

PAPERS ON PALEOPATHOLOGY

presented at the

Fifteenth Annual Meeting



22 and 23 March 1988

Kansas City, Missouri

SECTION 1: WORKSHOPS AND ROUND TABLE DISCUSSIONS

A. TUBERCULOSIS WORKSHOP

Marc A. Kelley, University of Rhode Island, Sean T. Murphy and Paul Sledzik, Armed Forces Institute of Pathology

An informal workshop of some 13 dry bone specimens of skeletal tuberculosis from the A.F.I.P. Medical Museum and the University of Rhode Island were placed on display to promote discussion and debate. The cases included classic examples of Pott's disease, tubercular arthritis of the hip and knee, and examples of subtle periostitis of the internal aspect of the ribs, resulting from pulmonary tuberculosis. One controversial case involved lytic lesions with surrounding periostitic spicules on the inner and outer tables of the calvarium. Many participants agreed that differential diagnosis should include fungal infections and metastatic carcinoma in addition to tuberculosis in this case. Another interesting case exhibited extensive destruction of the acetabulum and femoral head occurring simultaneously with an elevated periosteal surface over the internal aspect of the ilium. This latter inflammation is an excellent example of tubercular bacilli tracking underneath the psoas muscle sheath. Researchers interested in studying 19th and 20th century hard and soft tissue pathology are well advised to visit the A.F.I.P. Medical Museum in Washington, D.C.

B. FUSION CON-FUSION ROUND TABLE

Sean T. Murphy, Armed Forces Institute of Pathology, and Marc A. Kelley, University of Rhode Island

This round table discussion was initially inspired by an unusual case of nearly total bony fusion in a middle-aged man. The skeletal appearance superficially resembled ankylosing spondylitis, but the clinical history did not fit the classic pattern. The fusion began in the knees, followed by the hips, portions of the spine, and eventually all remaining joints. Rheumatoid arthritis was the favored diagnosis by the attending physicians of the day. Participants exchanged views on diagnosis, including whether both rheumatoid arthritis and ankylosing spondylitis might be present in this individual, or whether a general label of spondyloarthropathy should be attached. Participants compared notes on other such cases in the world, and determined that several others exist. The discussion then turned to ten other dry bone cases on exhibit that came from the A.F.I.P. Medical Museum and also displayed combinations of sygoapophyseal fusion, syndesmophytes, 'dripping candle wax' fusion, and bony fusion resulting from inflammatory reaction.

C. POINT COUNTERPOINT ANALYSIS OF SKELETAL PATHOLOGY: OSTEOPENIA AND ARTHRITIS IN FANTASY, PREHISTORY, AND PERSPECTIVE

Bruce M. Rothschild, St Elizabeth Hospital Medical Center, Youngstown, Ohio
Panel: Howard Duncan and James C.C. Leisen, Henry Ford Hospital, Detroit,
Ellis K. Neiburger, Waukegan, Illinois, R. Wade Ortel, University of West
Virginia, Sam Stout, University of Missouri-Columbia, David S. Weaver, Wake
Forest University and Robert J. Woods, Kent State University

Osteopenia or decrease in bony density represents a negatively balanced interaction of bone accretion and bone loss. Changes in cortical and trabecular bone occur as waves of activity of local bone structural units (e.g. osteoclastic resorption is the initiating factor for osteoblastic bone production). Microdamage, mechanical usage, nutrition, hormones (e.g. parathormone, growth hormone, thyroid hormone) all interact to affect bone structural unit activity. Although some of the interactions can be 'dissected' in contemporary skeletal material by microscopy, many cannot. Osteomalacia, unless it leaves evidence of pseudo fractures, is not assessable in most skeletal collections, as unmineralized osteoid, the identifier of osteomalacia, does not survive in recognizable form. Inability to distinguish osteomalacia precludes most nutritional assessment; rickets (nutritional osteomalacia in children) will show a disturbed growth pattern. Diagenetic phenomena also cannot be distinguished from osteoporosis, precluding definitive diagnosis. Animal model work to define bone response to specific metabolic/endocrine perturbation is necessary before population analysis of osteoporosis can confidently be applied to skeletal populations.

