object, they appeared to have received funerary treatment applied to all members of Chancay society, suggesting a social inclusion regardless of any impairment.

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17.6 Possible evidence for care and treatment in the Tyrolean iceman

Albert Zink¹, Marco Samadelli¹, Eduard Egarter-Vigl², Paul Gostner³

The Tyrolean Iceman, commonly known as Ötzi, is the world oldest glacier mummy. He was found in September 1991 on the Tisenjoch pass in the Italian part of the Ötztal Alps. Since his discovery a variety of morphological, radiological and molecular analyses have been performed that revealed detailed insights into his state of health. Amongst others, computed tomography (CT) analyses demonstrated the presence of healed rib fractures, degenerative arthritis, vascular calcification, oral pathologies and the presence of gallbladder stones. A detailed genetic study has shown that the Iceman had a genetic predisposition for an increased risk for coronary heart disease and, recently, genetic evidence for a virulent H. pylori strain was detected in his stomach. Despite the various pathological conditions found in the Iceman, little is known about possible forms of care and treatment during the Copper Age in Northern Italy. A possible approach to this topic is the presence of tattoos on the mummified body. In previous work it was already believed that the tattoos were done as a kind of treatment of his lower back pain and degenerative joint disease of his knees, hip and wrist. In other studies, the tattoos of the Iceman have been related to an early form of acupuncture. By using non-invasive multispectral photographic imaging, we were able to identify and certify for the first time the exact number and location of tattoos in various parts of the Iceman’s body. We carefully re-evaluated the various health issues of the Iceman, including joint diseases, gastrointestinal problems and arterial calcifications and compared them to the location and number of tattoos. Together with the finding of medically effective fungi and plants, such as the birch polypore or fern in his equipment and intestines, we suggest that care and treatment was already common during the Iceman’s time.

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18.1 Huayna Capac’s Hand: Making Inca Mummies, and Making Mummies Inca, in the Early Modern Atlantic World, 1532-1749

Christopher Heaney

It is a tenet of Peruvian ethnohistory that when the Inca emperor died, his body was preserved. Yet sixteenth century Spaniards, let alone Incas, did not call it a mummy—a specific materia medica made from ancient Egyptians that only recently referred to the dead as well. Although scholars have explored words indigenous Peruvians used for their dead—mallqui, aia, munao, yllapa—this paper articulates how Europeans included Andeans within the category of mummy. It argues that it hinges on the word embasalmado, or embalmed, and the specifically medical and royal meanings it implied. Early Spaniards to Cusco described the Inka dead as como embalsamados. It was only when they were confiscated in 1559 that ‘como’ was definitively dropped.

This change likely owed to Inka testimony, but also to the dead’s physical examination in Spanish contexts as medical as they were religious. While non-Inka dead continued to be described as curado—as one did with leather or meat—the Spanish identified the Inka dead as treated with balsam or a similar material, which established Inka medical expertise at this specialized art, and forestalled speculation that their incredible preservation owed to saintly grace. As José de Acosta and Garcilaso de la Vega’s scientific and surprisingly emotional descriptions circulated in the Atlantic world, English and French translators favorably compared Peru’s dead to that of ancient Egypt, making Peruvians capable of being mummies, and—notable in the history of mummy studies—mummies capable of being non-Egyptian.

Drawing 151, “Defunto Guiana Capac Inga, Illapa [el rayo] / Lo lleuan a enterrallo al Cuzco. / Traen el defunto de Quito a enterralle a su bóbeda real. / del Cuzco,” Felipe Guaman Poma de Ayala, Nueva Corónica y Buen Gobierno (1615), 377 [379].
18.2 The study and circulation of Peruvian mummies in the Atlantic World and Americas, 1790-1893
Christopher Heaney

In 1822, the Protector of Peruvian Independence, José de San Martín, sent King George IV of England an "Inca" mummy for the British Museum. This seems to have been the first Andean mummy successfully exported from Peru. Further representatives of pre-Columbian Andean death followed in the century to come. This paper explores the production, movement, and preservation of the Andean dead as both objects and subjects of science in the nineteenth century, offering a more political, post-colonial, and transnational beginning for mummy studies in the Americas. It argues that San Martín sent his mummy to reclaim the embalmed and sovereign reputation that the Incas had enjoyed in the Early Modern Atlantic World. It also demonstrated how the Peru’s particularly preserved dead could be useful in the study of the indigenous American biological past.

Andean mummies and skulls began to fill early biological museums and collections in the Americas and Atlantic World, such that the “ancient Peruvian” dead became the first and foremost population in the Smithsonian Institution, the Harvard Peabody Museum, and Chicago’s Field Museum. In the 1910s, Peruvian archaeological law almost ended the flow entirely. By re-estimating Peru’s importance for the nineteenth century study of indigenous history via its dead, rather than Northern European archaeological theory, this paper therefore suggests a more Andean chronology for mummy collecting in the Atlantic World, and a means of re-estimating their remains in museums.

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El estudio y la circulación de momias peruanas en el mundo Atlántico y América, 1790-1893.

En 1822, el Protector de la Independencia del Perú, José de San Martín, mandó al Rey Jorge IV de Inglaterra una momia “Incaica” para el Museo Británico. Es posible que esta haya sido la primera momia andina exportada exitosamente del Perú, y a la cual siguieron muchas más en los años después. Esta ponencia sugiere que la “fabricación,” movimientos, y preservación de los muertos andinos en el siglo 19º nos ofrece un comienzo más político, post-colonial, y transnacional para el estudio de las momias en las Américas. Propone, por ejemplo, que San Martín envió la momia para reafirmar la reputación soberana que gozaban los incas embalsamados en el mundo atlántico de la modernidad temprana, así como el modo en que los bien preservados muertos del Perú podían ser utilizados en el estudio del pasado biológico de los indígenas americanos.

En el siglo XIX las momias y cráneos andinos comenzaron a llenar las primeras colecciones y museos de biología en las Américas y el mundo Atlántico, al punto de que los “antiguos peruanos” se convirtieron en la primera y más grande población de los museos Smithsonian, Peabody (Harvard) y el Field (Chicago). Para la década de 1910, las leyes arqueológicas del Perú frenaron este tráfico de momias casi en su totalidad. Al reconsiderar la importancia de los muertos peruanos para el estudio decimonónico de la historia de los indígenas americanos, este trabajo sugiere una cronología más andina para la historia de las colecciones de momias en el mundo atlántico, y una mejor medida para reevaluar su preservación en los museos.
18.3 New contributions to Ancon bundles studies based on their intervention made between 1956 and 1962

Lucía C. Watson

This paper presents new information about funerary aspects of the bundles from The Necropolis of Ancon, located on the central coast of Peru. This Necropolis is one of the biggest and most extensive Pre-Hispanic cemeteries in the Andes. It was excavated by Julio C.Tello -Father of Peruvian Archaeology- from 1945 to 1949, but he could not finish his task because of his death. That excavation was completed by his student Rebeca Carrion Cachot. This research was conducted on information drawn from 48 digitized field notebooks.

The data was processed and integrated using a geographic information system (GIS) that allow us to visualize spatial distribution of 1570 tombs and the location of their funerary bundles. This study focuses on 55 bundles opened, by the National Museum of Peru, between 1956 and 1962 as part of a conservation project.

The analysis of the notebooks lets us know how bundles were built: their structural characteristics, offerings, treatment of the body (tattoos) and ornamentation of the individuals. The bundles in this sample include men, women and sub-adults of the Chancay Culture (1100BC-1532CE). Individual bundles containing multiple individuals were studied. By interpreting archival records in a new way, this study provides new insights regarding Chancay funerary customs and their social implications.

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18.4 The mummies of Andagua, southern Peru: an archaeological, ethnohistoric and ethnographic assessment

Alexander Menaker¹, Victor Falcón Huayta²

This paper examines the community of Andagua and their recovery of several mummies in the past 30 years, and places this recent discovery in a broader longue-durée perspective situating it within the Valley of Andagua’s dynamic past. Evident in a robust historical court case from the mid-18th century, the community of Andagua and the surrounding valley were central actors in and the setting for one of the latest known cases of the continuing veneration of local mummies as well as Spanish colonial efforts in the extirpation of idolatries in the mid-18th century. Furthermore, tacking back and forth between multiple lines of evidence this paper presents new archaeological data for the region (Andagua Valley) as well as ethnohistoric and ethnographic research that sheds broader light on local mummy traditions and interpretations of Andagua throughout the pre-Hispanic and Spanish colonial pasts, and continuing to the present with how the community and varying other groups currently regard the human remains from the past.

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Las momias de Andagua, sur del Perú: una evaluación arqueológica, etnohistórica y etnográfica

Este trabajo examina a la comunidad de Andagua y la recuperación de varias momias en los últimos 30 años, colocando este reciente descubrimiento en una perspectiva amplia y de larga duración, situándolo dentro de la dinámica del pasado del Valle de Andagua. Evidente en un grueso histórico caso judicial de mediados del s. XVIII, la comunidad de Andagua y los alrededores del valle fueron actores centrales colocándolos en el escenario de uno de los últimos casos conocidos de la continuidad de la veneración de momias locales así como de los esfuerzos coloniales españoles de extirpación de idolatrias en esa misma época. Además, yendo atrás y adelante entre múltiples líneas de evidencia este trabajo presenta nuevos datos arqueológicos para la región (valle de Andagua) así como también investigación etnográfica y etnohistórica que hecha más luces sobre las tradiciones locales de momias y las interpretaciones de Andagua a través del pasado prehispánico y colonial, continuando hasta el presente con la pregunta: ¿cómo consideran actualmente, la comunidad y varios otros grupos, los restos humanos del pasado?
18.5 The Marquis of Santiago de Oropesa and the mummies of the Inca royalty

Stefan Ziemendorff*

After various failed attempts to locate the mummies of the Incan royalty, among them Pachacutec, Huayna Capac and his mother Mama Ocllo, in the ancient San Andrés Hospital of Lima it is time to review the alternative hypotheses, which indicate that the remains are not there. This presentation will analyze the most intriguing of these hypotheses which was put forward for the first time by José de la Riva-Agüero in 1937. His hypothesis states that the mummies were extracted during the government of vice-king Francisco de Borja and most likely handed over to his family, the Marquis of Alcaníces and of Santiago de Oropesa. He arrives at this conclusion based on a statement made in the “Epítome cronológico”, attributed to José Llano Zapata, that the Marquis of Alcaníces exhibited the head of Pachacutec in his palace in 1776. Surprisingly this head remains in possession of the Marquis until today and it can be proved that it is not from Pachacutec and therefore this hypothesis can be discarded. Excluding this possibility makes it more likely that the sought-after remains are still in the basement of the former Hospital San Andrés.

The head that remains in possession of the Marquis until today is a shrunkn head - it can be proved that it is Pachacutec.

Detail of a Late-seventeenth-century painting showing the wedding of Inca imperial descendant Ana María Coya de Loyola and Juan Enriquez de Borja, Marquis of Santiago de Oropesa, both suspected of extracting the mummies of the Incan royalty from the ancient San Andrés Hospital of Lima.

Detail of a replica of Pachacutechs
Mummy made by artist William Mérida
not from (Inkariy Museum, Calca, Cusco)

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18.6 Following the traces of the Royal Inca mummies at the San Andres hospital in Lima

Antonio Coello¹, Brian Bauer²

The antique Hospital of San Andres was founded in colonial times and it received the remains of the inca mummies as a consequence of the process of destruction of the Andean religion by the Spanish. During this process many idols and ceremonial structures were destroyed, and the remains of the royal inca mummies found in Cuzco were brought to Lima. Those mummies were displayed as a “war Trophy”. Inca Garcilaso saw them and left a very good description. Later on, many other chronicles stated the same as Garcilaso, until they were forgotten.

As years passed Saint Andres kept on functioning as a hospital and suffered many architectural changes, until in the XIX century, Marino Odriozola spread the news about the Inka mummies after finding some bone remains, immediately many researches started to provide ideas about the Inka’s last dwelling. This research continued until the XX century when the excavations of historian Riva Agüero found bone remains inside the chapel, nevertheless these remains might have been of priests. We believe that the San Andres hospital was not considered a colonial cemetery, and this might have caused caused the misunderstanding.

At the end of the XX, century, a project sponsored by National Geographic and the University of Chicago- Illinois, co-directed by Dr. Brian Bauer and Antonio Coello was developed at San Andres. Modern technology like GPR was used to identify areas with possible human body remains, as well as funerary structures. After this first phase the project involved archaeological excavations around the hospital, unfortunately the mummies were not found, although important remains from the Medicine Faculty and a colonial cemetery were found.

