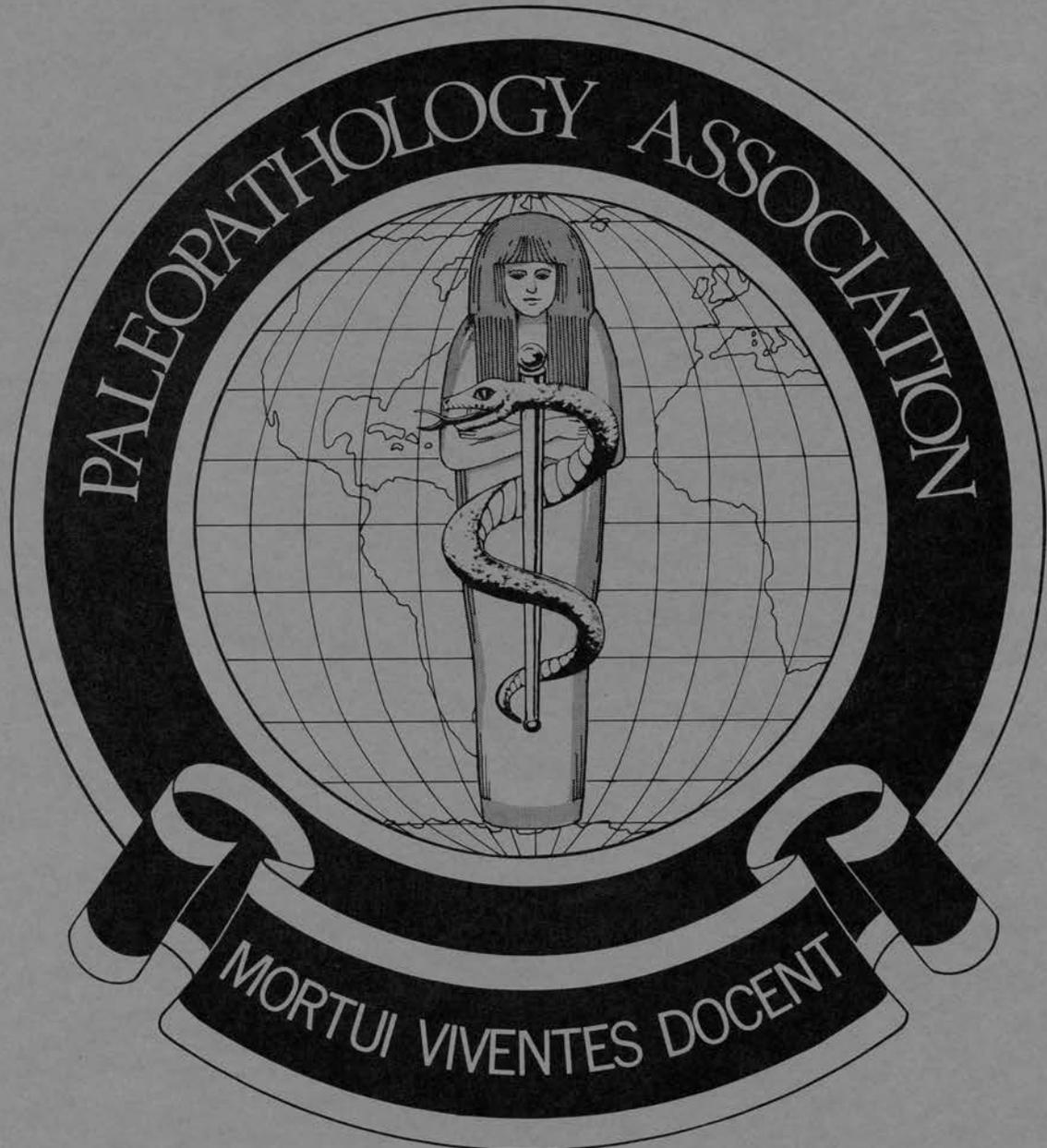


PAPERS ON PALEOPATHOLOGY

presented at the

Twentieth Annual Meeting



13 and 14 April 1993

Toronto, Ontario

Greetings from

Her Worship Mayor June Rowlands
(Mayor of Toronto)

On behalf of my colleagues on City Council, it is a pleasure to welcome to Toronto members of the Paleopathology Association. Studying human disease of the past has an important role in the maintenance of health today. By learning how and why ancient humans became sick, we can learn how to combat or avoid contagious diseases today. I am sure that your 20th Annual Meeting will renew and reaffirm your knowledge of paleopathology, allow you share resources and information, and, ultimately, help all of us to stay healthy.

Best wishes to the delegates and organizers for a successful event!

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OBSERVATIONS ON THE PRESENT STATE OF PALEOPATHOLOGY

Reflections Twenty Years After the Founding of the Paleopathology Association

The rapid growth of paleopathology and the unquestionably high value of the Paleopathology Association are legitimate sources of pride and pleasure. It is observable that an important part of the modern development has occurred outside the academic sphere. Concomitantly, paleopathology has received a minimum of formal academic recognition. It will be remembered also that in 1961 the American Association of Pathologists and Bacteriologists declared that the establishment of a registry of North American paleopathology is outside its scope. In other words, the positive attitude of the Paleopathology Association has defeated the negativism that existed in much of our environment.

As was predicted in 1966, paleopathology has reached out toward the new advances that were being created in chemistry, physics, and biology. This fact explains much of the progress that paleopathology has been able to produce in recent years. Outstanding opportunities are being created, in part by paleopathologic methods, for those who wish to study the origins and spread of infectious diseases, especially the treponemal infections, yellow fever, and malaria. Attempts to solve the problems and to answer the questions by the traditional paperwork of historical scholarship have not produced definitive, convincing results. Malaria offers the important subordinate problem of the origin of *falciparum* infections, a type that is not mentioned in the Hippocratic writings.

Other problems and opportunities await. Will today's hypotheses stand or fall? Can paleopathology contribute to acceptable answers?

Saul Jarcho MD, 12 May 1992
(excerpt from letter)

SECTION 1: REVIEW OF BASIC PRINCIPLES ('ANYTHING GOES') (workshop)

Bruce D. Ragsdale, Arizona State University and Donald J. Ortner,
Smithsonian Institution

The mechanisms operative in skeletal disease are aberrations of normal biology, and bone has a limited number of ways in which it can react. This leads to difficulty in diagnosing specific diseases through direct examination and radiography of dry bone specimens, unless disease mechanisms are clearly understood and an analytical morphologic approach is employed.

Workshops I (**What's in the Hole?**) and II (**What's on the Bump?**) emphasized understanding the soft tissue/bone interfaces responsible for morphologic changes. Just as the fossilized footprint is of interest for what it says about the creature that made it, the alteration of solid bone substance reflects the action of soft tissue on bone surfaces. Understanding this dynamic interface is the essence of studying mechanisms of disease. Workshop III (**Causes of Bone Density Change**) presented the view that a focal, regional, or generalized reduction of bone density (e.g., a 'hole' or osteopenia) occurs only through the sustained or unbalanced action of osteoclasts; focal, regional, or generalized gain in bone density (e.g., a 'bump' or exuberant periosteal reaction) occurs only through sustained predominant action of osteoblasts. Which cell activity predominates is explainable as due to one or more of three influences: altered circulation, metabolic factors, and mechanical stress. Workshop IV provided a forum to discuss **Descriptive Terminology** appropriate for paleopathology. Alternatives were sought for diagnostic labels (e.g., 'arthritis') and terms for processes (e.g., 'periostitis' and 'granulomatous') that imply knowledge not possessed. It was agreed that the use of biologically inaccurate terms (e.g., bone expansion) impedes understanding and the teaching of disease mechanisms.

Morphologic analysis of periosteal alterations, margins, and density changes (e.g., sclerosis or deletion of cancellous bone or cortex, and the pattern of change) is a systematic method used regularly by modern diagnosticians (ref: *Radiologic Clinics of North America*, 1981, 19:715-814). Each category of disease has at least a few distinctive hallmarks in dry bone specimens. Differential diagnosis with these seven possibilities in mind, rather than several thousand specific diseases is a powerful tool for the paleopathologist.

As in past workshops, dry bone macerates prepared from hospital acquired examples of known skeletal disease permitted quantification of diagnostic accuracy analogous to the quality assurance efforts operative in all branches of medical practice. The scoring was done by Elizabeth Miller. On average, 6 of the 9 participating groups classified 6 hospital acquired specimens as to disease category, but only 2/9 on average correctly pinpointed the specific disease process. Four of 9 groups correctly predicted that a lower leg and foot represented a metabolic problem, although none identified the condition as renal osteodystrophy (changes were very subtle). Eight of 9 identified an iliac wing with spiculated periosteal reaction as having harbored a neoplasm, but no group specified chondrosarcoma.

(Hospital-acquired specimens)

(# and % of the 9 groups correct)

<u>Case</u>	<u>Category</u>	<u>Disease</u>
Neoplastic = Frontal Sinus Osteoma	7 (78%)	1 (11%)
Neoplastic = Chondrosarcoma	8 (89%)	0 (0%)
Inflammatory/Immune = Coccidioidomycosis	6 (67%)	4 (44%)
Metabolic = Renal Osteodystrophy	4 (44%)	0 (0%)
Inflammatory/Immune, Circulatory = Leprosy	6 (67%)	3 (33%)

Chi-square analysis of the difference between category vs specific diagnostic accuracy was 23.94 at a 0.05 confidence level. Our five year experience in this annual workshop indicates a distinct trend of increasing accuracy for diagnosis by category, but not for specific disease state.

Paleopathologists might consider prefacing their specific diagnosis on human skeletal remains with the less ambitious but more often correct disease category. Specimens acquired from the modern hospital setting will undoubtedly become increasingly important as teaching specimens if the current trend for reburial of Native American remains continues. The method for papain digestion of fresh bone specimens is available from Dr Ragsdale.