Erosive arthritis is distinguishable from artifact because of the low grade remodeling that usually accompanies the erosive process. Osteoclastic action produces fronts of relatively smooth resorption contrasted with the ragged edges and disparate color characteristic of artifact. Erosive disease must be characterized on the basis of the amount of remodeling or reactive new bone formation. Assessment of relative bone density (defined radiologically by the extent of periarticular osteopenia or visually by increased thickness or decreased number of peri-erosional trabeculae) allows hypothesis formation as to possible diagnosis. Analysis of population and skeletal distribution of lesions is the major test of that hypothesis. It is important to identify all available disease parameters, including population distribution, age and sex ratios as part of the analysis. The greater the number of comparable parameters, the more certain one can be of a given diagnosis.

Generalized arthritis (sparing spinal/sacroiliac joints and without enthesial reaction) is more suggestive of rheumatoid arthritis. Enthesial or reactive new bone formation at the attachments of tendons and ligaments suggests a non-rheumatoid disease, such as spondyloarthropathy. Can a definitive diagnosis be made in the absence of clinical examination and immunology testing? The major premise of paleopathology is that skeletal remains do allow diagnostic efforts. Immunologic and other chemical techniques should be developed and utilized, when a testable hypothesis presents.

SECTION 2: CONTRIBUTED PAPERS

Moderator: Robert A. Benfer, University of Missouri-Columbia

PARASITISM AND LIFESTYLE: INFECTION INCIDENCE OF HUNTER-GATHERERS VERSUS AGRICULTURALISTS

Karl Jan Reinhard and Elizabeth A. Miller, Texas A & M University

More than 300 hunter-gatherer coprolites and approximately 450 agricultural coprolites from the southwestern U.S.A. have been examined for helminth parasite remains. Comparison of the parasite data from the two data sets demonstrates a significant increase in parasitism among agricultural populations over hunter-gatherers. Parasite diversity increases marginally among agriculturalists, with the occurrence of human specific species. The most pronounced increase is with pinworm (Enterobius vermicularis), which reaches phenomenal incidence among some agricultural populations. The analysis suggests that zoonotic infections, although present among agriculturalists, make up a larger proportion of hunter-gatherer parasitism.

BIOPHYSICAL STUDY OF A CHALCOLITHIC CALCIFIED LYMPH NODE OF PROBABLE TUBERCULOUS ORIGIN

C.-A. Baud, M. Klohn and A. Susini, Institut de Morphologie, Geneva

We studied a concretion found during the excavation of a collective Chalcolithic burial at the Dolmen des Peirières, Villedubert in southern France. Of ovoid shape, its dimensions were 12 by 8 mm. It showed:

- a. an outer smooth-surfaced and hard layer, with numerous perforations and erosions revealing a concentric lamellar structure. This was composed of collagen and carbonated apatite small crystals;
- b. two nuclei containing a white brittle substance identified as an association of whitlockite and carbonated apatite crystals.

The shape, size, and fibrous capsule with numerous perforations strongly evoke a lymph node, not to be confused with a kidney stone. Calcified foci formed of apatite and whitlockite suggest calcification of tuberculous origin. To our knowledge, this is the first case described in paleopathology. Such findings could improve the sensitivity of paleopathologic diagnosis of tuberculosis.

STUDIES ON A MEDIEVAL MINING POPULATION FROM ITALY

Kathy Gruspier and Grant Mullen, University of Toronto

The Rocca San Silvestro medieval mining village is perched majestically on a mountain top approximately 180 kilometers northwest of Rome. The 1987 season was the first during which exploratory investigations were made of the cemetery. During the authors' three week involvement, eight articulated skeletons and miscellaneous bone pits were excavated. The purpose of the explorations was to:

- a. establish archaeological control over the cemetery area;
- b. gain insight into the specific problems that would affect the recovery of human remains. This paper presents a summary of the paleopathological highlights in those first eight individuals. In addition, the intervening year has allowed the formulation of a philosophical/practical research design to incorporate specific considerations of an iron mining community, as well as general considerations of medieval health and death.