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19.1 The Lady of Cao, the tattooed mummy from the northern coast of Peru. La Dama de Cao, una momia tatuada de la costa norte del Perú

Régulo Franco

A partir del 2006, la Fundación Wiese y la revista National Geographic dieron a conocer el descubrimiento de la tumba de una mujer que fue denominada “Señora de Cao” en la Huaca Cao Viejo del Complejo Arqueológico El Brujo, en la costa norte del Perú. Este hallazgo remeció las teorías sobre el poder de la mujer en las antiguas civilizaciones del Perú y constituye un acontecimiento de alto valor histórico y científico para el Perú. El contexto funerario fue ubicado en la parte superior de la esquina noreste de un templo Moche, su datación se remonta al siglo IV d.C.

La apertura del fardo funerario sin precedentes, consistió en identificar las distintas capas superpuestas que lo contenían, que en general estaba formado por una apreciable cantidad de textiles y elementos metálicos, así como ofrendas. El tratamiento del fardo funerario requirió de un trabajo sistemático y cuidadoso. El Dr. John Verano de la Universidad de Tulane identificó que se trataba de la momia de un personaje femenino que murió entre los 20 y 25 años de edad, tenía 1.48 m. de estatura y padecía de un absceso o apostema en la muela del juicio (Verano, comunicación personal, 2005).

Los antropólogos John Verano, Guido Lombardi, Sonia Guillén y Jordi Esteban, coincidieron en señalar que el vientre altamente dilatado de la Señora de Cao y algunas características físicas observadas respondía a una muerte dentro de una etapa de post parto, con muchas posibilidades de la ocurrencia de una pre-eclampsia.

Se identificaron en el cuerpo de la Señora de Cao, tatuajes en los antebrazos y en los pies, de serpientes, arañas, felinos, y figuras geométricas. El estudio del pigmento utilizado en los tatuajes realizado por el Dr. Víctor Vásquez Sánchez, llegó a la conclusión que se trata de óxido de hierro. Existe la posibilidad que los tatuajes fueron realizados con agujas de metal como una primera opción, o quizás espinas de peces como una segunda opción.

La presencia de cinabrio (Sulfato de mercurio) en algunas partes del cuerpo, especialmente en el rostro, jugó un rol importante en su preservación como un elemento tóxico, así como la presencia de los iones de cobre de los artesanos que evitaron que los agentes microbiológicos se reproduzcan y destruyan la piel.

La presencia de sales en el cuerpo, observada por la Dra. Sonia Guillén y el análisis electrónico de microscopía de los fragmentos la piel, realizados por los Doctores Víctor Sánchez y Jordi Esteban, demostraron la presencia de un alto contenido de sodio. Bajo esta premisa, se establece que el cuerpo de la dignataria fue ritualmente lavado con agua marina después de su deceso.

Este descubrimiento representa la primera tumba de una mujer gobernante como un hecho inusual, por la naturaleza de su género y trascendencia cultural.

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El cuerpo de la Señora de Cao al final del trabajo de apertura del fardo funerario.

Ubicación de la tumba en la parte superior del lado derecho de la Huaca Cao Viejo.

Proceso de apertura del Fardo funerario, se observa la presencia de un estandarte en uno de los niveles.

Torso de la Señora de Cao con sus ornamentos personales.

El cuerpo de la Señora de Cao al final del trabajo de apertura del fardo funerario.
19.2 The Paracas mummies, from myth to reality

Mellisa Lund¹, Elsa Tomasto-Cagigao¹

Recent studies of Paracas individuals that were displayed as “mummies” in different museums at Peru showed that they were no mummified bodies but bones with little soft tissue preserved, that were artistically set up to give the impression of a mummy covered with textiles. Also C14 analysis carried out to a mummy whose cranial shape modification suggested a Paracas origin, which was also displayed as a typical Paracas mummy, resulted in a more recent date. In this context the question arises about the source of the myth of Paracas mummies. Is it really a myth and no true Paracas mummies existed ever? Or the mummies discovered by Tello decomposed very quickly when they were moved from the arid south coast of Peru to the humid capital, Lima? Until very recently there was no answer to these questions, as most openings of Paracas funerary bundles occurred more than 50 years ago and the access to the records of these studies was difficult. Nevertheless, in the last 10 years two more openings were carried out, giving firsthand information about the state of preservation of the bodies inside the bundles. Together with information from archives, this data sheds light about the Paracas process of mummification as well as the changes that occurred to these bodies during their curation time at museums around the world.

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First display layer of bundle 298

Second display layer of bundle 298

Detail of the interior of bundle 381
19.3 Mallquis, ancestors of the Ayllus. Documentary and archaeological evidence

Guillermo Cock

The Mallquis have been described as the human remains from the ancestors of the Ayllus. The references to these “mythical” individuals are scarce in the 16th and 17th centuries chroniclers, which concentrated in the “beliefs” at the state level. However, in the documents left by the extirpation of idolatries process, in the 17th and 18th centuries, is where we have most of the information and the more detailed descriptions of Mallquis. That because they were considered as sacred ancestors at the level of the community and were considered as the creators of the ayllus, something that allowed the members of the community to reconstruct a sacred or mythical genealogy, related to a common ancestor.

One of the Mallquis principal characteristics is that they were represented by mummified bodies, which were venerated at given times during the year. In the highlands, the Mallquis were placed in Machays or Machayes, which were caves or buildings where the bodies wrapped in textiles were left exposed –not buried.

On the Coast, the documentary references to Mallquis are less frequent, and the bodies do not seem to have been left exposed, but were buried. In the Puruchuco cemeteries, which we excavated in 1999-2001 and 2004-2006, we try to determine if some individuals were Mallquis, but we did not find the necessary evidence to conclude.

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19.4 Mummies and Art

Anna-Maria Begerock¹

Mummies from Egypt and South America have always fascinated people. Unsurprisingly, they inspired artists as well, who sketched, drew and painted mummies or even used them as a primary resource for their paintings. This presentation shows different uses and influences, comparing the differences between Egyptian and South American Mummies. Also we show the evolution from scientific illustration and to being included in comic art and inspiration for paintings by Munch and Gauguin.

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19.5 A mummy of the Chachapoya culture in the works of Gauguin, Munch and others
Stefan Ziemendorff

In 1967, the American modern art expert Wayne V. Andersen postulated that a Peruvian mummy was one of the sources of inspiration of the painter Paul Gauguin and there is now definitive evidence that confirms this hypothesis. In addition to the paintings mentioned by Andersen, a series of figures in many of Gauguin’s other works are believed to have been inspired by the mummy. For the first time a complete list of Gauguin works that appear to have been inspired by the mummy is compiled and the strength of such claims reviewed. Also in 1978 the art historian Robert Rosenblum deduced that the central figure of Edvard Munch’s famous painting The Scream was inspired by the same mummy that inspired Gauguin. New evidence that confirms this hypothesis is presented, rejecting alternative explanations.

As Gauguin and Munch having been very influential on modern art, it is unsurprising that other artists have been inspired by them not only stylistically, but also by the motif of the mummy. A number of art historians have been able to identify artists inspired by the mummy, including Mario Vargas Llosa, Pablo Picasso and Henri Matisse. However, the references to the mummy in their art are scattered and have not been connected until now. For the first time there is now an extensive list of works which evince a possible direct or indirect inspiration by the mummy. Because of its role in modern art history, it is important to understand and collect all the facts related to the origin and history of the mummy, especially how it was found and how it came to Paris in the late nineteenth century.

Additionally, the mummy is now known as the remains of a Chachapoyan warrior and the archaeological site where it comes from is identified.

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Location map – Chachapoya culture and archeological site where the mummy that inspired Munch and Gauguin were found.
19.6 Chachapoya mummy and drilling trepanation: an experimental anthropological study

Christophe Bou1,2,3, Larbi Benali2, Christophe Lair3, Arnaud Ansart3

South American trepanation trends over 2000 years, and numerous studies show that trepanation can be found in nearly all the regions of the Peruvian Andes dating from 400 BC to the Late Horizon. Trepanation, a surgical procedure involving the intentional penetration and the removal of a part of the cranial vault can be divided into four broad categories: scraping / linear cutting / circular grooving / boring and cutting.

According to Verano (2003) two different trepanation methods were found in the Chachapoya region of northern Peru: circular growing and boring-cutting.

The Museum of Man in Paris includes in its collection a Chachapoya mummy with a large drilling and boring trepanation, however little information exists on the methodology used. The objective of this work is to reproduce the “modus operandi” used for this skull trepanation through an archaeological experiment. First, CT scan analysis and photos of the skull allow us to identify the parameters characterizing the trepanation. Then the manufacturing of tools, flint and obsidian arrowheads were tested on bones and animal skulls in order to validate the choice of the materials. To validate our working hypothesis and reproduce the mummy trepanation, a human skull experiment is performed in the anatomy laboratory of Bordeaux.

Experiment marks are analyzed according to various methods: binocular microscopy, 3D laser acquisition and photogrammetry and then compared to the Chachapoya mummy trepanation. The results that stem from the experimental trepanation allowed us to understand the operating difficulties of this medical act, but also provided the opportunity to discuss the indication of this type of drilling trepanation: therapeutic or a mean for better understanding of cranial anatomy and improvement of techniques.

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3. National Museum of Natural History (MNHN) Paris France
Symposium 20. The study of mummies in the reconstruction of mortuary rituals

Chairs:
Elsa Tomasto-Cagigao, Pontificia Universidad Católica del Perú
Lucía Watson, Universidad Nacional Autónoma de México

20.1 Bundles from the necropolis of Ancon: a methodological proposal for the study of museum material

Lucía Watson Jiménez1

This work aimed at getting an insight into the construction process of Chancay funerary bundles from the Necropolis of Ancon, central coast of Peru (AD 1100 – 1532). Results improve our understanding of mortuary ritual of that period and their social implications. A sample of 112 bundles was studied. Their contextualization was based on archival data, direct observation, and Osirix® CT-Scan 3D reconstructions. Combined information clarified the following: minimal number of individuals per bundle, the position of the bodies inside the bundles, and the relationship of the paraphernalia to these bodies; all in all, explaining how each bundle was made and setting up construction patterns based on variables such as sex and age. In consequence, a new methodology to work with bundles without context integrating different type of data is proposed. Our results suggest the Chancay offered different mortuary treatments for men, women, and sub-adults. For instance, associated offerings were differentiated according to sex, age and status. However, it was not possible to establish a definite pattern for body or offerings’ positions inside the bundles. Evidence also suggests that the sample represents a local kinship group hierarchically organized, in which funerary bundle construction patterns were shared by the entire population.

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20.2 The lord of cotton: study of a Chancay-Inca funerary bundle

Arturo Ruiz Estrada¹, Kit Nelson², Elsa Tomasto-Cagigao³, Carmen Thays⁴, Mellisa Lund⁵, María Inés Velarde⁶

We present the results of the study of a Chancay-Inca funerary bundle found at the monumental archaeological complex of Rontoy, valley of Huaura, North of Lima. The tomb was located below three niches inside one of the largest spaces of the complex possibly corresponding to a plaza. Most interments of this time in the valley of Huaura are located in non-monumental areas, so this tomb is atypical. Next to the bundle several textile and ceramics offerings were found. The bundle contained the remains of a male, approximately 40 years old. The study of the body showed elements suggesting evisceration through the anus. The excellent preservation of organic materials allowed a detailed reconstruction of the procedures used to build the bundle that apparently occurred in two moments. Typical elements of masculine clothing, such as unkus (tunics), loincloths, headdresses and slings were identified, as well as nine mantles. Between the mantles agriculture products and tools were disposed in a symmetrical and dual way. Next to the individual a little idol or cuchimilco dressed in the same way as the personage was found. In the presentation we propose hypothesis regarding the importance of the personage and the symbolic content of the associated elements.

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4. Museo Nacional de Arqueología, Antropología e Historia del Perú
5. Museo de Arte de Lima
20.3 A pre-Columbian funeral bundle from the Santa Rosa necropolis (Lima, Peru), an example of virtual excavation

Christophe Moulherat\textsuperscript{1}, Philippe Charl\textsuperscript{2}, Sylvain Ordureau\textsuperscript{3}, Omar Bouhelal\textsuperscript{4}, Paz Núñez-Regueiro\textsuperscript{5}

We present the study of a pre-Columbian funeral bundle or fardo held by Musée du Quai Branly in Paris (France), registration No. 71.1878.54.83. We show the revolutionary contributions of new medical imaging tools to the knowledge of complex objects.