Paleopathologic cases from the Smithsonian collection shown this year were: fluorosis, ankylosing spondylitis, multicentric cranial osteomas, myositis ossificans, and infectious destruction of the hip. In all cases, careful attention to anatomic detail is crucial to understanding the processes leading to bony abnormality. For example, more than one disease condition can result in abnormality of the spinal canal. In fluorosis, for example, the spinal canal is reduced in size due to the ossification of ligaments in the canal. In achondroplasia, the canal fails to develop normal size due to problems in endochondral ossification. Despite other features that resemble fluorosis, such as fusion vertebrae, ankylosing spondylitis usually does not result in significant bony encroachment of the canal.

In dry bone specimens, myositis ossificans is seen as a bony projection usually associated with muscle attachments. Thus the association of a bony spur with an origin or insertion of a tendon should suggest this diagnosis as the most likely option rather than tumor. Anatomical location was also important in understanding the pathogenesis of the one Smithsonian tumor case demonstrated. In this case of multiple cranial osteomas, all the benign nodular osseous lesions were at sutures or muscle attachments. A specialized connective tissue is associated with both these sites, and it seems likely that the multiple osteomas in this case arose through dysplastic overgrowth of this tissue.

Septic arthritis of the hip is a well known but uncommon condition of this joint. Bacterial organisms can be introduced into the joint directly through penetrating injury or can arrive there via the hematogenous route. The latter is the pathway taken by mycobacteria in tuberculosis. The infected hip case could be caused by other bacteria, but it shows some of the classic features seen in tuberculosis, including perforation of the acetabulum and minimal reactive bone formation.

SECTION 2: AIDAN COCKBURN MEMORIAL SYMPOSIUM

Moderators: Patrick D. Horne and Peter K. Lewin

OPENING REMARKS

Donald J. Ortner, Smithsonian Institution

It is not only an honor but also a pleasure to offer a few remarks as we open the Aidan Cockburn Memorial Symposium on the occasion of the twentieth annual meeting of the Paleopathology Association.

How well I remember the lively discussions that I had with Aidan when I first met him in the 1960s. I was still a graduate student, but very much interested in developing new methods of extracting biological data from archaeological skeletal remains. Those who had the privilege of knowing him will remember not only his enthusiasm but also his opinion that much more could be learned about ancient diseases from mummies than from human skeletal remains. He was only slightly impressed by my argument that, although he might be right, there were many more archaeological skeletons available than there were mummies.

One of my most vivid memories is of a 1968 dinner hosted by the Cockburns at their home in Detroit. Several legendary figures were there, including Arthur Mourant, the renowned British human geneticist, who spent the early evening discoursing on the flowers in the garden (and then drew a ginkgo leaf on the Cockburns' graffiti wall --- it's still there). For a young graduate student, the occasion was very heady stuff, with ideas zooming around like shuttlecocks at one of their backyard badminton games.

Aidan's 1963 book, *The Evolution and Eradication of Infectious Disease*, had already established him as an authority of the history and evolution of human diseases. His knowledge rested on a broad base of experience in practicing medicine in many parts of the world, where he had confronted infectious disease, often in its natural, untreated state. The potential that he saw in paleopathology as a way to clarify many issues and questions about the evolution of disease was a major factor in the commitment that he and Eve made in founding the Paleopathology Association twenty years ago.

The publication of their jointly edited book, *Mummies, Disease, and Ancient Cultures* was a clear expression of his own interest in mummy research, but although the emphasis in this symposium is on skeletal evidence in paleopathology, I am very certain that he would have been an enthusiastic participant, because, above all else, Aidan enjoyed new ideas and new approaches to research problems. To honor his memory through the presentation of these symposium papers is exactly the kind of tribute he himself would have chosen.

MALIGNANT TUMOURS IN THE OLD WORLD IN ANTIQUITY

Eugen Strouhal, Institute for the History of Medicine, Charles University, Prague (Hannah Lecturer)

Malignant disease, until recently considered rare in ancient populations, has been emerging as much more important in those regions that are the focus of ongoing intensive research, and this is so notwithstanding all the limitations inherent in this kind of investigation. The regions where numerous examples of malignant tumours have been found are Egypt, Europe, and Japan. In these countries we can evaluate the **proportion** of different kinds of malignancy, such as primary carcinoma, skeletal metastases of carcinoma, myeloma multiplex, and sarcoma, and this proportion seems to differ from that seen in present day populations. All chronological periods are involved except for the Palaeolithic and the Mesolithic, with the highest incidence seeming to occur during medieval times. This view can be biased, however, by the scarcity of human skeletal remains from two earliest periods and by the abundance of a long series from the later period. In the light of this ongoing paleopathological research, malignant disease does not obviously belong in the group of so-called 'diseases of civilization,' but represents a disease inherent in mankind, perhaps even from the time of our animal ancestors. This conclusion agrees with recent theories on oncogenes.

THEORY MEETS DATA: COCKBURN'S CONTRIBUTIONS TO THE STUDY OF ANCIENT TUBERCULOSIS

Jane E. Buikstra, University of Chicago

Aidan Cockburn's interpretation of the history of tuberculosis-like pathology in both Old and New Worlds championed theoretical and ecological perspectives. Explicit theoretical expectations, given modern clinical and epidemiological experience, and characterizations of human population densities, animal hosts, and the natural environment were stimulated by his approach. This paper reviews the histories of study of tuberculosis-like pathology in the Americas and the Old World, with emphasis upon the impact of Cockburn's approach, and will also present new evidence concerning the American example.

WHAT DOES THE EROSION OF RHEUMATOID ARTHRITIS 'LOOK LIKE' IN DRY BONE?

J. Leisen, H. Duncan, and J. Riddle, Henry Ford Hospital, Detroit

A conference on the antiquity of arthritis, chaired by Aidan Cockburn, was held at Henry Ford Hospital in 1979, since when we have observed a burgeoning of lay and scientific literature, have participated in international conferences, and have seen a television series on arthritis in antiquity. Dr Cockburn would surely have enjoyed the various speculations on diagnosis, origin, transmission and evolution of these

diseases created by this research. Despite all these endeavors, however, we believe that the central issue remains: What does an erosion look like in dry bone, and how can one speedily distinguish erosions resulting from a chronic synovial inflammatory process such as rheumatoid arthritis? To answer this question, we studied surgically resected metacarpal heads and tibial plateaus from 8 and 7 patients respectively with rheumatoid arthritis. Mean disease duration was 8 years (range 4-20 years). Control specimens were obtained from cadavers. Specimens were macerated and examined under a dissecting microscope. We observed alterations in the articular calcified tissue that consisted of: 1) partial or complete resorption of the articular surface; 2) circumferential obliteration of the chondro-osseous junction, with; 3) minimal para-articular osteophytosis. Based on this study, the erosion of rheumatoid arthritis appears as a generalized alteration in the anatomy of the articular end of an affected bone, and is not an isolated or focal lesion as suggested in paleopathology literature.

TECHNICAL ADVANCES IN PALEOPATHOLOGY AND MEDICAL ARCHEOLOGY, PAST AND FUTURE

Peter K. Lewin, Hospital for Sick Children, Toronto

Having pioneered the use of electron microscopy in the examination of ancient Egyptian mummified tissues in 1966, I received an invitation from Aidan Cockburn in 1973 to participate in the autopsy of Egyptian mummy PUM II in Detroit. It was after this exciting meeting that a group of us, under the guidance of Aidan and Eve Cockburn, formally established the Paleopathology Association. In close collaboration with other PPA members, I performed the first scanning electron microscopy of an archeological specimen (a fly larva) in 1973, and did extensive histological examinations of both PUM II and of Nakht, a weaver from a funerary chapel in Thebes, whose autopsy was undertaken at the University of Toronto in 1975. Dr Derek Harwood Nash and I performed an x-ray computerized axial tomograph (CT scan) on Nakht's extremely well preserved brain, an examination that was the first archeological use of this most important imaging technique. We have since extended these techniques to produce the first three dimensional images from the sequential data obtained from CT scans. Other topics to be discussed include concerns about infectious agents like smallpox that may still be viable in frozen bodies preserved in the permafrost.

UNDECALCIFIED SECTIONS STUDY FROM THE RIGHT FIBULA OF EGYPTIAN MUMMY PUM II

J.T. Benitez, William Beaumont Hospital, Royal Oak, Michigan and Harold M. Frost, Southern Clinic, Pueblo, Colorado

Radiologic study of Egyptian mummy PUM II demonstrated a wavy irregular contour of the right fibula with loss of sharp cortical margin. Unwrapping of the mummy at autopsy revealed a swollen right leg compared to the left, showing the

marks of the bandages and suggesting edema of this leg at the time of embalming. Conventional histology of a specimen from the distal half of the affected fibula was performed. We found what appeared to be a non-infectious periostitis of undetermined etiology. We processed a cross-section from the same area by the undecalcified method. The specimen was fixed in 80% alcohol and sections were made on the horizontal plane. Ground down by hand under gently running tap water with #500 sandpaper placed in Villanueva, stained for 48 hours, followed by washing, dehydrating and mounting. Osteon morphology and activity will be discussed with color slides. A theory will be put forth as to the swelling of the leg and the nature of the periostitis.

A MEROITIC SKULL WITH IMBEDDED ARROWHEAD FROM GEBEL ADDA, OLD NUBIA, EGYPT

James E. Harris, National Rowe and Chris Edwards, University of Michigan School of Dentistry (NR and CE)

During the 1965 University of Michigan-Alexandria expedition to the ancient Nubian Citadel and Necropolis of Gebel Adda, Egypt, a skull with an arrowhead penetrating the right gonial angle of the mandible was discovered. This skull, of a female about 20 years of age, was located in a Meroitic Cemetery dated at approximately 250 AD. The cranium, maxilla, and mandible all exhibited dramatic facial asymmetry, confirmed by posterior-anterior x-rays. This asymmetry is most dramatic in the mandible, and in life would have resulted in severe facial disharmony. The facial asymmetry is the result of the overgrowth of the right side of the face rather than the lack of growth on the left side. It has been hypothesized that the imbedded arrow head and the malformation were not independent events. To test this hypothesis, it was necessary to show that the subject continued to live for an extended period after the arrowhead had entered the mandible. Recently, the skull was examined in the pathology laboratories of the University of Michigan Dental School, utilizing new equipment called EXAKT, an instrument that can section through both metal and tissue without separating them. The results of this study and their implications for the etiology of craniofacial asymmetry in the Nubian female are discussed.