TWO MUMMIFIED HANDS AND ARMS FROM PERU

Rose A. Tyson and Alana Cordy-Collins, San Diego Museum of Man

The physical and cultural aspects of two mummified hands and forearms from the Chillón Valley of Peru are examined. Both are from the right side of the body, one from a child approximately two years of age, and one from a child about six months. The forearms are wrapped with thread, and each hand is clutching two segments of cane-like plant material.

A PRELIMINARY REPORT ON PRE-COLUMBIAN SKELETONS EXCAVATED AT TINGI-HOLO RIDGE, SURINAME

M.R. Khudabux, University of Suriname

Pre-Columbian skeletons were excavated at the Tingi-Holo ridge in Suriname for comparison with results from small samples of older times. Both primary and secondary burials were noted. Sometimes more individuals were found in one grave. All the burials were scattered randomly. Demographic features were a more or less equal sex ratio and a low life expectancy at birth. A high incidence of caries and fistulas of the root were noted. Occlusal attrition increased steadily with age. Evidence of artificial skull deformation was observed. Pathological changes in bones demonstrated treponematoses and rachitis. Study of Harris's lines revealed a high incidence of lines, appearing on a seasonal basis. The results described supplemented data and confirmed previous hypotheses about the site.

WHY HAVE CALCIFIED TUBERCULOUS RENAL, URETERAL, AND PROSTATIC LESIONS NOT BEEN REPORTED IN MUMMIES?

John K. Lattimer, Columbia University

Tuberculosis invades the kidney and prostate by the same (hemic) route that it invades the bones, and at about the same rate (5-10%). About 5 to 10% of these tuberculous lesions in the kidney will become calcified. Sometimes the entire kidney will turn into a mass of calcified tissue. Sometimes the entire ureter will become a 'rod' of calcium. Other times, part of the kidney will calcify. Tuberculous lesions in the prostate gland also calcify. The calcium is often of a lower density than urinary stones, but should show up in good quality x-rays of any mummified bodies whose kidneys are still 'in situ'. Have these lesions already been observed in mummies? If not, can we look for them in the future?

PROBLEMS IN PHYSICAL ANTHROPOLOGY

E.J. Neiburger, Andent Foundation, Waukegan, Illinois

Physical anthropology and related sciences are experiencing severe problems threatening their existence as specialties. Among other things, improper use of techniques and materials in physical anthropology research is invalidating much of that research. Problems involving conclusions based on faulty analysis have contributed to vast mountains of meaningless research. Unwarranted assumptions and claims often extend beyond the reliability of the data available. Medical diagnoses are commonly made on the basis of circumstantial data where bone pathology is not diagnostically accurate. Continued use of obsolete assumptions will continue to produce problems for physical anthropology. Research is presented to show examples of some of the problems; suggestions for their correction are offered.

SECTION 3: EXHIBITS

POSSIBLE TREPONEMATOSIS IN HUMAN SKELETONS FROM A PRE-COLUMBIAN OSSUARY IN COASTAL NORTH CAROLINA

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

Several individuals, two well represented and at least three fragmentary, from a Late Woodland period (A.D. 850-950) ossuary associated with the Flynt site (31 On 305) in coastal North Carolina show skeletal lesions that are consistent with treponemal infection. Archaeology and ethnohistory suggest that the ossuary, containing the remains of at least 100 persons, was in use for only a few years. The skeletons present localized erosive cranial lesions and resorptive periosteal lesions in most of the postcranial bones, and show very few of the proliferative bone changes often seen in pyogenic osteomyelitis. Differential diagnosis also excludes trauma, myeloma, carcinoma, osteosarcoma, mycotic, and mycobacterial conditions. Given recent suggestions of a treponemal condition in other pre-Columbian skeletal samples from southeastern North America, we propose a diagnosis of endemic treponemal infection as the most likely cause of the pattern and prevalence of the skeletal condition.

