PAPERS ON PALEOPATHOLOGY

presented at the

Nineteenth Annual Meeting

31 March and 1 April 1992

Las Vegas, Nevada
SECTION 1: WORKSHOPS AND LECTURE

A. DESCRIPTIVE TERMINOLOGY (workshop)

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

The theme for this year's workshop (No. 4 in the series) was chosen because, as has frequently been pointed out, most recently by Robert W. Mann (PPN 77:9-10):

1) There is no illustrated thesaurus of terms specifically for dry bone description;
2) Diagnostic labels (e.g., 'arthritis') and terms for processes (e.g., 'periostitis' and 'granulomatous') commonly but inappropriately find their way into descriptions;
3) Use of biologically inaccurate terms (e.g., bone expansion') impedes understanding and the teaching of disease mechanisms.

A thorough description of one or a few lesions will include:
1) Anatomical location --- the bone, joint, or constellation of bones and/or joints involved, including the specific regions or segments thereof;
2) Quantification (distribution and size);
3) Morphology.

The morphologic description will vary with whether the lesion(s) are:
1) Intraosseous or cortical --- describe the three parameters: margins, periosteal reactions, and matrix additions (neoplastic and/or reactive);
2) Surface feature(s) only;
3) Of subchondral bone;
4) Clearly a fracture --- with or without repair.

Systemic skeletal changes (i.e., affecting many bones of the body) should be described in terms covering bone shape, size, and density (cortex and cancellous abnormalities). Additionally, it is of interest to estimate the activity of the process at death or at the time of specimen acquisition (acute, chronic, inactive/healed).

As in previous workshops, this year the 13 groups, each consisting of 4 to 6 people, were asked to classify the general disease category and the specific disease shown. Not all groups got to all specimens in the allotted time. The scoring was done by Elizabeth Miller. If only the 6 specimens acquired in a hospital environment and therefore with firm diagnoses are considered, 43% of 9 groups correctly provided the disease category, and 21% of the 9 groups correctly identified the specific disease diagnosis for the 6 specimens. Thus again, as in previous workshops, the greater likelihood of being correct as to basic category regarding specific disease was demonstrated.
67% of the groups correctly recognized a femoral head (from a steroid-treated patient) with a large articular defect due to avascular necrosis (the necrotic area falls out after maceration). Only 33% correctly placed it in the circulatory disease category; the most common error was to place it in the trauma/repair category. This reminds us of the rheumatoid arthritis case last year that led to controversy as to whether RA should be considered an Inflammatory/Immune disease (favored) or a Circulatory disease. Eventually, a consensus on categorization of some conditions (e.g., Paget's disease) may have to be arrived at by arbitrary assignment.

A provisional list of descriptive terms was distributed for comment. This is organized in three columns according to term acceptability: yes, no, maybe. Additional copies will be provided to any interested party if requested from BDR. It is hoped that this will initiate lively discussion and eventual consensus.

B. CRANIOSYNOSTOSIS (workshop)

John C. Kolar, Humana Craniofacial Institute, Dallas

Because of its rarity, craniosynostosis, the premature closure of one or more of the sutures of the cranial vault, is seen infrequently by skeletal biologists, and may be misinterpreted, particularly in cultures that practice artificial cranial deformation. Much of the archeological information is anecdotal, and the interpretations are based primarily on the classification system developed by Rudolf Virchow in the 1850's. The workshop stressed recognition of the various forms of craniosynostosis, primarily isolated closures, based on JCK's extensive clinical work with children with congenital defects of the head and face, including more than 300 patients with some form of synostosis. Pediatric cases provide a unique approach to this study, as there is less likelihood of misdiagnosis in children than in adults.

Clinical studies of craniosynostosis indicate that the patterns of dysmorphology associated with these closures is much more complex and variable than is usually appreciated in skeletal samples. Growth of the face is often affected by craniosynostosis, and can provide clues to early closure in adult specimens, also in the process of normal suture closure. For example, metopic synostosis appears to result not only in narrowing of the upper face and orbits in clinical patients, but elongation of the upper face and nasomaxillary protrusion. Neurosurgical research indicates compensatory cranial growth at the posterior edge of the coronal suture and at the sagittal suture, producing an increase in the biparietal width.

The suture by suture description of the synostoses included clinical and dry skull examples of each, as well as some even rarer specimens showing multiple suture closures. A few examples of craniofacial syndromes that involve craniosynostosis also were presented. Judy Suchey provided several specimens of early metopic synostosis from her forensic collection at California State Fullerton, and Susan C. Anton brought in examples from the Atkinson collection at the University of the Pacific. Kell Douglas (University of Hawaii) showed a series of slides, and Charles Merbs presented an example from a collection of Inuit skeletons that he had analyzed many years ago. Finally, the workshop was nicely supplemented next day
by Kenneth Kennedy's podium presentation* of a classical example of a skull with sagittal synostosis excavated from Harappa. [*For abstract, see Section 2, p. 8.]

(This workshop developed out of the round table discussion arranged by Sheilagh Brooks at the 1991 meeting in Milwaukee.)