NEW WORLD ORIGIN OF TREPONEMAL INFECTION

George J. Armelagos, Emory University

Baker and Armelagos (1988) presented an argument for a New World origin of treponemal infection in human populations. The infection was transmitted by contact as a non-venereal disease. Europeans who acquired the disease from Native American populations contracted the infection sexually. We argue that there should be no skeletal evidence of treponemal infection in the Old World before 1492, and after that period there should be skeletal evidence of sexually transmitted treponemal infections. Even in light of recent reports of treponemal

diseases in European populations prior to 1492, we argue that there is not sufficient evidence to reject our original findings.

NEW WORLD TREPONEMAL DISEASE BEFORE 1492: WHY CALL IT SYPHILIS?

Mary Lucas Powell, University of Kentucky Museum of Anthropology

As noted by Donald Ortner in the September 1992 *Paleopathology Newsletter*, the origin of the late 15th century epidemic of venereal syphilis in Europe is still vigorously debated, as is the closely related question of the venereal or non-venereal nature of treponemal disease in the New World at that time. In this paper I argue that the New World disease was essentially non-venereal in form, as indicated by available paleopathological and paleoepidemiological evidence. The rare examples of apparently congenital treponematosis in young children mentioned by Ortner can, I believe, be attributed to atypical cases of venereal transmission such as rarely occur in modern yaws and endemic syphilis. The term 'syphilis,' with its perceived venereal connotation, is therefore inappropriate to characterize the pre-Columbian New World disease.

EVIDENCE FOR PRE-COLUMBIAN SYPHILIS IN MEDIEVAL EUROPE

Ann Stirling, Institute of Archaeology, University College London

There has been much debate regarding the origins of acquired syphilis. Greater numbers of skeletons with apparently diagnostic bone lesions have been reported from the New World than from the Old. It has been postulated therefore that acquired syphilis originated in the Americas prior to AD 1492 and was carried back to the Old World by Columbus's sailors. Recent work, however, has demonstrated the presence of treponemal disease in medieval Britain prior to AD 1492. The present example is a young adult male from a well-sealed context in a Norwich site with a *terminus ante quem* of AD 1468. He had widespread, bilateral, florid periostitis, especially of the tibiae and fibulae, and the radiographic changes support the diagnosis of treponemal disease. Others in the group have similar lesions, and there are individuals with evidence of leprosy. Differential diagnosis and geographical situation suggest that this individual shows evidence of syphilis. A case of pre-Columbian syphilis has been reported from France also, and there other early European cases. The contention that acquired syphilis is an exclusively New World phenomenon must now face serious challenge.

A NEW APPROACH TO DIAGNOSING SYPHILIS IN ANCIENT BONES BY HISTOPATHOLOGY

Michael Schultz, University of Göttingen

Although there are a few established theories on the origin of syphilis and different treponematoses, many questions still remain with regard to the origin of these diseases in time and place. To extend our knowledge of the prehistoric origin of treponematoses, we need to study archaeological bone findings very precisely. Any investigation should include microscopic examinations, the most efficient technique being light microscopy of unstained ground sections, using polarized light. Unfortunately, bone lesions caused by syphilis are frequently very similar to alterations caused by non-specific bone diseases (e.g. different types of periostosis and osteomyelitis), especially in long bones. Using polarized light in light microscopy, the internal bone structure, especially the arrangement of the collagenous fibres, is detected, and structures typically built up by different disease processes become visible. Thus microscopic investigation, in combination with macroscopic, radiological, and scanning electron microscopic research, provides a reliable diagnosis. Selected examples from the Göttingen Palaeohistopathology Collection are presented and discussed, with emphasis on minor syphilitic lesions that could be mistaken for other diseases. (Research supported by the Deutsche Forschungsgemeinschaft.)

COMMENTARY

Arthur C. Aufderheide, University of Minnesota-Duluth School of Medicine

Both the breadth and the depth of these symposium presentations would have pleased Aidan Cockburn, to whose memory the symposium itself is dedicated. Dr Strouhal established that cancer certainly did exist in the ancient world, a finding that presents a challenge for quantitating its presence. Dr Buikstra's review of the search for evidence of pre-Columbian New World tuberculosis indicates that the quest may have been completed, if the preliminary finding of the isolation from a pre-Columbian mummy of a DNA segment unique to *Mycobacterium tuberculosis* can be confirmed. The opposing views about pre-Columbian Old World treponematoses, presented so well in this symposium, reflect clearly that we do not possess the diagnostic precision necessary to resolve the question. Although the tools of molecular biology have attractive potential for clarifying the treponemal dilemma, Dr Schultz has suggested a possible histological alternative. All these and the many other stellar presentations in this symposium would have delighted Aidan, because they demonstrate an effective response to his challenges, and also reveal that the maturing discipline of paleopathology is becoming integrated with the other biomedical sciences

SECTION 3: WORKSHOP/SYMPOSIA

A. OSTEOARTHRITIS AND CALCIUM PYROPHOSPHATE DEPOSITION DISEASE: THE ELEPHANT AS VIEWED BY THE BLIND MICE

Coordinators: Bruce M. Rothschild and Charles F. Merbs

THE PATHOLOGIST'S PERSPECTIVE

Kenneth P.H. Pritzker, University of Toronto

Osteoarthritis (OA) and calcium pyrophosphate dihydrate crystal (CPPD) arthropathy are two of the most common forms of degenerative joint disease. OA is a group of degenerative joint diseases characterized by progressive architectural and compositional deterioration as well as by remodelling of articular cartilage and subchondral bone tissue associated with proliferative and fibroplastic changes in synovium. Difficulties in the diagnosis of OA include overlap of some morphologic features, the lack of critical distinction between features of disease activity and features of disease progression, and the lack of well defined disease markers. In contrast, CPPD crystal arthropathy has a well defined histologic marker, calcium pyrophosphate dihydrate crystals, which can be identified by their habit and positive birefringence with polarized light microscopy. The relationship of OA to CPPD arthropathy is controversial. However, in our experience, coexistence of this disease is uncommon. Further, epidemiologic evidence (genetics, age, etc.) and biochemical evidence (chondrocyte alkaline phosphatase) and comparative pathology evidence (degenerative joint disease in primates) are features that support the distinction between these two diseases.

THE RADIOLOGIST'S PERSPECTIVE

Joel Rubinstein, University of Toronto

The primary osseous changes of osteoarthritis (OA) are remodeling with spur formation, increase in density of the subchondral plate, and formation of metaphyseal cysts. The latter osteolytic foci (holes in the bone) may occur secondary to microfractures. The cyst-like structures occur in load-bearing planes, and are easily recognized on x-rays. Vertebral centrum osteophytes, however, do not identify OA. Although its extent is determined by joint space narrowing, caused by loss of cartilage, and by subchondral sclerosis, the presence of disease is

determined by documentation of osteophytes or subchondral cysts. Thus the most radiologically significant 'gauge' of disease severity is not amenable to assessment in archeologic populations. Calcium pyrophosphate deposition disease (CPPD) is recognized as calcification within fibrous or hyaline cartilage structures (chondrocalcinosis). This appears on x-ray as a dense line within the hyaline cartilage parallel to the articular surface. Another variety of CPPD presents with periarticular metacarpal phalangeal and interphalangeal joint calcification. Just as the pattern of CPPD can mimic rheumatoid arthritis, so too it can mimic OA. Although the human radiocarpal and metacarpal phalangeal joints would be extremely unusual joints to be affected in OA, OA-like changes in such locations in humans are highly suggestive of CPPD. Large subchondral cysts (geodes) are also rarely noted in CPPD. Another variety of CPPD has been described as a 'destructive' peripheral arthritis, associated with bony fragmentation. J. Rubenstein, University of Toronto

THE ANTHROPOLOGIST'S PERSPECTIVE

Robert Jurmain, San Jose State University

Anthropologists most typically examine OA in macerated remains derived from archaeological contexts. Such a perspective provides considerable advantages not available from clinical sources. Most especially, with macerated remains the joint surfaces and margins are clean of overlying tissue, and can thus be easily evaluated for degenerative changes, many of which do not clearly present radiographically. In addition, with population sources derived widely through time and over geographic space, a much broader epidemiological profile becomes possible. Equally, paleopathological analysis also presents significant constraints. The greatest limitation is that there is never a record documenting symptomatology. Thus, such manifestations as vertebral osteophytosis cannot be consistently linked with any clearly demarcated disease state. Over the last two decades, anthropological perspectives have helped introduce greater rigor in differential diagnosis and paleoepidemiological control. Great caution must be used in making functionally based explanations of joint change. As always in paleopathology, the greatest hope lies in close cooperation with clinicians.

THE CLINICAL PERSPECTIVE

Bruce M. Rothschild, Northeastern Ohio Universities College of Medicine

Even the term osteoarthritis is controversial, subtly implying inflammation of a synovial membrane-lined joint. Lack of actual inflammation has stimulated usage of the term osteoarthrosis. Any associated inflammation appears to be related to complications, especially related to deposition of calcium crystals. One clinical perspective is that osteoarthritis is an x-ray diagnosis, as direct clinical examination of the intact individual has a low predictive value, related to inaccessibility of the bones for direct examination. This perspective states that presence of disease is

determined by documentation of osteophytes or subchondral cysts, and extent is determined by joint space narrowing caused by loss of cartilage and by subchondral sclerosis. An alternative perspective is that clinical examination (with 'decision trees') allows diagnosis somewhat independent of x-ray findings. Mechanical disadvantage (e.g., joint instability) appears to be the more important variable influencing the development of osteoarthritis. Another important clinical issue is compromise of pain or position sense. The clinical perspective is that severity of disease requires assessment of the individual's ability to pursue activities of daily living, a somewhat 'circular' issue for the anthropologist.