(Research supported by a Research Contract from the North Carolina Office of State Archaeology)

INTESTINAL CONTENT ANALYSIS OF A HOHOKAM MUMMY

Karl Jan Reinhard and M. Pendleton, Texas A & M University

Four coprolites were excavated with Burial 5 at Ventana Cave, a partially mummified five year old child. Two coprolites were granular and dark in color, and two were fibrous and light in color. The coprolites are remains of the child's intestinal contents, and were submitted to dietary and parasitological analysis. No parasites were found. The fibrous coprolites proved to be remains of highly masticated mesquite pods (Prosopis). The granular coprolites consist of seeds of saguaro cactus (Carnegieia gigantea). Pollen analysis reveals two dietary pollen types, both derived from cactus. No evidence of cultivated plants except for trace amounts of corn pollen was found. As both mesquite pods and saguaro seeds are available in the fall, death at that time of year is inferred.

SECTION 4: TRACE ELEMENT ANALYSIS -- IMPLICATIONS FOR PALEOPATHOLOGICAL RESEARCH

Convener: Mary K. Sandford

INTRODUCTORY STATEMENT

Mary K. Sandford, Spina Bifida Association of Acadiana, Lafayette, Louisiana

Trace element analysis of human tissue from archaeological contexts was first used by anthropologists during the 1970s. Although interest in elemental analysis has increased markedly since that time, use of the technique has been largely restricted to the realm of paleonutrition as an additional tool for paleodietary reconstruction. In exploring the potential applications of elemental analysis to paleopathology, the eleven papers presented in this symposium represent something of a departure from most previous studies involving the technique. In addressing this unique theme, results stemming from elemental analyses of bone, hair, and teeth from prehistoric, historic, and contemporary populations were presented. In addition, the session also served as a forum to discuss methodological problems and interpretive concerns pertaining to the use of trace element analysis in anthropology.

ELEMENTAL HAIR ANALYSIS: AN APPLICATION FOR PALEOPATHOLOGY

Mary K. Sandford, Spina Bifida Association of Acadiana, Lafayette, Louisiana

Although human hair is infrequently preserved in archaeological settings, elemental analysis of this tissue may provide paleopathologists with valuable information. Such an analysis was performed on 168 hair samples, recovered from the Nubian community (A.D. 550-1500) of Kulubnarti. Concentrations of six essential elements were used to investigate the etiology of cribra orbitalia, which is believed to reflect iron deficiency anemia. The results implicate iron and magnesium deficiencies as causal factors in the development of cribrous lesions among Kulubnarti children. Endogenous and exogenous processes governing elemental hair deposition are basic to the interpretive model used in this study.

TRACE ELEMENT ANALYSIS OF HUMAN HAIR: A PALEOPATHOLOGICAL PERSPECTIVE

Robert A. Benfer and John Typpo, University of Missouri-Columbia

Trace element analysis of human hairs may yield important information about nutrition and disease. Changes in elemental composition distally from the scalp record dietary changes for some elements. Contamination or leaching is held constant as each hair serves as its own control, and the pattern of changes, if not the magnitude, may be preserved. In any case, elemental concentrations from studies of 5,000 to 6,500 year old human hairs from the Paloma site in central coastal Peru produce elemental values that are in good agreement with modern controls. Signs of diseases like anemia may be present in iron and other metal concentrations. High levels of cadmium could indicate diabetes, but dietary intake (from fish, for example) must also be considered.

WHAT MAY ANALYSES OF SKELETAL ELEMENTS AND OTHER IONS REVEAL ABOUT CERTAIN PALEOPATHOLOGICAL CONDITIONS?

Linda Klepinger, University of Illinois-Urbana

Under certain ideal conditions, such as lack of significant diagenesis, chemical analyses of bone may provide clues about the relative importance of various etiological or risk factors for certain detectable skeletal abnormalities. Examples include zinc deficiency and dwarfism or hypogonadism in previously glaciated areas, and bone carbonate content and osteoporosis in Eskimos and other groups.