THE PREHISTORIC MAN FROM THE AUSTRIAN-ITALIAN ALPS: DISCOVERY, DESCRIPTION, AND CURRENT RESEARCH (lecture)

Torstein Sjøvold, Osteological Research Laboratory, University of Stockholm

On 19 September 1991 a male body was discovered at an altitude of 3,200 m above sea level in a glacier area within the European Alps, close to the border between Tyrol (Austria) and South Tyrol (Italy). The most recent C14 datings indicate a date of about 3,300 BC, thus assigning the man to the Late Stone Age: it is undoubtedly the oldest well preserved body ever found in Europe. The find was of such great antiquity that the news immediately found its way all over the world. Until 23 September, however, when the official 'salvage' of the body took place, it was considered a forensic case, and the remains were regarded as those of some comparatively recent casualty in the area. As a result, several attempts had been made to free the body from the ice in which most of it was embedded, and consequently the left hip and thigh were damaged in the process.

On 24 September it was announced that the find was definitely prehistoric, with a preliminary estimate of the date as approximately 4,000 years BP. Very soon, the South Tyrol claimed that the discovery had been made on the Italian side of the border, not on the Austrian as originally assumed. When this claim was confirmed, questions were raised about storage conditions for the body in Innsbruck. Expert witnesses testified that conditions were as optimal as possible, with every effort made to maintain the same environment (both temperature and moisture) that had preserved the body in ice for so long. They also recommended that the body should not be moved because of the risk of decay. Before any further scientific investigation could start, agreement between the University of Innsbruck and the autonomous province of South Tyrol had to be reached regarding study of the body and the other archaeological finds. This agreement was signed on 6 February 1992.

The total find consists of the body, which had been mummmified through natural causes, with a large number of archaeological implements, such as an axe with a wooden handle and a blade made of almost pure copper, a bow, a quiver made of fur or leather, containing 14 arrows, and a small knife with a flint blade and a wooden handle. There were also implements for making fire, a wooden stick shaped like a capital U, together with two crossboards (this could be the frame of a rucksack), a small container made of birch bark, and the remains of clothing made from fur or leather sewn together with either sinew, grass threads, or threads made from gut. Textiles were not found.

The body was lying extended in a snowfree spot, face down, with his left arm across the upper part of the chest. He had become naturally dehydrated, and such indications as the absence of insect eggs in his eyes point to a time during early
autumn after insects had disappeared, probably with warm sunny days that allowed him to dry out fairly quickly and a fairly rapid coverage with snow afterwards (there are no obvious marks from vultures or scavengers). Later, the hollow where he was lying must have filled with melted snow, which froze, enclosing both him and his equipment. The spot where he lay was quite close to the watershed, which prevented him from being dragged towards the valley by the down hill movement of the glacier during periods of glacial growth. It took 5,000 years before he was freed from the grip of the enclosing ice.

The body was covered with brownish, parchment-like skin. Remains of hair were observed on the body, and during the study of his clothing, around 1,000 human hairs were found. These were about 9 cm in length, and, according to the analysis, dark brown or black: the relatively short length implies that some kind of haircutting was practiced. One of the most conspicuous characteristics of the body is his head, with sunken eyes, thin, shrunken ears, and partly open mouth. His tongue is slightly protruding, covering the teeth of the lower jaw, but leaving the front teeth of the upper jaw clearly visible. The front teeth are heavily worn, with the left lateral incisor abraded down through the enamel on the distal side, and the right central incisor bluish in color. The cause of this coloring has not yet been studied. It is also not yet clear whether the severe dental attrition is caused by old age, by his occupation, or by abrasive agents such as sand in the food. According to computer tomography (CT scan), all third molars are congenitally missing. The age at death is not yet quite settled, but may very roughly be indicated as 25-45 years. The length of the extended body (approximately living stature) is 156-158 cm.

On the body, some of the most interesting features look like tattoos. There are a number of groups of 3 or 4 parallel, almost vertical lines, 4-5 cm long, on each side of the lumbar spine, three groups on the left side and at least two groups on the right, with two of the lines forming a cross on the medial right femoral condyle (but not, apparently, on the left), and also one group of three short, parallel lines on the front of the right ankle. Some lines exist on the left calf as well, from the knee to the ankle. It is likely that there may be other similar undiscovered lines on the body. As of now, other possibilities (for instance, postmortem subcutaneous hematoma caused by peculiarities of the clothing) should not be completely ruled out, but as tattooing is known to have worldwide distribution and has been reported from frozen and dried bodies before, the interpretation here is probable, even though not yet proven.