The funeral bundle was collected in the necropolis of Santa Rosa, in the province of Lima, and was brought to Paris by Léon de Cessac in 1878. It entered the national collections (musée d’ethnographie du Trocadéro) the same year. The necropolis of Santa Rosa, less extensive than the famous necropolis of Ancon in the same region, was subject to systematic looting like many other sites during the 19th century. It delivered many painted black and white ceramics characteristic of the Chancay culture (AD 1100-1450); the mummy also dates from this Late Intermediate Period culture. The fardo is a representative anthropomorphic funeral bundle with a “false head”. But it is small in relation to the average fardos found in the area. The Chancay culture is associated with an artistic style that spans over four coastal valleys (Chillon, Huaura, Chancay and Rimac) of the Lima area, on the central coast of Peru; it comprises a set of urbanizations constituted by residential areas and cemeteries, which do not seem to reflect a centralized state system. The knowledge of this culture remains difficult due to lack of accurate contextual sources.

This fardo has been researched by virtual autopsy and multidisciplinary analysis (tomography and 3D printing). It revealed the presence of a young child about 5-6 years old (age estimated from tooth eruption). The observation of his skull showed a deliberate ante-mortem distortion from front to back, presumably produced by the traditional application of wood chips or bandages on the child’s forehead and temples since a young age. The child was placed upside down in a fetal position. The detailed observation of the body revealed that the child was the subject of special treatment as gutting. No cause of death or traumatic injury was found at the end of this review.

The child wears a necklace of stone beads and holds in each hand a perforated metal piece of polygonal shape and provided with a ring, each of which is covered with an unidentified organic material. Corncobs and spinning tools are placed on both sides of the child, to accompany him on his final journey and sustenance. He is wrapped in several layers of fabric and many piles of raw cotton to ensure good stability of the dried body, additionally reinforced by a series of reed stalks.

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20.4 Funerary behavior of highland *mitimaes* in the central coast of Peru: Pueblo Viejo-Pucara, Lurin valley (Late Horizon)

Martha Palma Málaga¹, Krzysztof Makowski Hanula²

In this paper we will present the results of the study of funerary behaviors, documented and analyzed during the excavations at Pueblo Viejo-Pucara, probable center of the Caringa-Huarochiri chiefdom, and one of the more complex settlements during the Late Horizon period (AD 1470-1533) in the lower valley of Lurin. Located in the area of hills between 400 and 600 m a.s.l., this settlement was occupied permanently by mitimaes of Huarochiri, and abandoned shortly before the Toledan reductions. Its population was probably responsible for the herds as well as safeguarding the sanctuary and oracle of Pachacamac. The individual and collective funerary contexts were found within and between residential structures (in patios and walkways), in accordance with the highland traditions of most of the inhabitants and while contiguous domestic spaces were in use. The osteological and contextual evidence comes from 136 individuals excavated in 22 different enclosures, located in one of five clusters of residential architecture (Sector III). However, the results are representative for the entire site. Systematic crossing of the archaeological and osteological information confirmed the transformation of some residential and deposit areas into single and multiple, primary and secondary burials. We also have found evidence of manipulation and transport of bundles, as well as other expressions of ancestors worship. Our findings are supported by the detailed record of the body treatments and the postdepositional interpretation within the methodological framework of Duday’s Archéothanatologie, among others.

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Map of Valle de Lurin Project
(Pueblo Viejo - Pucará y Pachacamac)
20.5 Did the Paracas have a single mummy bundling tradition?
Lucie Dausse

The discovery of well-preserved conical textile bundles in the Wari Kayan Necropolis on Cerro Colorado by Tello between 1927 and 1930 documented an emblematic funerary tradition of the Paracas society. The same site contains other, partly contemporary, funerary architecture, the Cavernas, whose study permits to understand the diversity of the treatment of deceased bodies and their significance during the middle and late Paracas periods (400 BC - 100 AC). This study is part of a doctoral thesis using two complementary sources to analyze 311 Paracas individuals. The first is the systematic consultation of Tello’s archives. The second is a biological analysis of the anthropological material available in the Museo de Arqueología, Antropología e Historia del Perú using current and reliable morphological methods and systematic biological identification.

A detailed analysis of the procedure that created each individual burial will be proposed and the Cavernas patterns defined, then compared with the other types of funerary architecture at Cerro Colorado site. The study of the body will be put in a broader perspective considering body treatment throughout the life cycle. Transformed since birth, the body becomes the support for identity construction. Death marks an important step in this process since the study of the bundle can shed light not only on funeral practice but also on social relations between members of the Paracas society.

¿Tenían los Paracas una única tradición de elaborar fardos?

El descubrimiento de fardos cónicos de textiles bien preservados en la necrópolis de Wari Kayan en Cerro Colorado, realizado por Tello entre 1927 y 1930 documentó una tradición funeraria emblemática de la sociedad Paracas. El mismo sitio contiene otra arquitectura funeraria parcialmente contemporánea, la Cavernas, cuyo estudio permite entender la diversidad de tratamientos de los cuerpos y su significado durante los periodos Paracas medio y tardío (400 BC - AD 100). Este estudio forma parte de una tesis doctoral usando dos fuentes complementarias para analizar 311 individuos Paracas. La primera fuente es la consulta sistemática de los archivos de Tello. La segunda es el análisis biológico de material antropológico disponible en el Museo Nacional de Arqueología, Antropología e Historia del Perú, usando métodos morfológicos confiables e identificación biológica sistemática.

Se propondrá un análisis detallado del procedimiento que creó cada entierro individual y se definirán los patrones Cavernas para luego compararlos con los otros tipos de arquitectura funeraria en el sitio de Cerro Colorado. El estudio del cuerpo será puesto en una perspectiva amplia, considerando el tratamiento del cuerpo a lo largo del ciclo vital. Transformado desde el nacimiento, el cuerpo se convierte en el soporte de la construcción de la identidad. La muerte marca un paso importante en este proceso, puesto que el estudio del fardo puede dar luz no solo a la práctica funeraria sino también a las relaciones sociales entre los miembros de la sociedad Paracas.

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20.6 Reconstructing practices at the necropolis of Wari Kayan in late Paracas times: Patterns in organic conservation as both data challenge and source of information

Ann H. Peters

In what ways and to what degree does the Paracas Necropolis burial pattern demonstrate a distinct mortuary tradition, culture or society from the nearby Paracas Cavernas shaft tombs? Comparisons in the structure and content of mortuary bundles in the Paracas Necropolis assemblage from the Wari Kayan cemetery areas indicates changes over time associated with different artifact styles. Burials associated with artifact assemblages related in style, technique and imagery to late Paracas share many features with contemporary burials from the Cavernas tombs and the Ocucaje region to the south. These include some aspects of mortuary practice and bundle construction, as well as the types of artifacts present. An analytic focus on the reconstruction of practices is essential for defining the difference among the mortuary traditions.

One challenge in the study of mortuary practice is variability in the information available. In this study of Wari Kayan contexts designated as late ‘Early Horizon’, the pattern of soft tissue conservation and associated data on body treatment have been documented for 12 individuals from a larger sample of 20 mortuary bundles analyzed based on archival documents and restudy of artifacts conserved in museum collections. Both the human body and the textiles and other artifacts that compose a conical bundle constructed around the deceased individual demonstrate unequal organic preservation, with better conservation in areas above the thoracic cavity. Areas of decomposition present a challenge for interpreting mortuary practices, particularly during the first phases of postmortem ritual.

At the same time, the fragility of textile fibers makes them a rich source of information on production practices, subsequent use and exposure, and certain practices that recurred during bundle construction and display

Most Paracas Necropolis bundles preserve fragmented textiles. In the National Museum intervention to bundle 352 in 1951 the fragments were transferred to Kraft paper, trying to keep the original shape and dimensions. We maintained this information in 2011 when the fragments were transferred to a support of stable material.

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20.7 Funerary contexts in Cerro del Oro, Cañete: a funerary tradition from the Middle to the Late Horizon

Giancarlo Marcone¹, Francesca Fernandini², Nina Castillo¹

The archaeological site Cerro de Oro, located in the lower Cañete valley, was constructed, inhabited and reconstructed by differentiated populations from ca. 500 a.C.-1550 a.C., and up till now. Recent excavations developed by the Qhapac Ñan Program, registered a series of funerary contexts associated to the Early Intermediate, the Middle Horizon, and the Late Intermediate/Late Horizon in different parts of the site.

This study aims to present the recent discoveries of mummies associated to the Late period, and to compare them with those from the Middle Horizon/Late Intermediate, when the local traditions were under the influence of foreign states. A preliminar analysis will focus on how, further than the foreign influences, the local traditions behind the construction of the funerary characters persisted or not, within a long historical sequence.

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20.8 ¿Who is this child? Study of a Republican burial at the Sanctuary of Pachacamac

Elsa Tomasto-Cagigao¹, Denise Pozzi-Escot², Isabel Cornejo², Carmen Thays³

During works of investigation and conservation of the final stretch of the Xauxa-Pachacamac main inca road or Qhapaq Nan, at the Sanctuary of Pachacamac, Central coast of Perú an unexpected finding appeared: a burial from Republic times. A small bundle made with a goat skin and fragments of feminine and masculine clothes contained the mummified remains of a child that was approximately 6 months old. The detailed study of the garments that he wore revealed that most probably the burial was made during the first years of the 20th century by middle class persons. At this time in Lima the Presbítero Maestro Cemetery, also named General Cemetery was in use. In this presentation we show the details of the mortuary context and explore the possible reasons why this child was not buried at the General Cemetery. Pachacamac was a prestigious oracle and pilgrimage center in prehispanic times and maintained its fame during the first years of Colony. It is possible that this sacred character endured in the collective imagination until Republic times and this fact could help to understand this finding.

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20.9 Mongolian cave burials, trauma, and the reconstruction of nomadic behavior
Bruno Frohlich¹, Tsend Amgalantugs², David Hunt³ and Judith Littleton⁴

In 2004 nine executed individuals were found in the Mongolian Gobi Desert, just north of the present Chinese border. The mummified bodies, dating to the Yuan and/or Ming Period included sub-adults and adults of both sexes. All bodies exhibited causes of death as strangulation and/or fractured cervical vertebrae. A few years later, Khitan Period cave burials, including mummified bodies, were found depicting severe and multiple head traumas. In 2011 Bronze Age burial mound excavations yielded a double burial with two adult males having extensive head trauma. Other mummified remains in Mongolia have shown similar injuries to the head, from either a blunt force or sharp force occurrences. Common for all of these cases, representing different cultural periods is that the applied mortuary practices are consistently similar and yet differ significantly from what is normal for the related time periods. These unique findings bring to question the impetus to these deaths - are they the products of warfare, ritual violence, punishment, or justified killings? All these options will be discussed. However a pragmatic justification for killings may be the means to ensure the survivorship of the Nomadic group.

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20.10 Revaluation of the Mexican mummified bodies through time: Model for a diachronic study

Oswaldo Camarillo Sánchez¹, Judith L. Ruiz González¹

The following proposal invites to a reflection from a bioethical and anthropological perspective about the findings of mummified people, which from the time of their discovery become social actors once again. Their positive revaluation as direct evidence of the past that can help us understand the culture, biology and lifestyle of a different time creates an awareness of the need to protect and conserve this cultural heritage, preventing its destruction in favor of commercial interests. However, ignorance and very scarce information received by the public favor a negative appraisal. In the Northern region of Mexico, pre-Hispanic mummies are looted from rock shelters to be sold abroad for different purposes.

While death, from a Western perspective, marks the end of the vital expression of the human being, it is an event that defines a further stage in the symbolic transformation of the person, the ultimate rite of passage. However, from the Mesoamerican perspective, death is not the last social act of the individual. Despite the pass of time and the inevitable oblivion, people who became nameless dead are transformed once again into social actors after the discovery of their mummified remains.

A reflection on the context of the discovery of these mummified individuals allows us to understand their new role in history, creating a bridge through time that makes it possible to reintegrate them into contemporary society. The discovery is the phenomenon that opens the door to their resignification and their new categorization (positive or negative) will depend on the social, political and economic context in which it is made. We will make a historical review of how this revaluation has played in different times and places.

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1. Mortuary practices in the Late Period: The Memphis necropolis not pertaining to the elite. An approach from the Egyptian collection of Museo de La Plata.