ESTABLISHMENT OF CONSISTENT CRITERIA FOR DIAGNOSIS

Patricia S. Bridges, Queen's College, City University of New York

The lack of consistent criteria for scoring osteoarthritis has meant that it is difficult if not impossible to make a direct comparison of results obtained by different researchers. Of equal importance is the fact that there are no standards for data presentation, manipulation, and analysis. In particular, there is a great deal of variation in how the 'presence' of arthritis is defined, what surfaces comprise a joint, and on how composite scores for complex joints are derived. This paper shows how several commonly used methodologies lead to strikingly different results in prevalence and patterning of arthritis, and gives preliminary suggestions for establishing standards of data analysis.

CORRELATION OF CLINICAL IMAGING WITH PATHOLOGICAL AND VISUAL CHANGE IN THE KNEE JOINT

Juliet Rogers, Department of Medicine, University of Bristol

Pathological change in skeletal material is generally easy to see, although the diagnosis may be much more problematic. The visual appearance of bony pathology correlates poorly with radiological appearance, and in archaeological skeletal material there is no information on soft tissue or clinical assessment. In order to relate these changes to each other, observations have been made on a series of cadaveric and post-operative knee samples. The cadaveric knees had x-rays, visual assessment, and tissues collected before maceration, and then further x-rays and visual assessment after maceration. The post-operative knee samples had a clinical assessment and several types of imaging before total knee replacement. Post-operatively the specimens were subjected to the same procedures before and after maceration as the postmortem specimens. The relationship of the various assessment techniques with the clinical history and visual assessment of the bones is described.

OSTEOARTHRITIS: APPROACH TO QUANTIFICATION

Robert Jurmain, San Jose State University

OA is a common arthropathy, seen in all human populations that have been adequately surveyed. Accordingly, the mere *presence* of the condition provides but facile information. Of more consequence is the documentation of incidence and severity of osteoarthritic joint changes as reflected in specific joint areas. In order to accomplish these goals, some consistent form of quantification is required. To date, almost all such attempts have utilized ordinal scaling. In my research, an ordinaly scaled system was applied to highly specific regions within joints, including, for example, in the knee joint up to 17 separate areas. Although time consuming, this approach facilitates more robust statistical analyses. As a result of this work, considerable insight can be gained regarding the patterning of osteoarthritic involvement, both *within* and *between* joints. On the other hand, many skeletal studies seek to ascertain the general population pattern of involvement, and thus a simpler methodology may be more appropriate. Finally, it is crucial to note that degenerative changes do not manifest identically among the major joints, and therefore specific criteria must be established.

SUMMARY

Identification and quantification of OA were explored in a multidisciplinary fashion. Recognizing the analogy of five blind people trying to describe an elephant, the disparity of OA frequency and distribution in various populations was explained. Methodological issues were identified as the major limitation. Consensus was achieved on several issues. Osteophytosis and eburnation of synovial lined joints were recognized as clear signs of OA. Vertebral centre osteophytosis was clearly recognized as a different process, clearly distinguished from OA. Although overgrowth of the bone in non-weightbearing areas was considered consistent with OA, protrusions on weightbearing surfaces appear unrelated. Discussion of the physical chemistry of calcium crystals emphasized the limited manner in which tissues can respond to 'stressors' and our limited understanding of the process. As osteophytes less than 1 mm in size cannot be identified in clinical x-rays, the significance of such tiny bony overgrowth is not currently amenable to interpretation. Complex joints (e.g., elbows) are not well visualized in the intact individual. Thus the clinical significance of shoulder and elbow osteophytes remains a subject for future clarification.

Porosity was identified as an anthropologic character, without clinical, radiologic, or pathologic correlate. The term porosity has variably been applied to artifactual cortical bone loss (exposing underlying trabeculae), OA wearing away bone (in an eburnation process), and simple increase in prominence of cartilage ossification front channels. Although no consensus was reached on the implication of porosity, the recommendation was to eliminate it as a diagnostic criterion for OA. Although other signs of OA exist, the most reproducible sign is osteophytosis of synovial lined joints. If osteophytes represent a response to 'stressors,' what then determines 'normal' response and the pathologic state we call osteoarthritis? Something to think about!

B. CONGENITAL CONDITIONS: RECOGNITION AND BEYOND

Organisers: Susan C. Antón* and Gary D. Richards*

The focus of this session is congenital conditions, their recognition in the archaeological record, and their biological and cultural implications. Congenital conditions have frequently been treated as wastebasket categories by paleopathologists. Specimens are pigeonholed into a category such as 'hydrocephalic,' and left to languish on museum shelves. In so doing we lose most of the information available from these individuals. This session tackles the question of how to approach identifying the condition involved, how to go beyond simple classification, and how skeletal examples inform clinical practice. A workshop session featuring the cases described as well as others follows the presentations.

CONGENITAL CONDITIONS: WHAT ARE THEY AND WHAT CAN THEY TELL US?

Susan C. Antón, University of California, Berkeley

Congenital conditions result from genetic, environmental (teratological and mechanical), and mixed influences affecting development. They are best understood from a developmental perspective. The basic tenets of all good paleopathology apply: the most important step is detailed observation and description of the subject, paying attention to the developmental systems involved and the pattern of signs. Determine whether the condition you are examining is a malformation, a deformation, or a disruption. A good place to start learning about congenital conditions is Smith's *Recognizable Patterns of Human Malformations*, edited by K.L. Jones. The description and diagnosis of congenital conditions in skeletal samples indicates how significantly the condition affected the individual's life and also the time depth of a condition. Apparently minor, subclinical conditions provide information about relatedness and environment between populations. Finally, by comparing individuals with altered growth patterns to normative samples, we can inform theories of growth and modern clinical practice.

POSITIONAL PLAGIOCEPHALY: AN ARCHAEOLOGICAL CASE INFORMS CLINICAL PRACTICE

Catherine E. Ripley, Arizona State University and Stephen P. Beals, Southwestern Craniofacial Centre, Phoenix

Infants' heads are molded during the birthing process, and return to normocephaly within six postnatal weeks, but 1 in 300 retains an abnormal shape (positional plagiocephaly). Characterized by rhomboidal, asymmetric, non-synostotic heads, positional deformations correlate to environmental factors (e.g., premature birth, torticollis) or to multifactorial interaction. Infants may exhibit complex craniofacial

asymmetries or the expression may be localized. Our evidence indicates few spontaneous corrections, thus asymmetrical features are retained into adulthood. These asymmetries may disturb jaw mechanics, resulting in TMJ dysfunction, and may also compromise binocular vision. Clinically, however, the prevalent assumption is spontaneous correction, and many infants remain untreated. An adult with secondary plagiocephaly, from a Hohokam site, provides an example of the development and retention of asymmetrical features. Our work demonstrates the value of archaeologically recovered skeletal material to the clinical setting, and provides information important for recognition of non-synostotic plagiocephalic features in paleo crania.

CONGENITAL CONDITIONS OF TEETH

Teri L. Tucker* and Jerome C. Rose, University of Arkansas

Although congenital abnormalities of the teeth are rarely found in archaeological skeletal collections, their recognition and diagnosis are an important part of paleopathological skeletal collections, their recognition and diagnosis are an important part of paleopathological analysis. Congenital dental conditions can be divided into five broad categories for interpretive purposes: 1) inherited developmental defects such as amelogenesis and dentinogenesis imperfecta; 2) inherited morphological variants such as peg shaped crown, agenesis, and supernumerary teeth; 3) developmental anomalies secondary to inherited conditions such as Down syndrome and sickle cell anemia; 4) morphological and structural anomalies associated with congenitally contracted diseases such as syphilis; and 5) developmental disturbances such as hypoplasias and Wilson bands associated with prenatal stress. Both general and specific diagnostic criteria for differentiating among each of these five categories of conditions will be visually illustrated within a different diagnostic framework. An example of the analytical utility of each category for paleopathological analysis will be provided.

CONGENITAL CRANIOFACIAL CONDITIONS IN PREHISTORY: RECOGNITION AND DIAGNOSIS

Gary D. Richards, University of California, Berkeley

Recognizing congenitally related craniofacial alterations is complicated by the continual recognition of new conditions and the inherent overlapping of specific alterations within conditions. These problems challenge the clinician's ability to interpret observed morphology. Paleopathologists face a greater challenge in diagnosis because they lack patient-family histories, associated soft tissues, and because of the absence or fragmentation of skeletal elements. These problems have resulted in the use of vaguely defined categories. Although these investigators will be unable to make a specific diagnosis in many cases, significant improvement in delimiting conditions can be achieved by applying the functional matrices hypothesis. Evaluating prehistoric remains using this method results in significantly

refined diagnoses and a broader range of conditions. A feedback mechanism also results, in which observations on prehistoric material provide new criteria for diagnosis in the clinical setting. Case studies and specific features will be presented to illustrate this approach and the feedback mechanism.

DEVELOPMENTAL ABNORMALITIES OF THE VERTEBRAL COLUMN

Charles F. Merbs, Arizona State University

Development of the human vertebral column in utero and following birth is complex, and numerous possibilities exist for variation and error. Persistence of notochordal tissue in the fetus, for example, can interfere with normal chondrification, resulting in a centrum with a sagittal defect. Other developmental abnormalities seen clinically include hemi-vertebrae, failure of segmentation (block vertebrae), and aplasia of parts of the neural arch. These conditions, along with cranial and caudal shifting of regions of the column as seen in transitional lumbosacral vertebrae, and failure of developing laminae to form an intact neural arch (spina bifida), are frequently observed in ancient human remains.

RADIO-ULNAR SYNOSTOSIS AND ALLIED CONDITIONS: ARCHAEOLOGICAL CASES AND THEIR IMPLICATIONS FOR FUNCTION

Gina Polidoro and Susan C. Antón, University of California, Berkeley

Proximal radio-ulnar synostosis (RUS) occurs congenitally as either an isolated condition or as part of a syndrome (e.g., William's) or it may occur as a secondary complication of forearm trauma. Significant functional restrictions ensue, limiting the ability to supinate and pronate the forearm. The Hearst Museum of Anthropology, UCB houses two previously undescribed archaeological cases of actual or functional RUS from California localities. In one instance, actual longstanding bony fusion exists, fixing the right forearm in the neutral (half pronated) position. In a second case, bilateral absence of the radial notch and concomitant remodelling of the proximal radii results in *functional* fixation of the forearms in the neutral position. Several morphological accommodations are shared in these cases as a result of fixation in the neutral position. Such changes include the central migration of the ulnar interosseous crests and enlargement of Lister's tubercles. Understanding the pattern of accommodations made in the face of compromised function ultimately increases our understanding of growth in normal functional regimes.