BONE TRACE METAL STUDIES: WHAT WE NEED TO KNOW FOR APPROPRIATE PREDICTIVE INTERPRETATION

Lorentz E. Wittmers Jr., Arthur C. Aufderheide, JoAnn Wallgren and George Rapp, Jr., University of Minnesota-Duluth School of Medicine, and Agnes Alich, College of St. Scholastica, Duluth

Lead concentration in 134 recent autopsies (ages 0-100 years) was determined at five standardized skeletal sites selected because of their compact/trabecular bone ratio (C/T) differences. All bones of the skeleton were divided into five groups based on their C/T ratios, and each of the five sampled sites was considered to be the prototype for each group. An equation (including age-related constants) was derived, the use of which permits estimation of the lead concentration of any bone in the body, as well as the mean value for the entire skeleton, based on the measured amount at any one of the five sample sites.

VARIATION OF TRACE ELEMENTS WITHIN AND BETWEEN SKELETONS USING MULTIPLE SAMPLE SITES

Michael Finnegan, Kansas State University

Trace element ratios were recently utilized in human bones to show the efficiency of separating commingled skeletons. Although these results were positive, the sample was small, and the number of commingled skeletons was also relatively small. In this study, it was noted that within skeletons, 53 sample sites could vary a great deal. To show the amount of variation, the concentrations of 21 elements were sampled at 53 loci on each of 5 skeletons, with a resampling at the same 53 loci of the same 5 skeletons. Data on 11,958 individual element determinations were obtained and used as the basic data for the analysis. It was found that variation of sample sites within a skeleton often exceeded the variation for the same elements between skeletons. Part of this outcome is due to the sample site location, archaeological contamination, environmental contamination, sample procedure, and sample preparation by digestion. With greater control of the above conditions, we are able to reduce the within skeleton variation to a point where it is relatively lower than the between skeleton variation, which then allows us to analyze the variation and causes of variation within a skeletal population. Research into trace element analysis in skeletal materials is expected to continue at Kansas State University.

LOCALS OR FOREIGNERS? MORPHOLOGICAL, BIOMETRIC, AND CHEMICAL APPROACHES TO THE QUESTION OF GROUP AFFINITY IN HUMAN SKELETAL REMAINS RECOVERED FROM UNUSUAL ARCHAEOLOGICAL CONTEXTS

John W. Verano, Smithsonian Institution, Michael J. DeNiro and Henry Ajie, University of California Los Angeles

Archaeologists occasionally discover human remains that appear 'unusual' in some respect, either in terms of their morphological characteristics or because of the context in which the remains are found (e.g., isolated skulls, mass burials). An important issue in interpreting such discoveries is whether the remains represent members of the local population or an outside group. This paper examines several approaches to the problem, using a mass burial of young males from prehistoric coastal Peru as an example. Both multivariate biometric comparisons and carbon and nitrogen isotopic composition of bone collagen are explored as potentially useful approaches to the problem.

TRACE ELEMENT ANALYSIS OF HUMAN BONE: A PALEOPATHOLOGICAL PERSPECTIVE

Robert A. Benfer and Jeremy Edward, University of Missouri-Columbia

Neutron activation analysis of 144 human bones from the central coast Archaic site of Paloma, Peru have been studied for dietary information. These data also provide information about states of health. Because of the relatively slow rate of turnover in humans, only long term illnesses and their consequences can be detected. Anemia in children is indicated by low levels of iron; there is a significant relation between iron level and the presence of cribra orbitalia. Seven different criteria were used to measure contamination or leaching; despite the dry conditions and lack of rainfall, only 6 out of 18 elements were judged to be completely reliable. Changing patterns of reliable 'dietary' elements such as zinc and fluoride are related to improving adaptation to the coastal habitat, where wide yearly fluctuations in a rich resource area occur. Other skeletal indicators of improving health over time in these pre-agricultural populations are clearly related to the improving diet, one in which greater reliance is placed on maritime resources.