The Late Stone Age man will now be the subject of several different kinds of research. Out of respect to him as one of our ancestors, he may never be put on public display, but a replica may be used instead. Invasive methods are likely to be restricted as much as possible, which means that there could, for instance, be no general autopsy of the body: it is so completely unique that it belongs not only to this generation of researchers, but to generations to come. In this continuing research on a man to whom many of us may be distantly related, the study of bacteria and parasites has first priority. We do not take it for granted that his bacteria or parasites are all dead, or that we are necessarily resistant to the diseases from which he may have suffered, and therefore, before conducting extensive research on the body, any parasites and bacteria that may have been preserved in the ice are to be tested to make sure they are harmless.
SECTION 2: CONTRIBUTED PAPERS AND POSTERS

Coordinator: Charles F. Merbs
Moderators: Charlotte Roberts and M. Anne Katzenberg

HUMAN ENVIRONMENTS IN A CLASSICAL GREEK SOCIETY, AS REVEALED BY THE PALEOPATHOLOGICAL EVIDENCE

Anagnosti Agelarakis, Adelphi University

This paper presents analytical implications of paleopathological documentation and bio-archaeological research from a classical burial mound in Abdera, Greece. The human skeletal collection, relatively well preserved, was documented by standard visual methods, x-rays, mechanical (thin sections), and chemical (isotopic fractionation) means. Through the skeletal record and paleopathological evidence initial descriptive anthropological arguments implying inductive cultural interpretations based on the burial customs were tested, in order to derive to deductive assessments. Interpretations of social structural composition of this population are reflected based on integrated studies of burial spatial distributions, mortuary practices, and data provided by anthropological forensics and paleoenvironmental studies.

CRANIAL MODIFICATION AT NUVAKWEWTAQA (poster)

Peg Davis, Arizona State University

The site of Nuvakwewtaqa, also known as Chavez Pass Ruin (AZ:0:4:1), is located in north central Arizona. All crania (n=40) were modified in varying degrees. Nineteen per cent (13) are symmetrically modified, and eighty one per cent (57) are asymmetrically modified. Stewart (1937) identified two types of cranial modification in the southwestern United States. These are: 1) vertical occipital, in which the plane of flattening is at right angles to the Frankfort plane; and 2) lambdoid modification, in which the plane of modification is inclined 50 to 60 degrees from the horizontal plane. The angle of the plane of modification was measured in 34 crania, using a craniphore. Thirty eight per cent (13) have vertical occipital modification, and 62% (21) exhibit lambdoidal remodeling. Until recently lambdoid modification was thought to be geographically isolated to the north of the Little Colorado River (Bennett 1973). Nuvakwewtaqa (south of the river) is somewhat unusual in that both vertical occipital and lambdoid modification occur at the same site.
EVALUATION OF JOINT DISEASE IN THE HOTCHKISS POPULATION (CC0138)

Francine Drayer, University of California, Berkeley

Joint lesions of 134 individuals were examined and categorized according to criteria that would illustrate: 1) the distribution pattern in the body; 2) distribution over the population; and 3) nature of the bone destructive mechanism (erosive or abrasive). The examination revealed a persistent, polyarticular, symmetrical, and bilateral arthritis and a high incidence of osteopenia. The degeneration consists of both erosive and proliferative osseous changes with a high incidence of osteopenia. Interpretation of the observations is problematic. The marginal erosive lesions in the upper limbs and metatarsophalangeal joints, the symmetrical bilateral distribution, and the extensive local and general osteopenia are counter indicative of primary or erosive osteoarthritis but consistent with rheumatoid arthritis. The extensive involvement of distal intermediate phalangeal joints and the large percentage of affected individuals make that diagnosis unlikely. Inflammatory, seronegative arthritides are consistent with the type of lesions but are asymmetric and do not have osteopenia. Metabolic arthritides agree in overall distribution, cystic involvement and diffuse osteopenia, but generally do not have erosive lesions. Septic arthritides are predominantly monarticular. Viral arthritides seldom leave osseous lesions.

PATHOLOGICAL AND OTHER CHANGES IN THE HUMAN SKELETAL REMAINS FROM THE SWEDISH WARSHIP VASA, WITH EMPHASIS ON SOME SPECIAL CASES

Ebba During, Osteological Research Laboratory, Stockholm

On 10 August 1628, the magnificent Swedish warship Vasa capsized in Stockholm harbour on her maiden voyage. In September 1956, the ship was located, and in April 1961 the salvage operation was brought to a successful conclusion. Among the huge finds of material were human skeletal remains. Contemporary sources state that between 30 and 50 persons died, and osteological and anthropological analysis of the bone material revealed the remains of at least 25 individuals, both juvenile and adult. Two were female and either 18 or 19 male. Pathological and other changes in the bones were studied. Eight individuals (the two females and six males) show skeletal changes in their vertebral columns. Skeletal elements from one female and seven males show marks of healed fractures. Only one bone indicates the presence of an unhealed fracture. Seven metatarsals from one male and the two humeri from another show skeletal defects of an interesting and unusual kind. It is suggested that the many abnormalities noted in the metatarsals probably are due to a traumatic event or events, and that the bilateral defects in the humeri represent a possible case of osteochondritis dissecans. The tooth material shows evidence of enamel hypoplasia, tooth extraction, and caries.
OCCIPITAL SUPERSTRUCTURES IN PACIFIC ISLANDERS: OCCUPATIONAL MARKERS?
Gary Heathcote, University of Guam, Bruce Anderson, Timothy Bromage, Sara Collins, University of Hawaii, David Dean, Douglas Hanson, Forsyth Dental Center and Christopher Knüsel, University of Bradford