THE HETEROGENEITY OF DWARFISM: RECOGNITION IN HUMAN SKELETAL REMAINS

Anna Watrous, The University of the Pacific

Many systemic disorders result in abnormally short stature, or dwarfism. The term 'dwarf' is traditionally used in referring to an individual with disproportionately short stature (i.e., short trunk or short limbs). Disproportionate short stature syndromes are a heterogeneous group of growth disorders that produce a broad range of clinical and skeletal manifestations. Many forms of dwarfism are recognizable at birth. In a number of syndromes, however, short stature becomes manifest postnatally. In the past, most disproportionate dwarfs were classified under the term 'achondroplasia.' Today, medical research identifies achondroplasia as a specific genetic entity amidst a large and heterogeneous group of distinct short stature syndromes. Current clinical literature utilizes skeletal radiographs as the primary basis for differentiating growth disorders. Radiographs, coupled with detailed descriptions of diagnostic radiological criteria, can assist in achieving a substantial degree of refinement in diagnosing dwarf skeletal remains. At the same time, there are inherent difficulties in the process of extrapolating diagnostic criteria used on radiographs of living people and translating these criteria to assess dry bone specimens. Skeletal examples from the Hearst Museum, UCB are presented to illustrate interaction between the clinical literature and the paleopathological assessment of dwarf skeletal remains.

SUMMARY

Thanks to our many contributors and participants, we spent an enlightening morning exploring how to identify congenital conditions and what we can learn from them. Among the many themes, the implications of congenital conditions for understanding human growth and development (and, by extension, evolution) and informing clinical practice arose as the most powerful. The contributed papers and workshop combination proved especially fruitful in this framework, providing introductions to recognition and application as well as hands-on experience. The contributed papers provided valuable information on general classification (Antón), recognition and variation (Tucker and Rose, Merbs, Polidoro and Antón, Watrous), and implications for clinical practice (Richards, Ripley). This collaboration between clinicians and paleopathologists provides a powerful argument for retaining skeletal collections. The workshop featured more than 40 individuals from the Hearst Museum of Anthropology, UCB and the Atkinson Collection, University of the Pacific, San Francisco. These cases demonstrated all categories of congenital conditions, from developmental anomalies to malformation syndromes, and we hope that these new perspectives encourage the participants to make critical examinations of (and publish) case studies in their collections. The enthusiasm engendered by the symposium will thus translate into a burgeoning of research on congenital conditions. These valuable, though long dead, members of the human race have much to teach us.

SECTION 4: POSTER PRESENTATIONS

OSTEOPOROSIS IN PAST POPULATIONS: APPLICATIONS OF SCIENTIFIC METHODS TO THE PROBLEMS OF DIAGNOSIS

Grace Ballance*, Charlotte Roberts and Jennifer Wakely, University of Bradford

This project considers the problems of diagnosing osteoporosis in archaic human remains and investigates the relationship between osteoporosis and fractures. By applying scientific methods, we aim to establish criteria by which to diagnose this metabolic disease in antiquity. Osteoporosis, the most common metabolic bone disease today, results in decreased stability of bone due to a quantitative loss of bone mass. It is often the underlying cause of fractures of the vertebrae, colles fractures of the wrist, and fractures of the neck of the femur: elderly and post-menopausal women are particularly vulnerable. Because of the lack of suitable diagnostic criteria, its prevalence in the past is unknown. Radiography and the relative weight of bones within a cemetery population have been used previously to indicate its presence, but their accuracy is questionable because taphonomic processes acting on bone within the burial environment can mimic the low bone mass associated with the condition. Several scientific techniques are being used and then compared for their diagnostic precision: these include radiography, densitometry of x-ray, scanning electron microscopy, and microradiography. Skeletal remains from the later medieval cemetery site of St James and St Mary Magdalen, Chichester, Sussex and the Anglo-Saxon site of Raunds, Northamptonshire are being studied and compared with modern material.

A COTTON OBJECT INTRODUCED INTO THE ANAL CANAL OF A 16TH CENTURY AD COLOMBIAN MUMMY

Felipe Cárdenas Arroyo, University of Los Andes, Bogotá

The artificial preservation of human bodies was practiced by several Indian groups of the Central Andean highlands of Colombia, starting in the fifth century AD and lasting until the 18th century, almost 300 years after the Spanish Conquest. All the mummified bodies belonged to political and religious leaders, as attested by the artifacts placed with them. This case concerns a mummy C14 dated at 1520 ± 100 AD and is unusual. CT scanning showed a strange, nearly circular object inside the anal canal. The object was carefully extracted via the anus, and was discovered to be a circular cotton ball, which had probably been introduced into the body at the time of mummification. There is also a fragment of cotton inside the mouth, firmly held within the teeth. Introducing objects into the anus and the mouth has also been observed in ethnographic contexts in Colombia (tobacco, for example). There is no known medical purpose for this practice, and it seems not to have any relationship to the preparation of the dead body.

COCAINE AND OTHER HALLUCINOGENS IN HUMAN ARCHAEOLOGICAL REMAINS: SETTING THE CULTURAL- HISTORICAL CONTEXT FOR A GROWING FIELD OF ENQUIRY IN BIOANTHROPOLOGY

Felipe Cárdenas Arroyo, University of the Andes, Bogotá

This poster attempts to set a cultural and historical context for the use of certain narcotic drugs that originate in South America. A recent development in bioanthropology is the attempt to identify traces of coca, nicotine, and several hallucinogenic substances in human archaeological remains. The consumption of narcotic drugs has been, right up to the present, one of the most important aspects in the ritual life of aboriginal South Americans. Most plants were grown in tropical lowlands such as the Amazon region, but were traded over long distances. Although the use of narcotics was a world wide practice in ancient times, the plants employed in the Americas were unique to this continent. There is no evidence of pre-Hispanic distribution of plants such as coca or species of *Banisteriopsis* to any part of the Old World.

THE UPPER PALAEOLITHIC MAN OF NAZLET KHATER (UPPER EGYPT): DYSRAPHIC AND ARTHRITIC LESIONS

Christine Charlier, Centre of Human Genetics, Katholieke Universiteit Leuven

In 1980 an almost complete human skeleton was excavated in the Nile Valley by Vermeersch's team (K.U Leuven). The find was connected with an Upper Palaeolithic blade industry and a chert mining site. C14 dating yielded an estimated age of 30,000-35,000 BP. The skeleton could be related to the Mechtoid type: it is the oldest known specimen of this type and indeed the first known African *Homo sapiens*. It was probably an adult male. Paleopathological study showed: 1) several congenital anomalies, apparently of dysraphic type; 2) scoliosis; 3) severe and generalised arthritic lesions. Dysraphic syndrome as well as arthritic infections have been described in several Epipalaeolithic and Neolithic series in North Africa. Data are illustrated and discussed.

AUTOPSY OF PUM-II (video)

Eve Cockburn and T.A. Reyman, Paleopathology Association

In February 1973, an international group of scientists gathered in Detroit for a two day seminar, Death and Disease in Ancient Egypt. The first day was spent in carrying out a carefully controlled autopsy of an Egyptian mummy that had been lent by the Pennsylvania University Museum: because it was the second mummy lent to us by the museum, it became known as PUM II. Only the specialists actually involved in the examination were in the laboratory, but the entire eight hour

investigation was relayed over closed circuit television to an audience of staff and students from Wayne State University Medical School. This eight hour video was later condensed to the thirty minute highlights-only tape shown here. The seminar, co-sponsored by the Smithsonian Institution, the Detroit Institute of Arts, and Wayne State University School of Medicine, was the occasion of the founding of the Paleopathology Association.

THE PALAEOPATHOLOGY OF MIDDLE EAR AND MASTOID INFECTION

Gwen Dalby*, Keith Manchester and Charlotte Roberts, University of Bradford

Ear infections, among the most common childhood ailments seen today, usually respond well to modern antibiotic therapy, but in the past they frequently progressed to such fatal complications as meningitis or extradural abscess. This study explores different methods of assessing the prevalence of ear disease in past populations. The material consists of temporal bones from 99 skeletons from three Romano-British cemeteries, 286 from two Anglo-Saxon cemeteries, and 303 from two late medieval English cemeteries. Radiography allowed assessment of the type of mastoid, and planimetric data were considered to determine the size of the mastoid air cell system. The temporal bone was examined externally for evidence of periostitis or a draining mastoid sinus. The ossicles, where present, were removed and examined under a binocular microscope for evidence of erosive bone change, and a fibre optic endoscope was used to examine the external auditory meatus, the middle ear cavity, and the epitympanum for evidence of bone changes due to infection. The results are presented to indicate the prevalence of ear disease in British antiquity and the relationship that it might have to the socioeconomic environment at the time the various individuals lived. (Research supported by the Science and Engineering Research Council, UK.)

TWO EARLY CASES OF LEPROSY FROM NORTHERN AND SOUTHERN FRANCE

Jean-François Duvette and Joël Blondiaux, CRA/CNS, Sophia Antipolis, Valbonne

Until now, leprosy has been poorly documented for the Dark Ages of France (Vita of St Géry in the VIth century and the Leprosarium of Nancy in the VIIth century). Two recent excavations have demonstrated that leprosy was present during the Vth-VIth centuries in northern and southern France. Neuville-sur-Escaut (Vth-VIth centuries) is the cemetery of a Frankish settlement. Vaison-la-Romaine (VIth-VIIth centuries) is the cemetery of ordinary craftsmen. Two cases of leprosy are described and analyzed according to the Andersen-Manchester classification.