Maria Belén Daizo

In the Late Period Ancient Egypt (664-332 BC), there were inhumations in the Memphis necropolises corresponding to new social groups that arose due to political and economic changes. These burials were collective and belonged to individuals external to the Egyptian elite of the period. This is an interesting phenomenon as it has not received too much attention. The funerary practices of these groups are not very well known, especially the process of mummification, due to the fragmentary state of the archaeological register and the absence of titles in the coffin inscriptions. The interpretations of the symbolic representations, their inter- and intra-group relationships, and the aspects related to their quality of life will be approached. It is proposed that these groups emulated the elite ones and that they had access to certain similar resources. To prove this, demotic papyrus belonging to priests in charge of the mortuary cult in the Memphis necropolises will be analyzed. The remains of two mummified individuals from these necropolises, with their respective coffins—in excellent conservation state, belonging to Museo de La Plata (Buenos Aires, Argentina)—will also be under analysis.

In this research, the study of the pigments, the inscriptions and decorations of the coffins, as well as the study of the mortuary treatment and the individuals’ quality of life will be considered. The results of this work will be detailed and examined in context, pointing out the importance of the local mummification study and its contribution to the issue of the social and symbolic dynamics of the Late Period in Egypt.

Prácticas funerarias en el Egipto Tardío: la necrópolis de Menfis no perteneciente a la élite. Una aproximación a partir de la colección egipcia del Museo de La Plata

En el Antiguo Egipto durante el Periodo Tardío (664-332 a.C.), aparecen inhumaciones en las necrópolis menfitas correspondientes a nuevos grupos sociales que surgen producto de cambios políticos y económicos del período. Estos entierros se caracterizan por ser colectivos y por pertenecer a individuos ajenos a la élite egipcia del período, lo que resulta en un fenómeno interesante ya que no ha recibido demasiada atención. Sus prácticas funerarias no son del todo conocidas, especialmente el proceso de momificación, debido al carácter fragmentario del registro arqueológico y la ausencia de títulos en las inscripciones de los ataúdes. Se abordarán los aspectos relacionados a interpretar las representaciones simbólicas, sus relaciones inter e intra grupales y aspectos relacionados con su calidad vida. Se propone que estos grupos emulaban a los grupos de élite y que tenían acceso a ciertos recursos similares. Para ello, se analizarán papiros demóticos de sacerdotes encargados del culto mortuorio en las necrópolis menfitas y los restos de dos individuos momificados—con sus respectivos ataúdes—provenientes de estas necrópolis en excelente estado de conservación pertenecientes al Museo de La Plata (Buenos Aires, Argentina).

Se contemplará en su análisis el estudio de los pigmentos, las inscripciones y la decoración de los ataúdes; así como el estudio del tratamiento mortuorio y la calidad de vida de estos individuos. De este modo, en esta investigación se detallarán los resultados de estos estudios examinándolos en su contexto, señalando la importancia del estudio de la momificación a nivel local realizando un importante aporte a la problemática de las dinámicas sociales y simbólicas del Periodo Tardío en Egipto.

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2. Sampling of microorganisms from Egyptian mummies of the National Museum of Rio de Janeiro, Brazil: A successful adaptation of the vacuum cleaner model

Ricardo França Alves dos Reis¹, Sheila Mendoça de Souza¹

The sampling of archaeological materials is expected to preserve their structure from physical damage like breaking or crumbling. Sampling devices have to be adequate to the characteristics of surface and the kind of material to be collected. Pulverized samples are the source of biological material like parasite eggs, spores, pollen, etc., that can be collected in archaeological materials. Tools such as tweezers, scissors, swabs and scalpels, may not be able to capture them, especially if the material to be sampled is trapped in textiles, inside the roughness of irregular surfaces, or even in the holes and gaps of mummiﬁed packs. The use of the conventional devices described above to collect multiple samples demands multiple sterile devices and speciﬁc storage procedures. In order to save time, preventing cross-contamination and improving the collection of pulverized samples in different conditions an adapted mini vacuum cleaner was developed and tested in a recent study, that aimed to evaluate the fungal contamination at two Egyptian mummies from the National Museum of Rio de Janeiro – Brazil. The adaptation consisted of adapting a connection tube to the vacuum cleaner in order to use disposable pipette tips protected with cottons pellets inside to sampling. Disposable urethral catheters were connected at tips when necessary, to sample inside narrow spaces. Some sampling using the conventional devices was also proceeded for comparison, especially conﬁrming time saving when vacuum cleaner was used. From a total number of 18 samples collected, 12 fungi strains were isolated and 4 different fungi genera could be previously identiﬁed. The authors recommend the use this adapted model of utility, not only for mummiﬁed material, but also for other samplings of pulverized material from archaeological or other contexts.

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3. Dental investigation of mummies from the Capuchin Catacombs of Palermo (circa 18th– 19th century AD)

Roger Seiler¹, Dario Piombino-Mascali², Frank Rühli¹

At the end of the 16th century, construction started on the Capuchin Catacombs of Palermo for use as a burial site for deceased friars. Over time, large subterranean corridors were carved out of the large deposit of tuff that underlies the Capuchin Church and Convent. The first preserved bodies were interned in 1599. Later on, until the catacombs fell into disuse in the 20th century, the layity and the citizens of Palermo chose? and paid? to be exposed after death in this “gallery of the dead”. Within the framework of the Sicily Mummy Project, the orofacial complex of a significant sample of these individuals were inspected and their dentitions investigated with an endoscope.

The recorded findings describe the preservation state of both skeletal and soft tissues, dental pathologies such as carious lesions and alveolar bone loss, enamel hypoplasia, and ante- and post-mortem tooth loss. From their position within the corridors of the Catacombs, sex and social status of the mummies – e.g. friars, laymen and women – could be inferred and an overview of dental problems of not only the community of the Capuchin friars, but also parts of the urban society of Palermo was accomplished. The frequencies of pathologies were compared between these populations. Interestingly, no differences in the caries frequency of friars and laymen were found, despite their different diets and ways of life. Attempts were made to link sociocultural and political aspects and the anthropological results, and the interpretations benefitted from a multidisciplinary perspective, including historical, social, and anthropological information.

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4. The late Monsignor Antonio Franco (1585-1626): computerized facial reconstruction of a Neapolitan blessed

Dario Piombino-Mascali¹, Sarah Shrimpton², Caroline Wilkinson²

Although generally employed for forensic identification purposes, facial depiction from human remains has often been utilized to evaluate the in vivo appearance of historic figures. While manual methods have been developed since the late 19th century, most notably by Russian, American, and English researchers, the advent of computerized systems in the late 20th century has allowed more effective and objective procedures. This paper presents the investigation into the facial appearance of a religiously significant individual, the blessed Antonio Franco of Naples, who spent much of his life in the Sicilian town of Santa Lucia del Mela, Italy. Within the framework of a survey carried out by the local Archdiocese prior to Antonio Franco’s beatification, which took place in Messina in 2013, the over-modeled head of the blessed was CT-scanned in order to produce a virtual replica of the skull and create a computerized facial reconstruction. The cranio-facial reconstruction involved interpretation of the preserved soft tissues using anthropological assessment, and a digital sculpting software (Geomagic FreeForm Modeling Plus) to predict how the face may have appeared in life. The finer details, such as hair and skin texture were added using a 3D modeling software (Pixologic Z-Brush). Bioanthropological data, along with historic documents and portraits of the subject were taken into account in order to provide his most likely appearance.

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El difunto Monseñor Antonio Franco (1585-1626): la reconstrucción facial computarizada de un napolitano bendecido.

Aunque generalmente empleada para propósitos de identificación forense, la representación facial de restos humanos se ha utilizado a menudo para evaluar el aspecto en vida de figuras históricas. Mientras que los métodos manuales se han desarrollado desde finales del siglo XIX, notablemente por investigadores rusos, norteamericanos e ingleses, el uso de los sistemas computarizados a finales del siglo XX han permitido procedimientos más eficaces y objetivos. Esta presentación se refiere a la investigación de la apariencia facial de un personaje de importancia religiosa, el bendecido Antonio Franco de Nápoles, quien vivió gran parte de su vida en la ciudad siciliana de Santa Lucia del Mela, Italia. En el marco de un estudio realizado por la Arquidiócesis local antes de la beatificación de Antonio Franco en Messina en 2013, la cabeza sobremodelada del bendecido fue escaneada con CTscann con el fin de producir una réplica virtual del cráneo y realizar una reconstrucción facial computarizada. La reconstrucción craneofacial involucró la la evaluación antropológica del tejido blando utilizando un software de escultura digital (Geomagic FreeForm Modeling Plus) para inferir la forma del rostro que pudo haber tenido en vida. Los detalles más finos, como el cabello y la textura de la piel se añadieron usando un software de modelado 3D (Pixologic Z-Brush). Datos bioantropológicos junto con los documentos históricos y retratos se tuvieron en cuenta a fin de proporcionar la apariencia más probable.
5. Natural mummification in a Mediterranean climate: a case study of a domestic cat

Maria Rita Palombo¹, Marco Zedda²

It is well known that natural mummification processes in humans as well as animals occur in wide world areas characterized by tropical and dry climates (respectively Group A and B following the Köppen's climate classification), but rarely under temperate conditions. This research aims to describe a natural mummification process underwent by a domestic cat belonging to the European breed under a Mediterranean temperate climate (Group Csa/Csb). The cat, forgotten and considered missed some years ago at the end of summer in a holiday house located in the southwestern coast of Sardinia (central Mediterranean), was found mummified by the owners at the next summer. We performed different analyses to understand the modification of the topography and structural organization of organs and tissues that occurred during this amazing natural mummification process. Radiographic investigations were made to visualize the skeleton disposal, autopsy dissections allowed to describe thorax and abdomen visceral organs, and histological sections of soft mummified tissues have been prepared to study tissue alterations.

The death of the cat was probably caused by starvation, that joined to the effect of the high summer temperature allowed a rapid dehydration, avoiding any putrefaction process. In cats, the starvation, indeed, leads to death within few weeks, causing a progressive dehydration of the soft tissues. Therefore, it could be hypothesized that the natural mummification process of the cat was probably due to the interaction of the high temperature in the closed house and the condition of starvation, which was an important requirement for the complete dehydration that occurred post-mortem. This mummified animal represents an interesting model of a natural event, due to stochastic circumstances, that occurred in a geographical area unusual for a natural mummification.
6. Royal entourage mummies: an update on human remains findings in the Kings’ Valley Tomb KV 31 and KV 40 (Western Thebes, Upper Egypt)

Frank Rühl1, Sabrina Meyer1, Nakita Frater1, Roger Seiler1, Susanne Bickel2

In this study we present an overview of the human remains from tombs KV40 and KV 31 in the Valley of the Kings. Archeological findings point to burial periods in the 18th dynasty and a reuse / looting in the 21th dynasty, respectively. Additionally, in KV 40 ancient tomb robberies and massive destruction by fire in the late 19th century AD led to disintegrations of mummies and to burnt and fragmented human remains.

More than 80 individuals have been identified in KV 40, and five individuals in KV 31 so far, and all mummies were assessed anthropologically and paleopathologically. All age ranges from perinatal to late adulthood are represented in KV 40, with juvenile-adult mummies only in KV 31. Interestingly, approx. 30% of the individuals in KV 40 are juveniles which is unusual for a burial in this location. The adult sample shows a 2:1 ratio towards more females in KV 40. Mummified and pathologically altered remains were conventionally X-rayed with a portable x-ray unit. These radiological imaging data were used for anthropological (when standard methods were not applicable) and paleopathological assessments.

Skeletal developmental abnormalities (e.g. Achondroplasia, degenerative joint disease in the spine and long bones), as well as skullcap deformations and long-bone fractures have been found in KV40. The human remains found in KV 31 and KV 40 give crucial insights into life conditions and burial practices of this upmost time period in Ancient Egypt.

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7. Invasive technique in accumulation of knowledge for a better non-invasive studies on mummies

Myeung Ju Kim¹, Dong Soo Yoo², Dong Hoon Shin³

Scholars in South Korea, like those in the other countries, always care about the minimal damage to mummies while studying on them by various scientific methods. To reduce such destructions, non-invasive technique has been applied to the mummies as a top priority of examinations. Radiological technique becomes a main research tool for any of mummy studies around the world, for seeing the preservation status of their internal organs and getting any clues for medical diagnosis.

Although the academic importance of non-invasive technique for mummy studies is unquestionable nowadays, however, it still has many drawbacks because this method (for instance CT image analysis), even when employed by highly experienced radiologists, cannot clearly distinguish each mummified organ that was seriously distorted and dislocated by dehydration. Actually as our Aufderheide pointed out, such modern CT technique developed for diagnosing living patients could not be easily used for mummy studies.