Preliminary findings, interpretations, and directions for future research are presented concerning the expression, distribution, and meaning of exuberant developments of three sets of occipital superstructures in anatomically modern human skeletal collections. These superstructures are 1) veritable tubercle developments at the trapezius and/or semispinalis capitis site(s) on the occipital; 2) retromastoid processes at the superior oblique insertion site; and 3) peri-Asterionic (posterior supramastoid) tubercles occurring near the superior and medial end of the sternocleidomastoid insertion. Present evidence suggests that there is a virtual geographic circumscription to the more extreme manifestations (scores of 3 or 4) of these traits, viz., that they seldom occur in populations other than Pacific Islanders. Micronesians appear to have the highest frequencies, and the indigenous inhabitants of the Mariana Islands (Chamorus) show both the highest frequencies and the most extreme development of the traits. Various occupational activities are suggested as having potential to contribute to the development of such structures, e.g., mining (and/or working in a confined space in chronically flexed positions), climbing coconut palm tees, carrying heavy weights in the hands with the arms held down, engaging in heavy construction work (building megalithic structures), and throwing activities (e.g., slingstones).

PALEOPATHOLOGY OF BASKETMAKER II ANASAZI FROM KANE COUNTY, UTAH
Heather Hecht, Arizona State University

Osteological studies of Basketmaker II Anasazi are uncommon, especially of populations from the western edge of the culture area. An analysis of 25 (?) individuals from three sites in close proximity shows that in general the health of this community was good. The negligible rate of trauma, nutritional stress, and infectious disease indicates a low morbidity. This is somewhat surprising to find in a population that lived during the introduction of agriculture to their region. The remains of one individual do include quite a few pathological changes, including vertebral olisthesis with a rarely reported etiology, but these changes are well within the range of age-related pathology.
SCAPHOCEPHALY AND IRREGULARITIES OF THE POSTCRANIAL SKELETON

Kenneth A.R. Kennedy, Cornell University

Examination of the well-preserved skeleton of an adult female with scaphocephaly, recovered during archaeological excavations in 1987 from the Indus Valley Civilization site of Harappa, Pakistan (Specimen H87/122-134a), leads to the conclusion that this individual is not significantly different from the rest of the Harappan skeletal series (N = 21) with respect to discrete non-metric cranial and postcranial traits. Multivariate analysis assessed 48 cranial and mandibular and 30 postcranial non-metric traits for the series. Kolmogorov-Smirnov tests of cranial and postcranial composite scores reveal that neither set of composite scores deviates significantly from normalcy. Bartlett's Chi-square test indicates that the Pearson product moment correlations coefficient for this relationship between individual composite score and number of traits possible for evaluation of cranial variations is significant (0.711). Graphs of individual composite scores, when plotted against the number of observations possible (traits) show that the scaphocephalic individual is not excluded from the 70% Gaussian bivariate ellipsoid imposed on the data set. It is thus concluded that precocious closure of the sagittal suture does not appear to affect other parts of the cranium with respect to non-metric traits. Postcranial non-metric traits and pathological abnormalities appear to be unaffected as well.

A COMPARISON OF THE PALAEODEMOGRAPHY OF CATASTROPHIC AND ATTRITIONAL CEMETERIES (poster)

B.J. Margerison, University of Bradford

In 1348-50 the Black Death swept across Europe, killing about one third of the population, supposedly regardless of sex, age, or status. The aim of this project is to examine the skeletons from a Black Death cemetery (the Royal Mint site, London), and to compare the population structure with that from an ordinary cemetery, which may not necessarily represent such a good cross section of the population. Areas of potential bias are being examined and allowed for, demographic techniques are being refined to fit the data available, and an attempt will be made to define and explain any differences found between these two types of cemetery. The results will also be compared with historical documentation.

THE EFFECTS OF HORSEBACK RIDING ON THE HUMAN SKELETON (poster)

Elizabeth Miller, Arizona State University

It is widely known in physical anthropology that the prolonged and continued stress imposed by habitual or occupational activities often leads to changes in bone, so
called 'markers of occupational stress.' No previous studies have been found, however, that detail the skeletal changes associated with horseback riding. In a study of a single forensic case and several hundred historic Plains skeletons, a suite of changes probably associated with intensive horseback riding was noted. These bony modifications include superior extension of the acetabulum, extension of the femoral head on to the neck, large muscle attachments for the extensor and rotator muscles of the leg and flexors of the foot, and ossification of cartilage and ligaments in the neck, chest, and thoracic regions.