ENIGMATIC LESIONS OF THE FACIAL SKELETON ASSOCIATED WITH CRIBRA ORBITALIA

Scott I. Fairgrieve, Laurentian University, Ontario

This paper examines the probable etiology of porous bone lesions found collaterally with cribra orbitalia on the exterior aspect of the facial skeleton and of an erosive lesion on the inner table of the bones of the cranial vault. These porous and non-expansive lesions are found on the zygoma, maxilla, greater wing of sphenoid and temporal bones, and the inner table lesion is found to varying degrees on the front, parietal, and occipital bones. One expansive lesion is present in the glabellar region of the frontal bone and is contiguous with active trabecular cribra orbitalia. In this same specimen, well defined erosive lesions are present in several areas of the inner table of the frontal bone. The presence of these lesions on juvenile skeletons from the Roman Period 'ein Tirghi cemetery, located in the Dakhleh Oasis of Egypt's Western Desert, prompted the investigation of this seemingly unusual occurrence. Possible etiologies for both vitamin C and folic acid deficiencies are presented in conjunction with a review of the physiological roles of each. In no instance were any intracranial lesions indicative of vitamin C deficiency noted in any of the skeletons excavated. The case for including folic acid deficiency in the differential diagnosis is presented. The close association of the facial lesions with cribra orbitalia suggests that a de facto diagnosis of a genetic anemia with cases found in North Africa or the Mediterranean may not necessarily be justified.

CRANIAL TRAUMA: A POSSIBLE EXAMPLE OF PREHISTORIC EXECUTION

M. Cassandra Hill, University of Massachusetts/Amherst

Excavations for the Jefferson Street Bridge Project conducted by Panamerican Consultants, Inc. were completed in March 1992 as part of a contractual agreement with the Tennessee Department of Transportation. The skeletal sample recovered was highly unusual in several respects. This presentation discusses the utility of data resulting from salvage projects of this type, and focuses on two interments that contain a total of four individuals, seemingly the result of a single traumatic event. Using forensic techniques of trauma evaluation, it appears that all four individuals received virtually identical blows to the head, in addition to being scalped.

IDENTIFICATION OF SOFT TISSUE CALCIFICATIONS IN ARCHAEOLOGICAL SITES FROM SOUTH AFRICA AND NAMIBIA

Alan Morris, University of Cape Town

This poster presents the analysis of two interesting cases of soft tissue calcifications found during the controlled excavation of skeletons from the arid region of southern

Africa. The finds tell us something of the health experiences of two individuals of late prehistoric Khoikhoi (Hottentot) populations in southern Africa. The first case is that of a middle-aged woman from Omdraai on the Orange River in northwestern South Africa. Bilateral calcifications were identified at the level of the 2nd and 3rd lumbar vertebrae in the anatomical position of the kidneys. X-ray dispersion and x-ray powder analysis confirm the presence of biological apatite in the calcifications. The morphological structure of the calcifications is not like that found in normal kidney stone disease, and it appears as if the calcification occurred around the exterior of the kidneys. The second case is a young woman from Rehoboth, central Namibia. A single cup shaped calcified object was found in the mid-abdominal region. The presence of biological apatite was again confirmed. Several possible diagnoses are considered, but the most likely explanation seems to be that the calcification is a biological response by the host to a large hydatid cyst.

SYPHILIS IN AN EARLY 15TH CENTURY FEMALE FROM GLOUCESTER, ENGLAND

Donald J. Ortner, Smithsonian Institution and Charlotte Roberts, University of Bradford

Recent investigations of the skeleton of a young adult female from the Blackfriars cemetery in Gloucester has revealed pathological changes consistent with syphilis. The changes are presented, and a differential diagnosis is given. The skeleton is regarded as important in the continuing debate about the appearance and transmission of syphilis in the Old and New Worlds

AN OVERVIEW OF THE PALEOPATHOLOGY FROM TUTU, A PRECOLUMBIAN SITE IN ST THOMAS, UNITED STATES VIRGIN ISLANDS

L. Sappelsa, M.K. Sandford and D.S. Weaver, Wake Forest University (LS and DSW) and University of North Carolina, Greensboro (MKS)

A range of lesions has been found in the human skeletal sample of 36 individuals (20 adults and 16 subadults) from the Tutu site: preliminary sex determination indicates 9 males and 10 females. Frequencies and sex and age distributions of the sample and of the lesions are presented. Some lesions are similar in frequency and distribution to other Caribbean pre-Columbian human skeletal samples, and can be linked to the diet and cultural ecology of pre-Columbian St Thomas. For example, porotic hyperostosis and cribra orbitalia may be associated with a diet relying heavily on manioc, which contains phytates that may inhibit iron absorption, and the possible presence of parasites such as roundworms and hookworms, which would also affect iron uptake. The cranial conditions also may be associated with enamel hypoplasias and Harris's lines. Other atypical skeletal and dental conditions are presented.

CUT MARKS OR VASCULAR IMPRESSIONS? CLUES FROM PALEOPATHOLOGY AND ANATOMY

Frank P. Saul, Medical College of Ohio and Julie Mather Saul, Lucas County Coroner's Office, Toledo, Ohio

A speaker at the February 1992 meeting of the American Academy of Forensic Sciences* asked the audience for opinions regarding the origin of grooves in the lateral portions of the frontal bone of a projected skull from a recent case. The forensic pathologist suspected that they represented 'cut marks.' For us, it was another case of 'déjà vu all over again.' These, and similar vascular grooves elsewhere in the skeleton, have frequently been misinterpreted by investigators studying ancient skeletal remains as being due to trauma or to medical procedures ('cauterization'). Grooves in this specific location are probably the impressions that are sometimes produced by the pulsation of the frontal branch of the superficial temporal artery (the 'checkpoint' for the temporal pulse). In support of this contention, we provide photographs of this vessel in place in one of our dissecting room specimens, and a scanning electron microscopic analysis of another groove that reveals fine grooves (= vessels) branching off from the main groove, as well as smooth muscle-like impressions. We also review the anatomy and paleopathology literature and present our own information on variation in presence and form. [* Note: This poster was originally presented at the February 1993 AAFS meeting, and was shown in Toronto in response to renewed interest by paleopathologists.]

A METHOD TO RECORD ACTIVITY-INDUCED PATHOLOGY IN THE HAND AND FOOT

Vanya R. Scott*, Susan L. Steen* and Christine L. Hanson, University of Alaska

An important research problem in physical anthropology is the study of the distribution of activity-induced pathology in modern and ancient human skeletons. This research addresses the problem of organizing data into a standardized and retrievable form. Expanding on the methodology designed by Merbs (1969) and Nagy (1991), this recording form allows for schematic mapping of graded levels of porosity, lipping, and eburnation on the articular surfaces of the bones of the hands and feet. Although the gradations within the scoring categories are subjective, inter-observer reliability should also prove very high, as shown by Merbs (1983). This recording method has the potential to be adapted to mapping other conditions and/or variations that are expressed on articular surfaces of the hands and feet. The potential also exists for the data to be encoded for use in statistical modeling.

THE ST MARY'S CITY LEAD COFFIN PROJECT

Paul S. Sledzik, Douglas W. Owsley, Henry M. Miller, Timothy B. Riordan and Allison Webb Willcox, National Museum of Health and Medicine/AFIP (PSS, AWW), Smithsonian Institution (DWO) and Historic St Mary's City (HMM, TBR)

In the fall of 1992, an interdisciplinary team consisting of archaeologists, conservators, engineers, historians, paleopathologists, physical anthropologists, and materials and atmospheric scientists excavated and analyzed three disinterred lead coffins dating from the late 17th century. These coffins had been buried in a church foundation located in St Mary's City, Maryland, the site of the state's first settlement and capital ca 1634. Before opening, the coffins were subjected to a series of nondestructive imaging techniques to view the interior. Using the information from these tests, a hole was drilled into each coffin in order to remove the air for analysis and allow the team to view the interior the coffin using a fiberoptic system. The coffins were then flooded with argon gas to create an inert environment. At the time of writing, we believe that the three coffins contain respectively the remains of a male, a female, and an infant or child of high social status. We are planning to conduct a battery of anthropological, DNA, immunoglobulin, and isotopic analyses on the remains, in order to assess, among other things, the cause of death. This report presents the project's findings to date.

CORRELATION OF ARTHRITIS AND ACTIVITY PATTERNS: A CASE STUDY OF A MEROITIC NUBIAN MALE

Jennifer A. Sol*, Arizona State University

This individual, from Semna South, shows a pattern of osteoarthritis throughout the skeleton, which strongly suggests specific movements. These patterns can be correlated with activities. The individual also showed evidence of diffuse idiopathic skeletal hyperostosis; possible explanations for this condition in the light of the inferred activity patterns will be explored.

POSSIBLE CARCINOMA IN ASSOCIATION WITH PROBABLE TREPONEMATOSIS IN AN OSSUARY SAMPLE FROM THE PRE-COLUMBIAN NORTH CAROLINA COAST

D.S. Weaver and G. Bogdan, Wake Forest University

Two adult individuals from an ossuary sample (the Flynt site, 31 On 305) present skeletal conditions that suggest metastatic carcinoma in association with treponematosi. Both cases present irregular, focal penetrating lytic lesions throughout both cortical and cancellous bone. Both individuals also show skeletal evidence of several separate episodes of a probable treponematosi. The combination of skeletal signs of long standing treponematosi and metastatic bone disease suggests a squamous cell carcinoma as the probable source of the metastatic disease. These cases add to the growing awareness of the paleopathology of metastatic bone disease and treponematosi. They also serve as reminders that multiple conditions may be seen in individual skeletons in paleopathological studies.

SECTION 5: CONTRIBUTED PAPERS

A. THE NEW WORLD

Moderators: James E. Harris and Patty Stuart Macadam

PALEOPATHOLOGY AT THE NATIONAL MUSEUM OF HEALTH AND MEDICINE/AFIP

Allison Webb Willcox, Paul S. Sledzik and Marc S. Micozzi, National Museum of Health and Medicine/AFIP

Aidan Cockburn's leadership in paleopathology planted the original seed for the formation of the NMHM paleopathology program. Several recent activities have been undertaken at the NMHM to disseminate paleopathological information and address new research areas. The NMHM Paleopathology Course was designed to bring together a diverse group of paleopathologists to share ideas and communicate information. In conjunction with Diane France of France Casting, numerous diagnosed skeletal pathological specimens have been cast, and are for sale to paleopathologists. The Skeletal Explorer Videodisc Project, under the guidance of John Blank of Cleveland State University, has used paleopathological specimens from the NMHM collections. Our participation, in terms of staff, collections, and exhibits at the First International Mummy Congress and Exposition underscores our research in the area of mummified tissue. The technical and ethical issues surrounding our involvement in the testing of DNA from Abraham Lincoln for Marfan's syndrome bring new dimensions and questions to paleopathology. Several additional ongoing research projects attest to our participation in the paleopathological community.