At this point, we note that in clinical fields, the correct reading of CT images is firmly based on the accumulated scientific data, comparing repeated post-factum autopsy with its counterpart CT diagnosis. This means that even the mummy autopsy, despite its drawbacks, might be indispensable for concerned researchers, cannot clearly under a due consideration of ethics, circumstances and consensus about the need of such studies. As the cumulative results of such invasive study on mummies in fact guarantee more accurate CT readings for them in the future, on autopsy of mummies, for making our invaluable non-invasive techniques much authentic, must be considered much positively than before.

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8. Conventional vs. Computed and Digital Radiography Systems for Bioarcheology

James Skufis

Conventional radiography is an indispensable tool to the bioarcheologist because of the information it makes available. Radiography and medical imaging are fields in which the technology has been rapidly advancing in terms of how the images are acquired, processed, stored, and displayed, and this offers new imaging possibilities to researchers. For those considering setting up a field imaging site, the choices are screen-film radiography, computed radiography, and digital radiography imaging systems, but the choice of which system is best to fulfill a project’s needs is not a simple one when taking into consideration a site’s remoteness from supplies, utilities, and transportation.

This presentation will present the important technical and logistical considerations when selecting between a screen-film radiography, computed radiography, and digital radiography imaging system while working in the field with cultural remains so that those considering setting up a field imaging lab might make a more informed choice. To better understand these three technologies, a brief history and then a description of each of them with their inherent strengths and limitations relevant to working with cultural remains will be presented with, in some cases, specific examples from actual field work.

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9. Human migration patterns based on genetic haplogroup analysis of the human pinworm, Enterobius vermicularis, from coprolites

Amanda Rollins¹, Frederika Kaestle¹, Karl Reinhard²

The human pinworm, Enterobius vermicularis, is an intestinal helminth that has been identified worldwide in prehistoric coprolites from environmental contexts, as well as from in situ mummy coprolites. Since this parasite is transmitted through close personal contact, the genetic haplogroups of E. vermicularis can be used to elucidate the prehistoric migration patterns of its human hosts. Here, we reconstruct partial sequences of the E. vermicularis mitochondrial cox1 gene obtained from Ancestral Pueblo coprolites from Antelope House in the Canyon de Chelly, AZ (circa 1200 CE) and from Turkey Pen Ruin in Grand Gulch, UT (circa 400 CE), in addition to contemporaneous Mesoamerican coprolites from La Cueva de los Muertos Chiquitos in Rio Zape Valley, Durango, Mexico (600-1400 CE). Coprolite DNA was extracted at the Ancient DNA Laboratory of Molecular Anthropology housed at the Indiana Molecular Biology Institute. Overlapping primer sets were used to target a 300-330 nucleotide region of the E. vermicularis mitochondrial cox1 gene, and the resulting sequences were used to reconstruct genetic haplogroups. We analyzed these haplogroups to infer the spread of E. vermicularis infection, and then compared them to migration patterns extrapolated from published mitochondrial DNA sequences of prehistoric human remains from the greater American Southwest. Establishing the relationships of individuals within and between Ancestral Pueblo and Mesoamerican sites provides a comprehensive means of assessing the geographic origins of the original migrants and subsequent migration patterns during the Ancestral Pueblo occupation of the greater American Southwest. This is the first study to reconstruct genetic haplogroups from prehistoric E. vermicularis samples, and the results from this work will provide new insight into our understanding of the prehistoric distribution of the human pinworm.

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10. The Cuban Mummy Project

Anna - María Begerock¹, Armando Rangel Rivero², Mercedes González¹, Alina Lomba³, Amàlia Valls¹

For centuries Cuba was a key point on the trade routes to North and South America. Along with other goods, mummies came to this part of the Caribbean. The Cuban Mummy Project aims to undertake a multidisciplinary approach to study these, determine their origin and to reconstruct the lives and history of these people, before they were mummified. Initial results are already obtained and are presented here.

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11. Burials from Chavín de Huantar: late funerary practices through the analysis of taphonomic processes

Lisseth Rojas Pelayo

Chavín de Huántar is located at the confluence of the Mosna and Wacheqsa rivers, in the department of Ancash, Perú. It is one of the most important ceremonial centers of the Central Andes, and after its decline it was re-occupied by various societies such as: Huarás, Mariash, Callejón and Inca. The Programa Arqueológico de Chavín de Huántar, directed by Dr. John Rick, has been carrying out various investigations at the site for the last 20 years. In the most recent field seasons, the excavation area was comprised of the North Esplanade of Building C, where a series of walls adjoining the building’s facade were registered. These formed small adjacent enclosures in the interior of which four funerary contexts were discovered, so our sample consist in: three individual burial (primary context: 02 male and 01 child) and one multiple burial that contains (primary context: two individuals: child and infant), all of which were associated with the Post Chavín period.

These contexts make up the sample for this study, with the objective of determining the formal characteristics of the funerary events, such as the depositional sequence as determined through the analysis of taphonomic processes affecting the preserved skeletal elements. As results, we obtained that the best preserved skeletal elements correspond to the long bones, skull and vertebrae; being the most affected: ribs and bones of the hands and feet. The analysis of the taphonomic processes affecting these elements allowed for the determination of the nature of the individual’s deposition as well as a better understanding of the funerary practices employed by the people who re-occupied the ceremonial center in late periods, carrying out primary burials. Finally, the analysis allowed us to assert that all the burials were realized in closed events.
12. Bioarchaeological evidence of care provided to an individual with physical disability in the archaeological site of Pachacamac, Initial Ychsma (Late Intermediate period), Peru

Martha Palma Málaga¹, Krzysztof Makowski Hanula², Alain Vallenas Chacón²

During the last season of excavations of the Archaeological Project “Valle de Pachacamac” in the “Cuadrángulo Tello”, a complex structure (96m x 96m) located to the north of the Old Temple and with unknown function and chronology, it was defined a complex stratigraphy with eleven levels (layers A to K) above the sterile. The excavation has shown that the “Cuadrángulo Tello” was built during the Late Horizon, and no architecture was registered during previous periods. Beneath the layers corresponding to the Late Intermediate Period and Late Horizon we register a funeral area associated with Initial Ychsma and Viñaque ceramics. In this funerary area we excavated three burials whose bundles were intentionally poured with diluted clay (Layer J). Textiles were not preserved but their impressions were recorded in the inner surface of clay bath which has adopted the ovoid shape of the wrappings. Similar, covered a clay seal burials were also found by Regulo Franco and Ponciano Paredes near the Old Temple between 1986 and 1989. Among the funeral contexts excavated, the Funerary Context 3 is of particular interest: containing an elderly Female with serious congenital health conditions that have caused some kind of disability, and required special care. In this paper we explore, through the approach known as Bioarchaeology of Care, the differential diagnosis of her condition, assessing the extent of the condition and potential levels of disability, as well as the care and “medical” interventions borrowed this person with probable intention of improving her health.
13. Canis familiaris offerings in the Sanctuary of Pachacamac
Isabel Cornejo¹, Denise Pozzi-Escott¹

The Pachacamac Archaeological Sanctuary was occupied for over 1000 years, since the first century of the Christian era until to the arrival of the Spanish conquerors to America. During Inca rule it was the most important ceremonial complex of the central Peruvian coast, to which pilgrims arrived from different and distant places. Here the Incas established buildings that delimited and controlled the nuclear area, for receiving and organizing the flow of pilgrims, to the temples where the oracle of Pachacamac was located.

In this context, the MSPAC (Museo de Sitio de Pachacamac) research group has been conducting excavations in: the Second Wall and one of the accesses linked with the North-South Street, to fully understand the functions of those buildings. We recovered in excavations a number of offerings, which would date from the Inca period, consisting of anthropomorphic wooden sculptures, ceramic vessels and remains of more than twenty canines, of different ages and good state of preservation. Thanks to the multidisciplinary work of archeology, veterinary medicine, and arts, it has been possible to identify the species Canis familiaris and the variety of the phenotypic characteristics of the pre-Hispanic coastal dog.

The species identification and forensic analysis were performed using a collection of comparative material of modern individuals and specialized bibliographical sources. Age and other animal characteristics such as size, weight, etc., were determined taking into account the state of fusion of bones, their dimensions, and the development of the teeth (deciduous or permanent, and degree of wear).

Phenotypic reconstructions made by an artist have shown so far three varieties within the group of offerings. This approach allows us to propose a hypothesis about the presence, variety, and role played by these animals in the Inca period as they related to the sacredness of the Sanctuary.

Lisseth Rojas Pelayo¹, Sarita Fuentes Villalobos¹, Claudia Roque Gamarra¹

Huaca Middendorf is part of the Maranga Complex located in the Rímac Valley, associated with the Lima culture from around the late phase of the Early Intermediate and the start of the Middle Horizon (400-600 A.D.). Archaeological sites such as Parque de la Leyendas Archaeological Complex and Huaca 20, which also belong to the Maranga Complex, have revealed valuable information about the funerary practices associated with the Lima style, even before comparing the evidence with that of other sites from the complex, such as Huaca Middendorf. For this comparison, we reviewed the data published by Jijón y Caamaño (1949) about various funerary contexts separated according to their depth; this information was contrasted with the human remains recovered by Proyecto Arqueológico Maranga. Our sample is composed of disarticulated human remains without a specific context, defined as osteological conglomerates (Byrd and Adams 2003), from which was gathered information such as: minimum number of individuals, characterization of the identified individuals (sex, age), and a summary of the major lesions and/or changes in the osteological morphology. This data is relevant for the reconstruction of the biological profile of the population. Associated with the skeletal elements were found materials such as: fragments of reed (Phragmites communis) mats, ropes, fragments of textile wrappings, and fragments of Lima ceramics. The presence of these elements allows us to infer that the individuals from Huaca Middendorf represent contexts similar to those described from adjacent Lima sites with a feasible correlation between this sample and the individuals analyzed from Huaca 20 and Parque de la Leyendas Complex. This enables us to make comparisons related to the characteristics of the populations and conjectures about funerary rituals.

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15. Analysis, conservation and cleaning of two mummies from Huamanmarca in the Lima highlands (Carania, Yauyos), Peru

Elizabeth Enriquez¹, Flor Bovadin², Lizbeth Tepo², Martha Palma Málaga³

Huamanmarca archaeological site is part of the so-called archaeological landscape of “Carania”, a Late Intermediate Period and Inca settlement with a large system of terraces and channels associated with a pre-Hispanic road. Located at 3,940 meters above sea level, in the district of Carania (province of Yauyos, Department of Lima) and at 8 hours from the city of Lima, we found two mummies (one adult and one child) housed at the district City hall. These mummies were rescued from tomb looters or “huaqueos” that long ago disturbed Huamanmarca funerary structures. The mummies were displayed in the mayors’ office in a glass case without proper conditioning. Within the framework of the research project at Huamanmarca archaeological site, we started a campaign to recover looted archaeological materials from local “huaqueos” or archaeological materials in possession of residents.

In order to improve the conservation and general condition of the mummies, both of them underwent a cleaning and conservation process. Both mummies were affected by the presence of insects and loss of body parts due to the presence of traces of cigarettes, cocaine leaves and other materials –mainly food– that villagers left as offerings and were placed inside the glass case. According to the villagers, the mummies came from the upper sector of Huamanmarca, where two funerary contexts were also found during the process of cleaning of the archaeological site in 2009. The present study aims to present the data obtained from the cleaning process, conservation, paleopathological analysis, x-rays and biological profile of the two mummies. Furthermore, data will be compared with those obtained from the analysis of osteological material from archaeological contexts, since all of them were found in a sector with Inca occupation and related architecture associated with burial areas.

Conservación, limpieza y análisis de dos momias procedentes de Huamanmarca en la sierra de Lima (Carania, Yauyos).

El sitio arqueológico de Huamanmarca forma parte de un paisaje arqueológico denominado “Carania”, constituido por asentamientos con ocupación del Periodo Intermedio Tardío e Inca, con un gran sistema de andenerías y canales asociados a un camino prehispánico. Ubicado a 8 horas de la ciudad de Lima, a 3,940 metros sobre el nivel del mar, en el distrito de Carania (provincia de Yauyos, departamento de Lima). En este lugar, la municipalidad distrital albergaba dos momias (un adulto y un niño) rescatadas de huaqueos realizados en Huamanmarca hace algunos años. Las momias se hallaban expuestas en el despacho de la alcaldía en una vitrina sin condiciones adecuadas. Dentro del marco del Proyecto de Investigación y Puesta en valor de Huamanmarca se realizó la recuperación de materiales arqueológicos procedentes del huaqueo y que se hallaban en manos de los pobladores caraninos.