**CAN SPECIFIC DISEASES BE DIAGNOSED IN DRY BONES? A COMMENT ON PALEOPATHOLOGICAL DIAGNOSTIC GOALS**

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

At present, the goal of paleopathological research is threefold: 1) to diagnose specific diseases in human skeletal remains; 2) to compare diseases and relative incidence within and between populations; and 3) to unravel the temporal and ecogeographical origins of disease processes. A statistical analysis of diagnostic accuracy on modern dry bone specimens with known diagnoses that were presented at workshops held at the 1989, 1990, and 1991 annual meetings of the Paleopathology Association finds an overall accuracy of 27% for specific disease recognition (it must be stated that the conditions of the workshops were statistically uncontrolled, and that this percentage is lower than could be expected for laboratory diagnoses). This is because morphologic resulda of different diseases significantly overlap. The mechanisms operative in skeletal disease are aberrations of normal biology, and bone has a limited number of ways in which it can react. Specific changes are rare, as pathologic morphology depends on aberrations of three factors only — circulation, metabolic factors, and mechanical stress. Furthermore, these influences act through two cell types only, osteoclasts and osteoblasts. There are only seven categories of disease, and each has recognizable hallmarks in dry bone specimens. The same collection of specimens was correctly classified as to disease category with 41% accuracy. A differential diagnosis with seven possibilities in mind rather than the hundreds of specific diseases can be a powerful tool for the paleopathologist. It is proposed that paleopathologists redirect their enthusiasm for diagnosis of specific diseases towards the less ambitious but more often correct goal of classification by disease category.

**ENAMEL HYPOPLASIA AND INCREMENTAL LINES AT NUVAKWEWTAQA (CHAVEZ PASS), ARIZONA (poster)**

Esther Morgan, Arizona State University

Approximately 110 individuals from Nuvakwewtaqa were studied to determine the incidence of enamel hypoplasia and radiopaque transverse lines (incremental lines). Ninety adults over 17 years of age were studied for the frequency of chronic and
linear (acute) enamel hypoplasia and incremental lines, and twenty subadults aged 6-17 were studied for the frequency of chronic and linear enamel hypoplasia. Linear enamel hypoplasias are present in 93.9% of the adult population, and at least one enamel hypoplasia is evident in 68.3% of all adult teeth (N=351/514). Enamel pitting is present in only 25% of the subadults with deciduous teeth, whereas 15/20 subadults with scoreable permanent teeth have linear enamel hypoplasia. Twenty per cent of these individuals have enamel pitting, and 6.6% have chronic enamel hypoplasia. Incremental lines are present in 29/30 adult distal tibias, the average number of lines being 4.9 per tibia. Transverse lines that occurred in yearly increments are present in 36.7% of the tibias.

RECORDING PATTERNS OF OSTEOARTHRITIC CHANGE ON JOINT SURFACES (poster)

Bethel Nagy, Arizona State University

Osteoarthrosis (OA), commonly known as osteoarthritis, is a joint condition closely associated with biomechanical processes, especially repetitive movement. Previous research has demonstrated that patterns of OA on joint surfaces can reflect specific movements, and therefore possible activities. In an attempt to better classify and quantify these patterns, new methods for recording OA in dry bone have been developed. This presentation discusses these methods and their ability to discern patterns of OA.

FORAMEN MAGNUM ENLARGEMENT IN PRE-CONTACT SKELETAL REMAINS FROM THE CENTRAL COAST OF CALIFORNIA (poster)

V.F. Ridgway, San Diego Museum of Man

Re-examination of human skeletal remains from a pre-contact central California coastal site has yielded new data. Forty-seven burials, excavated by George Carter in 1935 near Guadalupe, show evidence of unusual burial characteristics, including mandible removal, incomplete skeletons lacking post inhumation disturbance, and foramen magnum enlargement. This latter feature appears on nearly 50% of the individuals. Modifications range from minor enlargement to major damage to the cranial base. Foramen magnum enlargement has been noted among other North American groups, but has not been particularly noted in California burials. Recent investigations have revealed similar enlargements in burials excavated by Phil Orr in 1940 at Mescalitan Island, Santa Barbara. A single cranium from the Windmiller site in Northern California also shows this feature. Characteristics and possible causes of the postmortem damage are explored.
RIB LESIONS IN PALAEOPATHOLOGY: A MODERN STUDY AND ITS RELEVANCE

Charlotte Roberts, Keith Manchester and David Lucy, University of Bradford

This paper contributes to the debate on the etiology of pathological changes of ribs involving new bone proliferation on the visceral surfaces of ribs in skeletons from archaeological sites. It has been suggested that these lesions may represent pulmonary infection, and tuberculosis may be one of the most likely causes of these changes. The study concentrated on the examination of more than 1700 individuals from the Terry Collection, which is curated in the Department of Anthropology, Smithsonian Institution, Washington, DC. Each skeleton was examined for evidence of new bone formation on the visceral surfaces of ribs and for evidence of tuberculous bone change. Cause of death of each individual was noted, and it was appreciated that individuals who had not died from pulmonary infection may actually have been suffering from such an affliction. Consideration of the side of the rib cage affected, number of ribs affected, site in rib cage, and position of lesions on the ribs in relation both to tuberculous death and to deaths due to non-pulmonary causes suggested no marked difference. It is suggested that pulmonary tuberculosis may be likely to precipitate rib lesions due to transmission of the infection via the pleura to the rib cage.