REPATRIATION: A STUDY IN TIME AND COST

Lela Donat and Angela Tiné, University of Arkansas

With the deadline fast approaching for the inventory of Native American skeletons, the Arkansas Archaeological Survey, in cooperation with the Department of Anthropology at the University of Arkansas, has devised a procedure for the basic inventory of skeletal material, using the standards set forth by the Paleopathology Association (1991). Three studies have been conducted, recording the time and cost of analyzing each skeletal collection. Two collections consist mainly of fragments, but the skeletons in the other collection are nearly complete. For studies such as stable isotope and carbon 14 dating, the cost and the amount of sample per skeleton have been included. It is hoped that these studies will guide

all of us in budgeting the time and money to analyze skeletal collections thoroughly before repatriation.

SKELETAL EVIDENCE FOR TUBERCULOSIS AND VAMPIRISM IN 18TH AND 19TH CENTURY NEW ENGLAND

Paul S. Sledzik and Allison Webb Willcox, National Museum of Health and Medicine/AFIP, and Nicholas Ballantoni, Connecticut State Archaeologist

During the excavation of a cemetery from eastern Connecticut dating from 1740 to 1840, the remains of one individual were found to have been rearranged in the grave. The bones of the thorax of a 50-60 year old male had been jumbled, the femora crossed on the lower thorax, and the skull placed on the jumbled bones of the upper chest. The appearance of periostitic rib lesions on the upper left ribs indicates probable pulmonary infection from tuberculosis. Historic accounts of 'vampirism' in eastern Connecticut and western Rhode Island reveal that this practice was not uncommon in the 19th century. Some rural New Englanders believed that a person who recently died of consumption (tuberculosis) could cause the wasting away of other family members. Such a process is not inconsistent with the pathogenesis and epidemiology of tuberculosis spread. To counteract this suspected slow death, the grave of the 'undead' person (or vampire) was opened and the heart removed and burned. This practice was transplanted from central Europe, which had a long history of beliefs about vampires. This paper presents the pathological evidence from the skeleton, discusses historical accounts of vampirism from New England, and explains the interplay of postmortem change, disease, and vampirism.

A CASE OF CLEFT PALATE IN AN ANASAZI BURIAL FROM COLORADO

Elizabeth Miller* and Charles F. Merbs, Arizona State University

The remains of a 30-40 year old female demonstrating classic signs of cleft palate syndrome were excavated in 1963 from a late Piedras to Arboles Phase Anasazi village in Archuleta county, Colorado (LA 4131). Indications of cleft palate syndrome included a lack of development of the left naso-maxillary area, absence of the left maxillary incisors, canine, and first premolar, a wide interorbital breadth, and short stature. These changes are discussed in detail along with the complications that can result from clefting.

CORRESPONDENCE OF OSTEOARTHRITIS AND MUSCLE USE IN RECONSTRUCTING PREHISTORIC ACTIVITY PATTERNS

Bethel Nagy* and Diane Hawkey*, Arizona State University

Traditionally, either osteoarthritis (OA) or musculo-skeletal stress markers (MSM) have been used to determine habitual activity patterns in prehistoric populations. When the commingled skeletal remains from a disturbed site at Chavez Pass, Arizona were independently scored for both indicators, OA results were found to corroborate the activity pattern interpretation seen in the MSM data. Results of this analysis have several implications: 1) Precise scoring of type and location of OA strengthens behavioral interpretations at the local population level, particularly when used in conjunction with the MSM data; 2) Use of MSM data remains the preferred way to interpret behavior in young to middle age adult specimens, but OA is a more accurate indicator of activity patterns maintained into old age. Thus combined analysis of both kinds of data allows behavior to be inferred over a greater age range.

DENTAL WEAR 'NOT WHAT IT SEEMS TO BE' FROM CA-ALA-329 AND OTHER SITES IN CENTRAL CALIFORNIA

Leon E. Pappanastos, San Jose State University

Remains of 163 individuals were examined to determine various patterns of functional wear. Could this wear be more than it seems to be? Specimens shown are not consistent with functional etiology. Occasionally, the maxilla and mandible occlude in a manner that could not have been produced solely by functional wear. When placing the maxilla on the mandible and simulating mastication, typical wear patterns were not reproduced in the maxillary molars in every case. One would expect the wear to be mirrored on the mandibular teeth, but this wear pattern is not always seen. A comparable site in Arizona shows the difference in various populations as far as dental wear is concerned.

PREHISTORIC HEALTH STATUS IN THE PASIÓN MAYA LOWLANDS: ECOLOGICAL COLLAPSE RECONSIDERED

Lori E. Wright*, University of Chicago

Over the last twenty years, Mayanists have embraced the idea that poor health contributed to the decline of lowland Maya civilization around AD 900. This paper evaluates the hypothesis using paleopathological data from 3 sites in the Pasión River region of the Guatemalan Petén: Dos Pilas, Altar de Sacrificios, and Seibal. In a previous study, Saul (1972) found no chronological health differences at Altar de Sacrificios, yet argued that poor health contributed to the collapse. Among the data presented here, no statistical differences can be detected in the prevalence of

periosteal reactions, porotic hyperostosis, or enamel hypoplasias either between sites or at each site over time. Major diseases considered in the differential diagnosis of periostoses are chronic, endemic conditions --- unlikely culprits in population collapse. These results do not support archaeological models of overpopulation and ecological collapse.

BIOANTHROPOLOGICAL FINDINGS IN SIXTY-FOUR CHINCHORRO MUMMIES FROM ARICA, CHILE

Arthur C. Aufderheide, University of Minnesota-Duluth School of Medicine

The Chinchorro people populated the northern Chile coast between 9000 and 4000 years ago. Their spectacular anthropogenic ('artificial') mummification practices, initiated several millennia before the first Egyptian dynasty, were unique to the New World. This report identifies the bioanthropological findings in 64 *spontaneously* mummified bodies of this population that were excavated during 1987 from the Morro 1-6 site at Arica in northern Chile.

ORGAN PRESERVATION IN SOUTH AMERICAN MUMMIES: A PRELIMINARY REPORT

Michael Zlonis, University of Minnesota-Duluth School of Medicine

Internal organs are not preserved to the same degree in spontaneous mummification. Knowledge of the general pattern of organ preservation is necessary in order to plan studies utilizing autopsy material from mummies. Most morphologic mummy studies have been published as single case reports or on small groups of individuals. The author reviews the state of preservation of internal organs in 61 members of the Chinchorro culture excavated at the Morro-1 site near Arica, Chile. The relationship between internal organ preservation and burial conditions is discussed.

HEALTH AND DIET OF TWO PREHISTORIC POPULATIONS FROM CHILE'S SEMIARID NORTH

M.A. Rosado*, Rutgers University and M.F. Ericksen, George Washington University

An investigation of health and diet in two prehistoric populations from Chile's semiarid north, Bahia de Coquimbo was conducted in 1990-1991 at the Museo Arqueológico in La Serena, Chile. The preservation of the skeletal material is excellent, which permitted a detailed clinical study of dentition and of lesions observed on the bones. The archaeological, historical, and trace element data that

suggest differences in subsistence allow us to ask: do differences in health exist between the two populations, what are those differences, and how are they reflected in the skeleton and the dentition? The paleopathological analysis revealed the following: auditory exostoses, intentional cranial deformation, cranial trauma, healed long bone fractures, infectious arthritis, periostitis, osteitis, porotic hyperostosis, cribra orbitalia, osteoarthritis, dental caries, dental abscesses, and dental wear. This communication describes the pathology observed, especially conditions of unknown etiology, future studies, and some preliminary results.

CRANIAL THICKNESS AND NEURODEGENERATIVE STATUS ON GUAM

Gary Heathcote, University of Guam

This paper reviews the literature on the multiple determinants of increased cranial thickness and presents new information on clinicopathologic correlates of cranial thickness variation. The latter focus is based on a study of frontal bone sections removed at autopsy over the past 12 years at the Guam Memorial Hospital. Variation in the thickness of the inner and outer cortices and the diploic region, according to age, sex, ethnic group, and neurodegenerative status are reported. Cohorts from the sample include individuals who were diagnosed as having neurodegenerative changes and clinical disorders, including Guamanian amyotrophic lateral sclerosis (ALS) and Parkinsonism-dementia complex (PDC). This presentation adds new baseline information on craniopathy, which may prove to have bearing on the paleopathological record of unusually thickened crania.

B. THE OLD WORLD

Moderators: George J. Armelagos and Katherine Gruspier

THE ROLE OF OCCUPATION IN THE AETIOLOGY OF OSTEOARTHRITIS

Tony Waldron, Institute of Archaeology, University College London

It is commonly stated that occupation is an important aetiological factor in the development of osteoarthritis, and many authors have tried to determine the occupation of individuals during life from the pattern of OA in the skeleton. The epidemiological evidence for an association between occupation and OA is extremely equivocal. There are a number of studies showing that some sites are more commonly affected by OA in some occupational groups than others, but many other studies have failed to show any such relationship. It is also well known that OA occurs frequently in those who undertake no form of strenuous work at all. The aetiology of OA is undoubtedly multifactorial, and it is probable that the common end stage pathology is the result of a number of disease processes. Even if one accepts that occupation is an important sociological factor, it can easily be demonstrated with the use of simple models that it is impossible to establish the occupation of an individual on the basis of OA in the skeleton. The exception to this would be if there were one kind of OA that was unique to a single occupation: this we know is not the case.