BONE STRONTIUM CONTENT IN PREGNANT AND LACTATING FEMALES FROM ARCHAEOLOGICAL SAMPLES

Robert L. Blakely, Georgia State University

In order to use trace elements as diagnostic or corroborative tools in paleopathological research, it is necessary to know normal levels of elements in prehistoric human bone. Investigators routinely report relatively higher strontium/calcium ratios among females from archaeological populations. In three pre-Columbian samples from Georgia, elevated strontium and depressed calcium occur principally in females of reproductive age. This is attributed both to discrimination against strontium in favor of calcium in the transfer of ions to the placenta and mammary glands, and to increased ingestion of alkaline earth metals, probably from protein-rich nuts, in pregnant and lactating women.

PALEODIETARY ANALYSIS OF MISCELLANEOUS PREHISTORIC HUMAN SKELETAL REMAINS FROM SOUTH DAKOTA

John A. Williams, University of North Dakota

Under a contract with the U.S. Army Corps of Engineers, a series of miscellaneous human skeletal remains was analyzed, with a minimum of 55 discrete individuals being identified from 29 locations along the Missouri River in South Dakota. The skeletal remains from eight sites (nine

individuals) were targeted for stable isotope and trace mineral analysis. The results obtained were mixed. Using the $\delta^{12}\text{C}$ and $\delta^{15}\text{N}$, seven of the nine samples indicated a diet consisting of C4 plants (maize) and terrestrial herbivores (bison). The remaining two samples had δ s that indicated a diet of terrestrial herbivores with little or no maize consumption. The analysis of seven trace elements was less clearcut. The sample results were for the most part consistent. Iron concentrations varied widely, possibly because of the type of bone sample used, or perhaps caused by iron deficiency. Zinc concentrations also varied, with one individual apparently zinc deficient and two others marginally sufficient. Both iron and zinc deficiency could be the result of a diet with a high maize content. All nine individuals were identified as severely copper deficient. The reason for this was unknown. Skeletal pathology observed in the series as a whole included several mild vertebral anomalies such as spina bifida occulta and several mild expressions of porotic hyperostosis: these may be significant.

DENTAL ENAMEL COMPOSITION OF AN URBAN SLAVE POPULATION: A PRELIMINARY REPORT

Kim M. Schneider, Wichita State University, and Douglas W. Owsley,
Smithsonian Institution

Sixteen elements in dental enamel were examined from a sample of ten succedaneous canines collected from the St. Peter Street cemetery (16OR92) in New Orleans, Louisiana, dates circa 1720-1810. Scanning electron microscopy energy dispersive x-ray analysis was performed, and data were collected for the following elements: Mg, Sr, P, Ca, Mn, Fe, Mo, Pb, Zn, Se, Ni, Cu, Au, As, Co, Sn. Results indicate significant differences among teeth sampled for five trace elements. These elements discriminate independently established ethnic members of the sample, and they may reflect differences in lifeways between slave and non-slave members of New Orleans society during this time.

TRACE ELEMENTS IN NINETEENTH CENTURY SOUTHEAST POPULATIONS

Ted A. Rathbun, University of South Carolina

The biocultural and biohistorical implications of variation in concentrations of lead, strontium, copper, and zinc for 36 Afro-American slaves, 17 Euro-American elite, 19 Euro-American rural farmers from the 19th century, and 11 Euro-American elite from the 18th century are presented. Concentrations varied by gender, age, social status, and health status. Methodological considerations of instrument for analysis, sample preparation, skeletal element tested, and soil conditions are discussed for intra and intersample comparisons.

SUMMING UP

Abstract of remarks by Arthur C. Aufderheide at the conclusion of the Trace Elements Symposium

Although this symposium includes many examples of the predictive value of skeletal trace metal analysis, the principal hazard to its anthropological applications still lies in diagenetic effects.

Early reports suggested that diagenetic effect was a minor problem. Initially, independent variations of metal in bone and associated soil seemed to support that impression, although later studies demonstrated evidence of interdependence. Attempts to study metal ion movements between bone and soil produced mixed results. Intraosseous spatial distribution patterns of some elements has revealed inconsistencies. Use of exclusively soil elements (aluminum, barium) as a diagenetic marker assume covariance with the metal of interest (rarely established). Resolution awaits directed research on the diagenetic process.

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