SPONDYLOARTHRITIS IN THE AMERICAN SOUTHWEST

Bruce M. Rothschild, Arthritis Center of Northern Ohio

Shared characteristics and occurrence of rheumatoid arthritis and spondyloarthropathy in contemporary populations have compromised development of clear diagnostic criteria for distinguishing between them. Although modern populations contain individuals with both conditions, ancient populations often manifest only one. The fortuitous presence of spondyloarthropathy as the sole present erosive disease in many ancient populations allows further clarification of its nature. The tendency towards pauciarticular, asymmetrical involvement and to new bone formation, axial involvement, and peripheral joint fusion in these populations clarify diagnosis and distinguish this phenomenon from rheumatoid arthritis. The significance of peripheral joint fusion appears to be unequivocally established on the basis of these findings. The population frequency and joint distribution of spondyloarthropathy were relatively uniform (1.3 - 2.5%) during the four thousand year interval studied.
PALEOPATHOLOGY OF HUMAN SKELETAL MATERIAL FROM THE TUTU SITE, ST. THOMAS: A PRELIMINARY REPORT

M.K. Sandford, University of North Carolina Greensboro, L. Sappelsa and D.S. Weaver, Wake Forest University, C.S. Larsen, Purdue University, K.F. Russell, Kent State University and E. Righter*, US Virgin Islands

During the summer of 1991, a team of physical anthropologists and archaeologists excavated human skeletal remains from the Tutu Site, a multicomponent pre-Columbian village. Dates for human occupations of the site range from approximately 500 to 1100 AD. In this paper, we describe our preliminary assessment of this material, focusing on two categories. First, infectious lesions on postcranial skeletons may resemble those described from sites in the southeastern US that have been attributed to treponematoses. Second, we have documented an unusual pattern of robusticity, affecting skeletal elements in the upper body, that may be related to occupational activity and/or gender. In some individuals, these conditions appear to be associated with degenerative joint changes in the elbow.

(*State Archaeologist)

PRELIMINARY RESULTS FROM MORODVICE, MACEDONIA

Patty Stuart-Macadam, University of Toronto

The site of Crkvishte, in Eastern Macedonia, incorporates a complex of four churches superimposed one above the other; these were rebuilt and enlarged between the 5th and 17th centuries. Each church had its associated cemetery, and over the course of the last ten years, 260 graves have been excavated by archaeologists from the Museum of Macedonia in Skopje. Comprehensive analyses of the skeletal remains have been hindered by political and logistical considerations, but some interesting data on porotic hyperostosis have emerged. A great disparity in the prevalence of porotic hyperostosis between adults and juveniles suggests that a genetic anemia may have been a factor in this population.

THE STANFORD-MEYER COLLECTION AT THE SAN DIEGO MUSEUM OF MAN (poster)

Rose A. Tyson, San Diego Museum of Man

In 1981, Stanford University gave the San Diego Museum of Man a collection of human bones that demonstrated various pathological conditions. The collection, composed of dissecting room specimens, was started in the early part of the century by anatomist Arthur W. Meyer, MD. The specimens were used for teaching and research until the 1970s. The collection consists of nearly 3500 osteological specimens, and includes lesions from the pre-antibiotic era, trauma, and anatomical
variations. Part of the collection is documented with vital statistics from Stanford University. Recently, more than 500 radiographs with diagnoses have been supplied by Donald Resnick, MD. Charles F. Merbs, PhD has given us the benefit of his expertise to catalog and describe the specimens, and slide sets for teaching and research are currently in preparation. This work has been supported by two National Science Foundation grants.

PALEOPATHOLOGY BIBLIOGRAPHY PROJECT (poster)

Rose A. Tyson and Daniel V. Elerick, San Diego Museum of Man

A draft copy of the paleopathology bibliography currently being compiled at the San Diego Museum of Man was presented for perusal. There are over 13,000 entries, many of which need correction. The foundation of this project is the Bibliography of Human Paleopathology by Armelagos, Mielke and Winter (1971), with numerous additions made by Armelagos, Ortner and Beck. In 1987, Ortner and Beck transferred the project to the Museum of Man, where it has been supplemented with entries from Paleopathology Newsletter, Crane 1971, Zimmerman 1980, and many others. Dr Armelagos has taken on the formidable task of compiling an index. The Museum of Man plans to publish a printed version and have copies available on disc in a database. A previous request to PPA members to send us their publication lists (PPN 74:11) has elicited only nine responses. We hope that displaying this project, even in its preliminary stage, will encourage more members to respond. Please send the complete list of your publications (in WordPerfect if possible) to: Dan Elerick, San Diego Museum of Man, 1350 El Prado, San Diego, CA 92101, FAX (619) 239-2749.
SECTION 3: SYMPOSIUM

TRAUMA

Chairman: Charles F. Merbs

BLOODY NOSES, GOOD CROPS --- OR, RITUALISTIC BATTLES IN THE TIWANAKU COLONIES?