PALEOPATHOLOGY AND MANIFESTATIONS OF STRESS AT THE DAWN OF SEDENTARY LIFE: THE *HOMO SAPIENS* POPULATION OF THE SHANIDAR CAVE

Anagnosti Agelarakis, Adelphi University

This paper presents the results of paleoepidemiological studies on the *Homo sapiens* population of the Shanidar Cave. Both sex subcategories and most age subgroups are represented, and there is no evidence of biodistance between them. Changes in human organizational systems and perceived environmental context, as reflected by ecofacts, tool assemblages, and the intensification of harvesting resources during this proto-Neolithic cultural component could have altered existing interrelations among pathogens, vectors, and hosts. Paleopathological investigation of the skeletal record revealed the presence of hemopoietic and metabolic disorders, benign tumors, lesions of the joints, lesions of the jaws and teeth, infectious diseases, and severe traumatic conditions. Bone isotopic testing for the investigation of dietary patterns indicated a diet heavily based on C3 plants, with the animal protein component calculated as less than 10%. The paleopathological profile, in conjunction with archaeometric studies and the rest of the archaeological record, presents significant reflections of the lives of these proto-Neolithic people in SW Asia during a transitional time period. The study demonstrates anew how the

integrated use of paleopathology serves as a unique and powerful medium in deciphering perspectives of prehistoric human conditions.

DIACHRONIC ANALYSIS OF CORTICAL BONE GROWTH AND REMODELING IN SUBADULTS DURING THE AGRICULTURAL TRANSITION IN NEOLITHIC AND CHALCOLITHIC IRAN

Brett Waddell*, University of Manitoba

Cortical bone cross sections of the femurs of two samples of subadults from the early Neolithic site of Tepe Ganj Dareh (9000-7000 BP) and the Chalcolithic site of Seh Gabi (6000-4500 BP) in central western Iran were analysed. The results are placed within the context of the biocultural transition associated with the shift from incipient food production to fully sedentary agriculture in western Iran, and in relation to other non-specific indicators of stress. Results were also contrasted with other comparative samples, both contemporary and archaeological.

PALEOPATHOLOGY OF CREMATED, COMMINGLED BONE

Maria A. Liston, Adirondack Community College

The American excavations at Kavousi, Crete have recovered approximately 140 human skeletons from the Late Bronze Age and Early Iron Age sites of Vronda and the Kastrol. The majority of these were from cremation burials interred in ceramic vessels and as primary burials of the cremation pyres. Despite the fragmentary remains of the cremated bone, the Kavousi bone displays a wide variety of identifiable lesions, as well as some unidentified anomalies. This paper addresses the potential and limitations of paleopathological analysis of cremated bone, and presents a description of the identifiable pathology. In addition, some of the unidentified anomalies will be presented in the hope of eliciting audience response.

TREPANATION IN A BRONZE AGE CEMETERY IN YUGOSLAVIA AND SOME POSSIBLE ANATOMICAL AND BEHAVIOURAL CORRELATES

E.A. Rega, University of Sheffield

One of the more impressive manifestations of prehistoric surgical skill is the practice of trepanation, whereby a portion of the calvarium is removed, without disturbing the underlying soft tissue structures surrounding the brain. A number of suggestions have been advanced by researchers concerning the possible reasons for this procedure (Bennike 1985, Jennbert 1991, Lisowski 1967, Merbs 1989, Ortner & Putschar 1981, Parker et al. 1985, Steinbock 1976, Stewart 1958). The most cited

grounds for this surgery include treatment of cranial trauma, releasing of harmful substances or spirits, and procurement of bone for ritual purposes. This paper investigates eight trepanations from the Bronze Age cemetery at Mokrin in northern Yugoslavia. Although it has been proposed that these trepanations were performed as treatment for cranial fractures, the regularity of locations and form, as well as connections with other aspects of the funerary programme suggest that the people of prehistoric Mokrin may have been practicing trepanation in order to manipulate the underlying brain tissue, possibly for shamanistic purposes, including production of visions and spontaneous speech.

ANEMIA IN THE INDUS AND NILE VALLEYS: EVIDENCE AND INTERPRETATION

Nancy C. Lovell, University of Alberta

The ancient Indus and Nile Valley cultures traditionally have been considered among the earliest and most developed early civilizations, sharing features such as highly specialized and functionally integrated economies, centralized bureaucratic institutions, and large population bases. These two civilizations contrasted sharply, however, in three ways that may be reflected in different morbidity patterns: degree of urbanization, socioeconomic class differentiation, and ecological diversity. New data on vault and orbital lesions representing anemia in predynastic and archaic Egypt, plus a review of the literature reveal that the prevalence of anemia in ancient Egypt was greater than that in the Indus Valley, and that the etiology of anemia may be linked to differences in settlement, stratification, and subsistence in the two areas.

POTT'S DISEASE AND ARTEFACTS ASSOCIATED WITH THEM IN GRAVES DURING EGYPTIAN PREDYNASTIC TIMES

E. Crubézy, Université de Bordeaux and T. Janin, UPR 290 CNRS, C.D.A.R.

During the 1990 and 1991 excavations in the necropolis of Adaima (Esna District, Egypt), more than 50 graves totalling over 60 skeletons were recovered. Included in this sample were 2 skeletons whose vertebral columns are pathological: they came from 2 graves found in close proximity. Analyses of these specimens and careful consideration of a differential diagnosis compatible with the patterns lead us to consider the possibility that these individuals suffered from Pott's disease. If correct, this would be the earliest documented case of this condition. Additionally, and of archaeological interest, was the discovery in both these graves of unique pottery artefacts not found elsewhere in the site. These were characterized by distortions that appear to have been intentionally made prior to firing, reminiscent of the actual physical distortion of the disease process on the human body.

TB OR NOT TB? INFECTIOUS DISEASE IN HUMAN REMAINS FROM THE NORTHERN CEMETERY AT ABYDOS, EGYPT

Brenda J. Baker, Tufts University and University of Massachusetts and Janet E. Richards, University Museum, University of Pennsylvania

During the 1988 Pennsylvania-Yale Expedition to Abydos, 53 burials and numerous concentrations of human bone were excavated from the Northern Cemetery. These burials range in date from the Middle Kingdom to the Roman Period (ca 2040 BC to AD 395). Preliminary examination of the burials revealed an extremely pathological group, and prompted several questions regarding the patterns of pathology present and the differential diagnosis of the diseases. Detailed analysis of pathology, initiated during the 1991 field season, documented lesions diagnostic of tuberculosis in two individuals, but the overall pattern of pathology presented is atypical. Several individuals display pathology more consistent with mycoses. Central to a differential diagnosis is an understanding of disease vectors and the social and environmental context in which they occurred. Disease synergism and evolution are also considered.

DIFFERENTIAL DIAGNOSIS OF VERTEBRAL BODY LESIONS IN SKELETAL MATERIAL FROM ENGLAND

Charlotte Roberts and Keith Manchester, University of Bradford

Recent research at the universities of Bradford and Leicester concerning tuberculosis in antiquity has considered the nature of two distinct lesions of the surfaces of vertebral bodies from skeletons excavated from a variety of cemetery sites from different periods. The lesions consist of depressions in superior and/or inferior aspects of vertebral bodies. Macroscopically, one type appears to have a cortical bone lining, and can be likened to the typical Schmorl's Node. The second type appears to be a lytic lesion extending into the cancellous structure of the body without a lining of cortical bone. Both types are antemortem in appearance. Scanning electron microscopic and microradiographic studies have been undertaken to establish further details of the appearance of these lesions, and the results are presented in this paper, with differential diagnoses.

THE EPIDEMIC OF 'MODORRA' (1494-1495) AMONG THE GUANCHES OF TENERIFE

Conrado Rodríguez Martín, Museo Arqueológico de Tenerife

'Modorra' (also known by several authors as 'moquillo') is the best known epidemic of the Canary Islands prior to the Spanish Conquest in 1496. The dates of this obscure epidemic were the last month of 1494 and the first ones of 1495, coinciding with the campaign of the Spaniards against the Guanches during the

conquest of Tenerife. The consequences of this epidemic were terrible for the prehispanic inhabitants of the island from every point of view: social, economic, demographic, biological, and, of course, military. Almost all authors agree that the length of the conquest was shortened because of the huge mortality among the Guanche population, which weakened their military forces. Although no one knows how many people died, it is believed that at least 3,000 out of a total of 15,000 to 20,000 must have been killed by the unknown pathogen. Modorra is not the specific name of a disease, so it is understandable that the diagnosis has been debated for many years. Plague, acute anterior poliomyelitis, encephalitis, typhoid fever, rabies, etc. have been considered, but none of them coincide with the symptoms, duration, or epidemiological features described in historical and literary sources. We think that it must have been a virgin soil epidemic brought by the Spaniards and transmitted to the Guanches during first contact. Although obviously a new disease for them, it must have been known to the Spaniards because none of them was affected (they regarded this as a miracle).

CANNABIS SATIVA (HASHISH) AS AN EFFECTIVE MEDICAMENT: THE ANTHROPOLOGICAL EVIDENCE

Joe Zias, Israel Antiquities Authority

Although the use of cannabis as a drug in the ancient Near East was widely known from literary sources as early as the 16th century BCE, it is rarely found in archaeological contexts (Mechoulam 1986). Of considerable medical importance in many ancient cultures, it was used to reduce haemorrhage and pain in childbirth. Nineteenth century European physicians reported that not only was hashish widely used but that it was therapeutically effective in reducing pain and increasing uterine contractions during the birthing process. Recent excavations carried out by the Israel Antiquities Authority west of Jerusalem uncovered a fourth century AD burial complex containing the remains of 40 individuals, one of them a 14 year old girl with a full term foetus in the pelvic area. The anterior-posterior distance of the pelvic outlet was 7 cm (2 cm less than needed for a normal vaginal delivery). Lying on her abdominal cavity was a solidified mass of carbonized material, in which subsequent chemical analysis by gas chromatography showed the presence of THC, the active ingredient in *Cannabis sativa*. The clear implication is that its use was intended to increase uterine contractions and prevent haemorrhaging. A glass vessel at the site provided positive forensic evidence that the substance had been burned in it.

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