Las dos momias pasaron por un proceso de limpieza y conservación ya que se hallaban en mal estado de conservación y afectados por la presencia de insectos y perdida de algunas zonas del cuerpo, presencia de restos de cigarrillos, coca y otros alimentos que los pobladores dejaban como ofrenda al interior de la vitrina. Según las informaciones de los pobladores, las momias procedían de la parte alta de Huamanmarca en donde también se hallaron dos contextos funerarios secundarios durante la limpieza del sitio arqueológico realizada en el año 2009. El estudio a presentar expone los datos obtenidos a partir de la limpieza, conservación, perfil biológico y radiografías de las dos momias, que se compararán con los resultados obtenidos durante los análisis osteológicos de los materiales provenientes de los contextos arqueológicos mencionados, ya que todos ellos se hallaron en un sector con clara ocupación Inca y con arquitectura elaborada relacionada a las zonas de enterramiento.
16. Unwrapping two bundles from the Huachipa Project, La Capitana, Rimac valley, Peru

Elizabeth Enriquez¹, Martha Palma Málaga², Ana Fernández Valdivia², Rossana Mendoza¹, Augusto Neyra¹, Jacqueline Ángeles¹

During 2005 we developed the Archaeological Rescue Project Huachipa- La Capitana, at the archaeological site located within the existing facilities of the modern cemetery “Campo Santo Mapfre”. Archaeological rescue was performed on the southwest slope of a hill located in the edge of a rocky outcrop, located at the southeast sector of the archaeological site San Antonio. The rescued area showed evidence of severe looting (possibly occurring during the time of the “Hacienda” Huachipía and the “Establo San Antonio”, which was installed near the rocky promontory at the end of the 1950’s). Modern modification of the pre-Hispanic landscape included the removal of land for the design of a modern water channel, the construction of terraced fields and the use of the hill as a quarry that included a severe cut with machinery during the late part of the last century. Despite modern alteration, numerous funerary contexts of the Late Intermediate Period (60 cm. deep) and the initial period (2 m. deep) indicated that the use of this area as a cemetery over a long period of time. Numerous funeral contexts from the Late Intermediate Period were found, some of them disturbed and emptied without apparent order. Around 14 of 69 primary burials from the Late Intermediate Period that were identified and excavated belonged to infants. From these 14 funerary contexts, two small bundles of different types of packaging methods and materials were selected to undergo an unwrapping process and subsequent analysis of all the materials. This study presents data obtained from the analysis of the associated objects, the archaeological context, textiles, as well as the osteological and dental analysis of the two infants’ bundles. Finally, this information will be compared with all the analysis of skeletonized funerary contexts excavated from the funerary areas associated to the Late Intermediate Period.

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Desenfardelamiento de dos fardos procedentes del Proyecto de Rescate La Capitana, Huachipía, valle del Rimac

En el año 2005 se realizó el Proyecto de Rescate denominado La Capitana – Huachipía dentro de las actuales instalaciones del Campo Santo Mapfre. Los trabajos de Rescate se realizaron en la ladera media de un cerro, en el flanco sur oeste de un afloramiento rocoso ubicado al sur-este del sitio arqueológico San Antonio. El área rescatada presentó evidencias de intenso saqueo (posiblemente ocurrido durante la época de la Hacienda Huachipía y el establo San Antonio, que se instaló cerca del promontorio rocoso a fines de la década del cincuenta), remoción del terreno para el acondicionamiento de un canal, construcción de terrazas de cultivo, uso del cerro como cantera y severo recorte del área con maquinaria a fines del siglo pasado. Pese la alteración moderna del área, se encontraron numerosos contextos funerarios del Periodo Intermedio Tardío (a 60 cm. de profundidad) y del Periodo inicial (a 2 m. de profundidad) indicando el uso de esta zona como cementerio. Se hallaron numerosas matrices funerarias del Periodo Intermedio Tardío, disturbadas y vacías, distribuidas sin orden aparente, y sin mayor cuidado en cuanto al sello y relleno de las mismas. Se identificaron 14 entierros primarios de 69 entierros excavados correspondientes al Periodo Intermedio Tardío, la mayoría de ellos disturbados y pertenecientes a infantes. De esta forma, se escogieron dos pequeños fardos, de diferente conformación, tipos de envoltorios y materiales asociados que se hallaban sin alteración aparente dentro de unos hoyos circulares delimitados con cantos rodados, los cuales fueron desenfardelados y analizados. Este estudio presenta los datos obtenidos del análisis de los objetos asociados, el contexto arqueológico, los textiles, así como también de el análisis osteológico y dental de los dos infantes desenfardelados. Finalmente, esta información será comparada con el análisis de los materiales óseos de infantes provenientes del área funeraria del Periodo Intermedio Tardío.

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17. The finding of tattooed mummies in the funerary complex of Cerro Colorado, Huacho, Peru

Pieter Van Dalen Luna¹, Dayanna Carbonel Arana², Anton Samplonius Angobaldo¹

Cerro Colorado is a vast funerary complex located at the southern end of the valley of Huaura, in the district of Santa Maria. The advance of developments has made much of this complex gradually disappear beneath the houses, generated during nearly three decades of consecutive invasions. The rescue archaeological works developed between 2014 and 2015 in the Village Center Los Pinos has recovered nearly 2,000 funerary contexts dating to the Middle Horizon (Huaura culture) and Late Intermediate (Chancay culture); because this cemetery remained in use until the Spanish invasion.

Among the identified funerary contexts, figure near hundred medium characterized by presenting body tattoos on different body parts (face, chest, arms and legs), with representations of geometric shapes, waves, lines, points, etc. So far it is the most significant example of this kind of funerary contexts, retrieved from the central Peruvian coast. It highlights the plethora of materials associated with these contexts, including pottery, metals, textiles and other supplies; especially cuchimilcos, anthropomorphic ceramic figurines characteristic of the Chancay culture.

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18. The preservation of mummy bundles at the Arturo Jimenez Borja Site Museum in Puruchuco

Selene Figueroa¹, Rubén Buitrón¹, Clide Valladolid¹

The Arturo Jimenez Borja - Puruchuco Site Museum holds an important collection of mummy bundles, dating from different archaeological campaigns conducted since the 1960s. The mummy bundles came from various archaeological sites East of Lima, such as Puruchuco - Huaquerones, Rinconada de la Molina, Cajamarquilla, Pedreros, and Huanchihuaylas. Since 2013, a new policy for mummy bundle conservation started upon management of Clide Valladolid. Therefore, a diagnostic study of the risks to which the collection was exposed was performed; resulting in the identification of risk levels for each agent of decay. Based on these results and some particular characteristics of the collection, a methodology was devised for gradual implementation, according to available resources. Fortunately, in 2014, the museum was awarded the US Ambassador’s Prize, which was applied to preserve, among other assets, the museum’s valuable mummy bundle collection. This grant helped to speed up the process over 2015. The applied approach considers that each bundle resulted from a process in which layers of textiles, ropes, cotton balls, and other items were organized around one or more deceased individuals. We suggest there were different stages during the process of wrapping. Additional elements, such as ‘false heads’, clothing, wigs, and other accessories were also been added over the original mummy building process. Direct observation helped to characterize outer and inner wrapping items, the latter only visible in bundles with broken outer layers that allowed to see them. Direct observation then, also helped to reconstruct the original technique of placing wrapping and packaging items; therefore identifying different types of elements used by ancient Peruvians, probably dependent on chronological, chorological or other aspects or social origin. Conservation of mummy bundles comprises Preventive Conservation, which requires building a documentation corpus, along with the design and development of storage items, including shelves, and climatic monitors. Micro climatic monitoring is carried out before, during, and after curative conservation.

On the other hand, Curative Conservation, refers to the intervention actions that are performed directly on the cultural items with the aim of stabilizing them. However, the conservation approach proposed is not only the physical preservation of cultural property, but also the preservation of inspiring knowledge useful to society. This wider goal is achieved through dynamic activities and workshops, generating life experiences that link our past to the present. Therefore, the proposed conservation of mummy bundles at the Museum of Puruchuco encompasses a continuous technical, investigative, and educational process; considering an integrated conservation of cultural goods aimed at the community.

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19. Assessing the genetic diversity in the extant Chachapoya population from northeastern Peru using uniparental DNA markers (mtDNA and Y-chromosome)

Evelyn Guevara¹, Jukka Palo¹, Antti Sajantila¹, Sonia Guillén²

The aim of this study is to elucidate the origin and population history of the human communities inhabiting northeastern Peru, with both contemporary and ancient DNA data. The first phase of the project involved the study of the contemporary Y-chromosomal (23 STRs) and mitochondrial (HVR1 and HVR2 sequences) data from four populations (Chachapoya=276; Jivaro=47; Huancas=21 and Cajamarca=34) distributed in the northeastern region of Amazonas (Peru).

At haplogroup level, the markers showed different proportions of non-indigenous genetic contribution (mtDNA=11%; Y-Chromosome=43%). This reflects the history of European colonization that took place during the 16th century, which favored male-mediated European gene flow into the native gene pool. However, even though the Chachapoya area shares a common population history with several other native populations in the Americas, the levels and nature of genetic diversity suggest that the Chachapoya have had a distinctive demographic history, shaped by their geographical position between highlands and jungle. For instance, the Chachapoya showed a pattern of population expansion seen only in few other South American groups (e.g. large Tajima’s D and Fu’s Fs values). Another interesting feature is that the Chachapoya assume a basal position in mtDNA phylogenetic trees among other American populations, which may suggest the survival of very old genetic diversity retained in this particular region.

Acknowledgments
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Chachapoyas Provincial Municipality, Peru
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21. Interpersonal violence in Pumahuayuna, a cave in the cloud forest of northeastern Peru.

Marcela Urízar Vergara1

In this work, I present an analysis of 25 adult skulls found at the Pumahuayuna Cave, in San Francisco del Yeso district, Luya Province, Department of Amazons. It’s cultural affiliation is Chachapoya, Late Horizon period. The sample consists of 25 skulls, of which 17 are male, 6 are female, and 2 are of undetermined gender. The analysis reveals that the male individuals had a higher frequency of head injuries (60%) than the women (24%). The most affected skull bone was the parietal bone (64%) followed by the frontal bone (20%). Nasal traumas were also recorded (12%). The most recurrent injuries were trepanations (48%) and traumas caused by direct blows (36%). The frequency of healed antemortem trepanations is 28% and the frequency of postmortem drilling type trepanations is 20%. Two skulls with large injuries affecting the parietal bone were observed. These injuries were interpreted as trepanations because of other large injuries of similar characteristics, still in the process of healing, affecting the frontal and parietal bones were observed. Nine observed cases of trepanation affected the parietal bone, of which 28% affected the left parietal bone, 8% the right parietal bone, 20% the left frontal bone, and 4% the right frontal bone. There are three cases associated with an oval-shaped trauma. Perimortem (16%) and antemortem (20%) traumas were also identified. The antemortem cases were categorized as both non-lethal and oval-shaped. Male skulls, which show depressive traumatic injuries, were the most affected. These cranial injuries are directly associated with interpersonal violence, which means that the men were more exposed to activities that involve violence.

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22. A Veterinary Radiologist’s Contribution to Animal Mummy Interpretation

Gerald Conlogue¹, Anthony Fischetti², Sonia Guillén³, Ronald Beckett¹

The interpretation of various shapes in black, white and subtle shades of gray that comprise a radiographic image can be a daunting challenge for an inexperienced individual. Medical radiologists train for five to seven years after obtaining a medical degree to refine their skills for the clinical setting. Image interpretation becomes more complex when the remains are mummified, altering the location and shape of once familiar organs and soft tissue structures. The concept of a diagnosis by consensus was proposed whereby anthropologists would establish the historic and taphonomic context of the remains assisting the radiologist, in consultation with other medical specialties such as orthopaedists and pathologists, to arrive at a generally agreed upon diagnosis. Similarly, a veterinary radiologist who has committed three or four years after becoming a veterinarian to qualify for board certification in the specialty area, can contribute to the interpretation of animal remains. This study provides an example of the type of contribution provided by a veterinary radiologist. The mummified remains of a young dog were radiographed along with human mummies at the Inka Museum in Cuzco, Peru. Initial interpretation by the anthropologist was that the young dog may have died from an intestinal obstruction. Since the dog was not the focus of the study, further observations were not noted. Recently, the images were evaluated by a veterinary radiologist who provided expected and unexpected findings. The age and health status at the time of death were confirmed. A more detailed evaluation of the intestinal content was reported, but questioned the suspicion of an obstruction. An unexpected finding was absence of both scapulae and proximal humeri in what appeared to be a complete mummy. Based on the veterinary radiologist’s findings, the anthropologist revised the interpretation and presented several possible explanations for the missing skeletal elements.