Bernardo Arriaza, Arizona State University

The sample studied represents Andean people living in the small oasis of San Pedro de Atacama in the Atacama desert. Nearly every individual from the Coyo Oriente site has trauma, which is seen as localized fractures on the face, especially healed nose fractures. These were noted even in young adults. It was originally thought to be evidence of domestic violence, with females getting the worst of it, but statistical analysis rejected this view: both sexes were about equally affected. A second hypothesis was that the healed nose fractures were evidence of warfare, but this idea was more or less rejected because of the non-lethal nature of the fractures or blows. A possible explanation was found in ethnographic studies from Bolivia, Peru, and Ecuador. On special occasions, rural Andean populations engage in ritualistic combat, with groups fighting each other in war games. Great physical damage and often death may result from these encounters, but the real aim is to shed blood, not to kill the adversary. Although it is believed that bleeding will assure fertility and good crops, if too many people are killed or too much blood shed, that would be a bad omen. The non-lethal nature and facial distribution of the fractures observed in the Coyo Oriente site points to ritualistic combat or low intensity conflict rather than warfare.

TRAUMA AT NUVAKWETQA (CHAVEZ PASS), ARIZONA: EVIDENCE OF PERIMORTEM SKULL FRACTURES (poster)

Andrea L. Buck, Arizona State University

Studies done in the 1940s by E.S. Gurdjian, MD and associates attempted to identify the patterning of skull fractures when a human skull was struck in specific regions. Twelve regions of the calvarium were delineated. Experiments were conducted on cadaver and dry skulls, wherein they were subjected to blows at three levels of intensity in each region to identify primary, secondary, and tertiary regions affected. A high correspondence was found between the experimentally induced fractures and clinical cases of skull fracture of known etiology. These studies indicate that
it would be possible to identify perimortem skull fractures in an archaeological population. Ten skulls from Nuvakweetaqa (Chavez Pass), Arizona representing the Sinagua culture, have been identified as having possible perimortem skull fractures. Four regions are identified as recipients of fracture-inducing blows. Eight skulls are presented, two for each region, as typical of the fracture patterning found.

PERIMORTEM CRANIAL TRAUMA IN PREHISTORIC NATIVE AMERICANS IN SOUTHWEST COLORADO

M. Anne Katzenberg, University of Calgary and Phillip L. Walker, University of California, Santa Barbara

Three burials out of a sample of 18 from the Sand Canyon Pueblo show evidence of perimortem cranial trauma. The patterning of these injuries suggests that these people, all adolescents, were homicide victims. The injuries are oval in shape, suggesting that they were produced by an axe-like weapon. Archaeological evidence indicates that the interments occurred at the time of site abandonment. Other skeletons at the site were found in positions suggesting mass burial and unceremonious interment. These data, together with other archaeological evidence, indicate that the abandonment of this area of southwestern Colorado was associated with a significant amount of interpersonal violence.

SKELETAL TRAUMA, ETHNOHISTORY, AND ANTHROPOLOGICAL THEORY IN THE PRE-CONTACT PEOPLES OF THE CAPE REGION OF BAJA CALIFORNIA

J.E. Molto, Lakehead University, Ontario

Among New World aboriginal populations, the pre-contact Pericue Indians of the Cape Region of Baja California show an exceptionally high prevalence of skeletal trauma, particularly of the cranial vault. An overview of ethnohistoric literature in conjunction with lesion characteristics and ecological information, suggests a number of possibilities for interpreting the data. Of the competing hypotheses, intergroup conflict over limited geographically concentrated resources best fits the data on trauma. The practice of polygyny among the Pericue, well described in ethnohistoric literature, provides an interesting association in terms of anthropological theory, as this mating system is known to be positively correlated with endemic warfare and high female status.
CRANIAL TREPHINATION AMONG THE ANCIENT ZAPOTECOS FROM MONTE ALBAN

Lourdes Márquez Morín and Ernesto González Licón, Centro Regional de Oaxaca, Instituto Nacional de Antropología y Historia

Monte Albán was one of the biggest and most important pre-Columbian cities in Mesoamerica, and during the Classical Period (250 - 800 AD) cranial trephination was practiced there. As of now, we have found and studied 12 crania with clear evidence of this operation. The specimens, both female and male, are all adults, ranging in age from 25 to over 40. The techniques employed were scraping, which left bevelled edges, and perforation with a drill, which resulted in edges that are perpendicular to the outer table. Most skulls have one or two trephinations, but one case has four and another has five. The osseous regeneration seen in several specimens shows that the individual survived the operation, usually in cases where the scraper was used.

TREPHINATIONS IN ANCIENT ANATOLIA

Erksin Güleç, University of California, Berkeley

Several cases of trephination have recently been discovered in ancient inhabitants of Anatolia, Turkey. In this presentation, we particularly want to draw attention to trephinations from Dilkaya, an ancient settlement in the east of Turkey. Two individuals from approximately the 9th century BC are identified as the first examples of trephining in Anatolia. In the first individual, thirteen bores in juxtaposition formed an oval opening, and it was interesting that the piece removed by this process was also unearthed in the same grave. The second example of trephination represents a smaller, round opening. Here there are five bores. Both trephinations were made by the same technique.