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23. Drilled teeth from Cusco: clues for Prehispanic dentistry in the Andes

Elva Torres Pino¹, Eliza Orellana², Alejandra Ortiz³

Intentional dental modification for personal ornamentation and ritualistic purposes has been extensively documented across the globe. In contrast, prehistoric dental treatments for therapeutic reasons are extremely rare, and most reported cases come from the Old World. While written accounts indicate that early Andean population extensively used medicinal plants to treat diseases affecting the oral cavity, bioarchaeological evidence of pre-Hispanic dental surgery in the New World is poorly known and limited to a handful of cases from North America.

Here we examine two individuals dated to the Late Horizon Period from Cusco, Peru, and report the first evidence of pre-Hispanic dentistry in the Andean region. The right upper canines of the individuals exhibit a large perforation centered on the incisal surface, suggesting the teeth were intentionally drilled. Using traditional radiography, computed tomography and scanning electron microscopy, we identify the presence of striations and deep marks along the walls of the perforations, as well as an overall alteration of the morphology of the pulp chambers. In both cases, the smoothing of the openings’ margins shows that the individuals continued using their modified teeth after treatment. The poor oral health of the individuals and location of the perforations suggest that tooth drilling was presumably performed to remove decayed tissues.

While our understanding of a pre-Hispanic tradition of dentistry in the Andes is in its early stages and the number of reported cases is too small to draw any general conclusions regarding the presence of oral health specialists, evidence suggests that early American inhabitants had some knowledge to treat dental pathologies.

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Dientes perforados del Cusco: claves para la odontología prehispánica en los Andes

La modificación dental intencional para ornamentación personal y con fines rituales se ha documentado ampliamente en todo el mundo. Por el contrario, los tratamientos dentales por razones terapéuticas de época prehistórica son extremadamente raros, y la mayor cantidad de casos reportados provienen del Viejo Mundo. Mientras que las crónicas y relatos escritos indican que la población andina temprana utilizó ampliamente plantas medicinales para tratar las enfermedades que afectaban la cavidad oral, la evidencia bioarqueológica de cirugía dental prehispánica en el Nuevo Mundo es poco conocida y limitada a unos pocos casos reportados en América del Norte.

En este trabajo examinamos a dos individuos procedentes de Cusco, Perú que datan del período Horizonte Tardío, y que presentan la primera evidencia de odontología prehispánica en la región andina. Los caninos superiores derechos de los individuos presentan una gran perforación ubicada superfcie incisal, lo que sugiere que estos dientes fueron perforados intencionalmente. Mediante el uso de radiografía convencional, tomografía computarizada y microscopía electrónica de barrido, identificamos la presencia de estrías y marcas profundas a lo largo de las paredes de las perforaciones, así como una alteración generalizada de la morfología en las cámaras pulpares. En ambos casos, el pulido en los márgenes de las aberturas demuestra que los individuos continuaron usando sus dientes modificados después del tratamiento. La mala salud dental de los individuos y la ubicación de las cavidades sugieren que la perforación dental se pudo haber realizado con el objetivo de extraer el tejido afectado por infecciones cariosas.

Aunque nuestro conocimiento de la existencia de una tradición prehispánica odontológica en los Andes se encuentra en sus primeras etapas y el número de casos reportados es muy pequeño para emitir conclusiones generales acerca de la presencia de especialistas en salud bucal, la evidencia sugiere que los primeros habitantes de América tenían algún conocimiento para el tratamiento de patologías dentales.
24. Colonial mummies from the temple of Maras, Cusco

Elva Clara Torres Pino¹, Karla Isela Vargas Arenas Cárdenas², Elizabeth Aragón Silva³

Natural mummification is a phenomenon which involves the body desiccation by water evaporation of the soft tissues, making impossible the growth of germs and inhibiting the putrefaction process.

This poster presents the study case of two sub-adults individuals from colonial time whose age range from 0.1 to 2.5 years that were naturally mummified due to the lack of moisture. These mummies were recovered by specialists during archaeological excavations carried out by the component of archaeological research during the restoration work led by the staff of the Ministry of Culture Cusco’s branch, in the St. Francis of Assisi temple. The temple, located in the town of Maras (Urubamba - Cusco), at about 3,028 meters above sea level, was built in 1650.

The mummies were found beside each other in extended dorsal-ulna decubitus position. Due to the soil conditions (salty earth) that covered the bodies when they were buried, they had a process of natural drying favoring the dryness and the air circulation around the infant bodies. There is no evidence of the structure that contained them, but a pit dug in the ground towards the north of the Virgen de las Nieves Chapel, along with 32 other christian burials, which were distributed around the dome and were discovered next to the crypt.

Laboratory analysis and imaging records undergoing, such as dental panoramic radiographs, will provide further information about the mummies’ health status.

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25. The crypt of Nuestra Señora de la Candelaria in the Basilica Cathedral of Lima. A look at the ways of burial in viceregal Lima

Edwin Greenwich Centeno

The Cathedral of Lima includes important burial spaces housing many archaeological remains of colonial origin most of which have had limited studies. These spaces hold a representative sample of the population of historical Lima since the XVI century. Issues such as burial patterns, lifestyles are undergoing following the project under my direction since 2006: Proyecto Académico de Investigación Bioarqueológica e Historiográfica Francisco Pizarro.

This poster presents a summary of the work in the crypt of Nuestra Señora de la Candelaria in the Cathedral of Lima. It was discovered by chance in the middle of 2011, this burial area was closed in the early nineteenth century to comply with the Royal Decree of 27 March 1789 by King Carlos IV of Spain ordering the establishment of cemeteries in their American viceroys, in order to provide sanitation in churches, hospitals and convents that until then were also the city cemeteries. The crypt is believed to have belonged to the brotherhood of shoemakers since its chapel is under the patronage of the Virgin of Candelaria, aside from the Christian martyrs St. Crispin and St. Crispian who are patrons of shoemakers and furriers. Bioanthropological and archaeological work involved the study of 70 burials including men, women and children distributed in 5 mass graves. This project is contributing to the reconstruction of forms during colonial times in Lima.

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26. Parasites of ancient Andean dogs and llamas

Carlos Herz

Quantitative analysis of faeces samples from ancient dogs and camels associated to the Chiribaya culture (900-1400 A.D.), in the Moquegua region in southern Peru, provide information on the relationship and prevalence of parasites with the ways of life of the ancient human societies. To develop the paleoparasitological studies, the rehydration of eggs and larvae in dried coprolites was carried out (standard method of Callen and Cameron, 1960), complemented with other treatments validated by Jones (2003), Carvalho et al. (2003), Faulkner et al. (2000) and Seabra et al. (2003). This study is important to highlight the importance of paleoparasitology as a discipline that generates information and findings on the relationship between parasites, humans and other species of fauna and flora; as well as the spread of parasites and their relationship with past human migrations (Carvalho et al. 2003; Araujo et al. 1988, Reinhard (1988). Archaeological evidence of parasitic infections could help in modern epidemiological studies.

This study focuses on the Chiribaya herding dogs and their important contribution to the life of the ancient populations in this coastal region. Their economy combined herding, agriculture and maritime activities. The dogs were buried in the Chiribaya cemeteries, nearby the human inhumations.

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27. Timing and duration of enamel defects in the Chiribaya of southern Peru

Christopher Barrett

Enamel hypoplastic defects represent interruption of amelogenesis caused by periods of acute stress. Timing and duration of enamel defects was examined in two prehistoric populations from Southern Peru: the formative period site of Roca Verde (1000 BC to 500 AD) and the late intermediate period site of Chiribaya Baja (900 to 1300 AD approximately). Defect position was converted to a percentile of crown height and compared to published references for age (Reid and Dean, 2006) to estimate defect timing. Duration of stress was estimated from perikymata counts within each defect. Average timing of defects was 2.44 years for Roca Verde and 3.09 years for Chiribaya Baja. Perikymata counts for Roca Verde averaged 6.75 per defect and 5.11 per defect for Chiribaya Baja. Among the Chiribaya Baja, timing and periodicity were shorter in duration and occurred later in life, suggesting that late intermediate period populations more effectively accommodated acute stress than populations from the formative period.

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Tiempo y duración de defectos en el esmalte en los Chiribaya del sur de Perú

Los defectos de hipoplasia del esmalte representan la irrupción de la amilogénesis causada por agudos periodos de estrés. La temporalidad y la duración de los defectos en el esmalte de los dientes fueron examinados en dos poblaciones prehistóricas del sur del Perú: del sitio Formativo Roca Verde (1000 a.C. al 500 d.C.) y del sitio del Intermedio Tardío Chiribaya Baja (900 al 1300 d.C.). Los defectos a la altura de la corona fueron convertidos a percentiles y comparados con las referencias publicadas para la edad (Reid y Dean, 2006) para estimar la temporalidad de los defectos del esmalte. Para estimar la duración del estrés se realizó la contabilidad de perikymata entre cada uno de los defectos del esmalte. El promedio de tiempo transcurrido entre la aparición de dichos defectos fue de 2.44 años en Roca Verde y 3.09 años en Chiribaya Baja. El conteo de perikymata para Roca Verde tuvo el promedio de 6.75 de defecto en el esmalte y 5.11 para Chiribaya Baja. Entre la población proveniente de Chiribaya Baja, la temporalidad y la periodicidad fueron menores en duración y ocurrieron en individuos de edad avanzada, sugiriendo que las poblaciones del Intermedio Tardío estuvieron más acondicionadas para periodos de stress agudo que las poblaciones del Periodo Formativo.
28. Estimation of stature from long bones of the Chiribaya Baja of southern Peru

Christopher Barrett¹, Jessica Lacerte²

Accurate stature estimation is a crucial part of reconstructing the biological profiles of prehistoric populations. Here, we utilize the revised Fully Method (Raxter et al., 2006) to estimate anatomical stature in a sample of complete skeletons (males = 15, females = 6) from the Chiribaya Baja population (AD 900-1300) of Southern Peru. Regression formulas for stature were derived from long bone lengths using the R statistical package. Average male stature was estimated to be 156.08 cm (5 ft. 1 in.) and average female stature was estimated to be 150.73 cm (4 ft. 11 in.). Our results show that average stature estimates for the Chiribaya Baja are similar to those reported by Pomeroy and Stock (2012) for other coastal and mid-altitude prehistoric Andean populations.

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Estimación de la estatura a partir de los huesos largos de la población de Chiribaya Baja del sur de Perú

La estimación precisa de estatura forma parte crucial para la reconstrucción de perfiles biológicos de las poblaciones prehistóricas. En esta investigación, utilizamos el Método Revisado completo (Raxter et al. 2006) para estimar la estatura anatómica de una muestra de individuos representados por esqueletos completos (sexo masculino: 15; sexo femenino: 6) provenientes de Chiribaya Baja (900-1300 d.C.) del sur del Perú. Las fórmulas de regresión de estatura es de los óseos largos, y fueron realizadas utilizando el paquete estadístico R. El promedio de la estatura de los individuos de sexo masculino se estimó en 156.08 cm (5 ft. 1 in.) y el promedio de estatura de individuos de sexo femenino se estimó en 150.73 cm (4 ft. 11 in.). Nuestros resultados muestran que el promedio de estatura estimado para Chiribaya Baja es similar a los reportados por Pomeroy y Stock (2012) para otras poblaciones andinas prehispánicas costeras y del valle medio.
29. The high cost of fitting into society: cranial deformation and early cranial sinostosis among the Chiribaya

Sonia Guillén¹, James Skufis², Eliza Orellana¹, Joel Tejada³

Intentional cranial deformation was a common cultural practice among ancient Andean societies. Evidence appears as early as the archaic period and is seen in both coastal and highland scenarios. These modifications varied in shape depending on the system of deformation used and the amount of pressure applied. Several typologies for deformations have been produced in an effort to systematize the observations. The list of varieties range from two to fourteen types. There is also an extensive academic discussion concerning the reasons for this widespread practice. Gender, social status, and ethnic affinity are all cited among the main reasons, but there is no general consensus.

The Chiribaya society developed in the extreme southern coast of Peru during the Late Intermediate period between 900 to 1450 of our era. Evidence of the Chiribaya is found mainly in the coastal areas with a limited number of sites found in the highlands. It is clear that there was interaction among groups at different geographical altitudes. Their economy was based on intensive agriculture, animal husbandry, and maritime activities. Cranial modification was a common practice among the Chiribaya, using mainly variations of the annular shape. This practice might have had relevance in differentiating the different ethnic groups and economic activities that converged in the Chiribaya cultural context.

The interest among the Chiribaya in producing such extreme cranial alterations, plus probably a lack of sufficient practice to produce these modifications or a lack of awareness concerning the health consequences, generated cases in which it is evident that the intention to modify the shape of the cranial vault was also the cause of death. A series of skeletonized and mummified Chiribaya crania were observed using radiographic imaging to present a clear connection between the tightening of the apparatus to cause the changes and the development of osteitis, porotic hyperostosis, early cranial sinostosis, distortion in dental occlusion, and at some point the death of the child or young person involved.

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El alto costo de pertenecer a la sociedad: la deformación craneana y la sinostosis craneal prematura en los Chiribaya.

La deformación craneana intencional fue una práctica cultural común entre las antiguas sociedades andinas. La evidencia de la práctica aparece tan temprano como en el periodo arcaico y se encuentra tanto en la costa como en la sierra. Estas modificaciones variaban en forma dependiendo del aparato deformatorio usado y la cantidad de presión aplicada. Se han producido varias tipologías para las deformaciones con el interés de sistematizar las observaciones. La lista de variedades identificadas van de dos a catorce tipos. También existe un gran debate para identificar la razón para esta práctica tan extensiva. El género, el estatus social, y la afinidad étnica se han citado entre las razones principales para su práctica, aunque no se ha llegado a un consenso al respecto.

Chiribaya es una sociedad que se desarrolló en el extremo sur de la costa del Perú durante el periodo Intermedio Tardío, entre los años 900 a 1450 de nuestra era. Aunque la evidencia se encuentra principalmente en la costa, también hay sitios Chiribaya serranos. Más aún, es claro que hubo una interacción entre grupos de diferentes altitudes geográficas. La economía estuvo basada en una práctica intensiva de la agricultura, la ganadería y actividades marítimas. La modificación craneana fue común y usaron principalmente variedades de la forma anular. Esta práctica habría tenido relevancia para diferenciar a los diferentes grupos étnicos y las diferentes actividades económicas que convirtieron en el escenario Chiribaya.

El interés entre los Chiribaya de producir alteraciones craneanas extremas, además de la falta de suficiente práctica para producir las modificaciones, o la falta de conocimiento sobre las consecuencias de salud, generaron casos en los que es evidente que el esfuerzo de deformar la forma de la bóveda craneal fue también la causa de muerte. Una serie de cráneos de esqueletos y momias Chiribaya fueron examinados usando radiografías para presentar una clara conexión entre el ajuste del aparato deformador para ocasionar cambios y el desarrollo de osteitis, hiperostosis porótica, sinostosis craneal temprana, distorsión en la oclusión dental, y eventualmente la muerte del niño o joven involucrado.
30. A CT study of a mummy from the Santa Rosita de Pica cemetery in northern Chile

Marcela Urizar

This poster presents the findings from a CT Study of a mummy from the Santa Rosita site in the Pampa de Tamarugal oasis in Northern Chile, belonging to the 1958 excavation conducted by Hans Niemeyer, burial number 2, Late Intermediate Period. A 16 channel Computerized Cross-sectional Tomography CT Scan with tri-dimensional reconstructions was done every 3mm to 2mm at 0,635mm and 1mm respectively. This young woman became mummified by natural conditions. The ribs show no injuries and no degenerative processes. The vertebral discs are free of pathologies. The dental cavity presents cavities and a loss of dental pieces in the jaw and mandible.

In the soft tissue, calcified lymph nodes were found near the right side of the breastbone, while others were discovered next to the trachea wall. A calcified granuloma on the spleen was also found. The study revealed a displaced fracture on the right margin of the pubis with a dent and displacement of the right ischiopubic branch which is associated to a dislocation of the ipsilateral sacroiliac joint. Both the femoral heads and the acetabula are intact. The woman does not present any craniofacial trauma or fractures due to violence. Her dental care was inadequate and it shows that she had a diet rich in carbohydrates. The findings of calcified lymph nodes show the recovering stages of infectious diseases such as tuberculosis or another non-specified illness. It’s possible that the lymph nodes and the granuloma were caused by tuberculosis or cancer, but histopathological studies are required to verify and complement these diagnosis.

The trauma is a high energy trauma caused by lateral antero-posterior compression. Other bones were not involved and this was the cause of death.

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31. Radiographic analysis of the Pisagua Mummies Collection curated at the Museo Nacional de Historia Natural of Chile

Verónica Silva-Pinto¹, Aryel Pacheco², Fernando Bahamondez³, Haroldo Cabello³, Yasna Olguín³

Radiographies as non-invasive analysis of mummies allow to observe bone and dental structures preventing the destruction of soft tissues and or bundles. Generally, mummies should be moved to medical facilities to be radiographed, which implies several problems. These are solved carrying the professionals and the technical equipment to the places where the mummies are curated.

The Pisagua’s mummies Collection curated at the Museo Nacional de Historia Natural (MNHN) of Chile comprise the human remains of 48 individuals dated to the Formative, Middle and Late Intermediate periods from Northern Chile. In January of 2016 the Pisagua’s mummies Collection was analysed at the MNHN using a portable X-rays machine and a computerised reader (CR). From the radiographies four variables were analysed: deposit and position of the bodies inside the bundles, sex, age category and stature (Table 1).

Mortuary and physical anthropological data generated by this study improve the curatorial record of these mummies of the MNHN and increase its heritage value. To know the anthropological composition of the Pisagua’s mummies Collection curated at the MNHN (Graphic 1) will contribute to the research and we hope that this promote the researchers interest. This study demonstrates the advantages of using a portable X-rays machine and a computerized reader (CR) and the benefits of the close collaboration among medical technicians and bioarchaeologists in mummy’s studies. During a month we took over 400 radiographies from almost 50 mummies. In the following months, data from other radiological findings (for example Artificial Cranial Modification, ACM and pathologies) will be systematized.

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32. Images and stable isotopes to discuss diet and osseous quality in the middle and late archaic of northern Chile, Cordón de Chacabuco, El Rutal, Rungue.

Carlos Coros Villca¹, Rodrigo Álvarez Gajardo², Yasna Olguín Madrid², Zahira Tapia Espinoza²

Amerindian populations were and are lactose intolerant, one of the hypotheses of this condition is related to the non-domestication of dairy cattle, so the contributions of calcium and vitamin D must had come from other sources, or people had decalcifications, as it has been observed in current Amerindian populations, as described by the prevalence of osteoporosis in contemporary Mapuche women, well above the rate of the general Chilean population. We assume that our ancestors who were not milk drinkers had no optimal osseus quality.

All mammals during the lactation period are capable of synthesizing the lactase enzyme, responsible for metabolizing lactose. This condition is lost during the first years of life due to a physiological decrease in lactase activity through the silencing of the expression of the LCT gene, responsible for the synthesis of lactase. Therefore, primary lactose intolerance is a natural condition in any adult mammal.

Two mutations in the C and T alleles of the LCT gene occurring about 15,000 years ago in Europe allowed lifelong persistence of lactase activity in these populations, inherited with success (with autosomal dominant pattern) by their progeny, currently with worldwide distribution.

In this research we present findings in bone tissue of two female individuals from the Rutal site, central Chile. One of them from the middle-late Archaic period and the other from the late Archaic period (3230 ± 25 and 1720 ± 20 AP C14 dating). Visual inspection, isotopic analysis, and x-ray densitometry (Rx) were performed.

The results obtained shows a bone densitometry with values that fall within a normal range, while they show some suggestive hyperdense Harris lines. The stable isotopes show a tendency of consumption of wild plants, which is consistent with the findings of the site carpological and dental studies. Therefore, we infer, that calcium ingestion derived from other sources, probably Quinoa or Algarrobo, and that the absence of milk in the diet in prehistoric populations was not a factor affecting their osseus quality. This leads us to believe that lactose intolerant populations and high rates of osteoporosis among the Mapuche, are sociocultural factors that led to this condition.

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33. Heads to display: Human trophy heads from Cabeza Larga, Paracas, Peru

Patricia Maita

The ritual use of human heads was a common practice in ancient Andean cultures. Human trophy heads is one of the major themes on Paracas iconography, they are depicted hanging by a cord or hair, in hands of mythical beings like the Killer Whale and the Oculate Being. The role of trophy heads in Andean societies has been a subject of debate. Some researchers postulate that these heads are war trophies taken from enemies and others believe that they are ancestors playing a ritual function related to fertility.

Osteological remains of trophy heads are uncommon in Paracas and few bioarchaeological examples have been described. In this poster we present two Paracas trophy heads excavated by Julio C. Tello in the cemetery of Cabeza Larga, located on the south coast of Peru. They were found associated with a club and fragments of two Paracas Necropolis mantles. Both trophy heads correspond to adult males with little evidence of diseases. Now they are skeletonized, but one of them preserved remains of braided hair. Modifications in the skulls include cutmarks at muscle attachment areas, extensive perforation of the frontal bone and slight expansion of the foramen magnum. Frontal holes do not show evident wear around the perforation, indicating that possibly they were not hanging by a rope, but a restricted area of polished bone on the mastoid process could indicate that these trophy heads were displayed placed on a flat base.

The type of preparation of trophy heads are homogenous, reflecting the same preparation style, but if they are compared with Nazca trophy heads there is variability in the size of the frontal perforation and the enlargement of the foramen magnum. Cranial modification styles of the trophy heads may reveal that they are local.

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34. Evaluation of 3D printed artifacts from CT scans of mummy bundles from the Puruchuco museum, Peru

Kyra Nolte¹, Kenneth C. Nystrom¹

Three dimensional scanning and printing is an emerging technology and one that holds great promise for the study of past cultures and peoples. The increasing availability of this technology is having a significant impact on biological anthropology and archaeology, particularly as it relates to cultural heritage and data sharing. The focus of this research is on the application of 3D technology in the analysis of intact Peruvian mummy bundles. As many of these bundles will not be opened, the technology offers the opportunity to visualize as well as ‘extract’ material artifacts and biological specimens contained within them. Therefore, the goal of this project was to digitally extract and print both organic (e.g., bones, gourds, corn cobs) and inorganic (e.g., metal, textile) objects from several different mummy bundles.

The CT scans are from mummy bundles curated at the Museo de Sitio Arturo Jimenez Borja in Puruchuco Puruchuco, which were originally scanned by the Horus Team as part of a project on atherosclerosis. The CT data was imported into the CAD modeling software Rhino and subsequently printed out utilizing two different types of printers (Project 660 3D Printer and a Fortus 400mc 3D printer) as well as different print mediums at the Hudson Valley 3D Design and Manufacturing Lab at the State University of New York at New Paltz. We evaluated which printers and print mediums were best for the reproduction of organic and inorganic objects, and for paleopathological description. Three-dimensional printing represents the ability to study these objects and share data that otherwise would never be accessible. The printed replicas can be used in cultural anthropological fields, for example in museum preservation efforts, as well as in biological anthropological fields. This project gives us the opportunity to study and make available objects that otherwise would never be, and gives us the ability to evaluate how best to reproduce organic and inorganic materials.

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35. An “old” material for an innovative intervention: the restoration of the Andean mummy of Museu Darder (Banyoles, Spain)

Mercedes González¹, Anna-Maria Begerock¹, Amalia Valls¹, Coralee Castillo¹, Patricia Prieto¹

There are many and varied processes of deterioration that we can find in a mummified body (cadaveric decomposition, fungi, insects, rodents, improper handling and display...) We are not in favor of restoring a mummy, but sometimes, it is essential if we want to restore its integrity and prevent the deterioration. During research we got aware of Japanese paper being used to replace missing parts of skin or to rebuild joints. But when the environmental conditions vary, we have seen that this material behaves badly, and can indeed destroy some areas of the mummy. For this reason, for two years we have been investigating other materials like parchment and vellum, most suitable for this type of intervention, since they are more similar to human skin.

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Un material “viejo” para una intervención innovadora: la restauración de una momia andina del Museu Darder (Banyoles, España)

Son muchos y variados los procesos de deterioro que podemos encontrar en un cuerpo momificado (descomposición cadavérica, hongos, insectos, roedores, incorrecta manipulación y exhibición) No somos partidarios de restaurar una momia, pero a veces, es imprescindible si queremos devolverle la integridad y evitar su deterioro. Durante la investigación, descubrimos que el papel japonés se utiliza para reemplazar piezas faltantes de piel o para reconstruir las articulaciones. Pero cuando las condiciones medioambientales varían, hemos podido comprobar que este material se comporta mal, y puede incluso llegar a destruir algunas zonas de la momia. Por esta razón, durante dos años hemos estado investigando otros materiales como el pergamino y la vitela, más adecuados para este tipo de intervención, ya que son más similares a la piel humana.

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