POSTCRANIAL TRAUMA AT NUVAKWETQA (CHAVEZ PASS), ARIZONA

Sharon Hurlbut, Arizona State University

A collection of human skeletal remains from Nuvakwewtaqa (Chavez Pass), Arizona, representing the Sinagua culture, was examined for evidence of trauma. The trauma involving the postcranial skeleton consisted primarily of fractures, with the bones affected most frequently being ribs and long bones. Included were the partially healed fractured ribs of an infant, probably sustained during birth, as well as ununited fractures, poorly healed fractures, and pathological fractures involving adults. The overall frequency of fractures appears relatively low in this population.
CRANIAL TRAUMA; SOME HEALING

Michael Finnegan, Kansas State University

Recent skeletal remains from 14DP2, an historic to prehistoric site in Northeastern Kansas, from Tac, a Late Roman Period cemetery excavated in the general region of Szekesfehervar, Hungary (where they are now stored), and from Bab edh-Dhra, an Early Bronze Age site in the Dead Sea Valley, Jordan, make up part of a growing sample of severe cranial trauma that displays various amounts of healing and some attendant pathology. An explanation is presented, with examples, of the expected difference between antemortem, perimortem and postmortem trauma. The morphological display of healing on the flat cranial bones is quite different from that on long bones for a number of reasons. As well, healing time and bone modification are slower and different than in long bones. Although periostitis is often prevalent, periosteal proliferation and osteomyelitis have not yet been seen in these samples. Further research in the form of cross section samples will be taken and analyzed in order to make a better prediction of the time taken in the healing process.

CODA: SKELETAL REPAIR MECHANISMS

Bruce D. Ragsdale, Arizona State University

Trauma/Repair is one of seven major categories of skeletal disease. As with the other six, a knowledge of cellular activities at the bone/matrix interface is required for an understanding of pathologic anatomy as expressed by dry bone. Because of program constraints, this discussion focuses on fracture repair. As with other disease processes, all alterations of bone density incurred during repair can be explained as the result of three influences: circulatory changes, mechanical forces, and metabolic factors. By way of example, consider:

1. Transverse metaphyseal lucent bands appearing 8-14 days post-fracture, the consequence of active hyperemia stimulating osteoclasts in the normally well vascularized bone end 'downstream' from a fracture that has evoked increased circulation into an entire extremity (circulatory);

2. Hypertrophic ('excessive') callus around an untreated intertrochanteric fracture that is vigorously walked upon (mechanical);

3. Utter lack of callus around the fracture of an individual with scurvy (metabolic).

A conspicuous feature of a healing fracture is external callus. Most of this is derived from modulation of proliferated traumatically activated parosteal soft tissues, including fascial sheets, fat, and interstitial supportive structural elements within skeletal muscle. The role of periosteum has been greatly exaggerated by basic scientists using small rodents as a fracture model, where the callus contributions of parosteal soft tissue other than periosteum are less obvious than in
humans. The increased likelihood of cartilagenous non-union in tibial fractures closer to the ankle is partly explained by the progressively lesser amount of surrounding soft tissue to be conscripted as a source of cells for callus production.

Internal callus is synthesized after involution and fibrovascular transformation of marrow. Cartilage will emerge along the fracture line in proportion to ischemia and excessive motion. Fracture healing can be conceptualized as occurring in three overlapping phases, conveniently designated in familiar terms that emphasize the predominant operative influence:

<table>
<thead>
<tr>
<th>Fracture Healing Phase</th>
<th>Time Span</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Circulatory</td>
<td>1-14 days</td>
<td>Vascular adjustments. Cellular proliferation and modulation</td>
</tr>
<tr>
<td>II. Metabolic</td>
<td>2-8 weeks</td>
<td>Matrix synthesis (cartilage and bone)</td>
</tr>
<tr>
<td>III. Mechanical</td>
<td>2 months to years</td>
<td>Remodeling of callus. Structural revision towards normal</td>
</tr>
</tbody>
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* The precise duration of the phases varies somewhat with patient age, fracture site, adequacy of circulation, metabolic (nutritional) support, and applied forces. A well nourished youngster may heal and completely remodel a long bone fracture to the point of radiographic normalcy within four months, but a similar fracture in an older person will remain incompletely remodeled after several years.

Union can be delayed by a variety of factors operating through the three basic influences, but it is less amenable to being speeded up because **Mother Nature Always Works At Top Speed.**

Fracture of a long bone in a child is a significant setback. Body priorities are reoriented away from growth and towards repair. This can be expected to result in transverse lines of increased density (Harris lines), a systemic metabolic effect of major trauma. These are not necessarily seen only at the end of the fractured bone. Occasionally, peculiarities of constitution may produce unusual repair, such as hypertrophic callus in osteogenesis imperfecta tarda, or a paraplegic who unwittingly abuses the fracture site.

Fracture complications include death as a direct result (e.g., vascular injury; fat embolism), infection, non-union, pseudo- and neo-arthritis, overlap with shortening, angulation with consequent secondary osteoarthritis, and avascular necrosis (e.g., of femoral head). Transarticular fractures predispose to osteoarthritis because articular cartilage repairs poorly.
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