ANTHROPOLOGIA HUNGARICA

STUDIA HISTORICO - ANTHROPOLOGICA

Tom. XXI. 1990.

ANTHROPOLOGIA HUNGARICA

STUDIA HISTORICO - ANTHROPOLOGICA

Tom. XXI. 1990.

Sectio Anthropologica
Musei Historico-naturalis Hungarici
Budapest

Redigit
DR. T. TÓTH

Adiuvante
DR. Ildikó PAP

ISSN 0574-3842

Múzsák Közművelődési Kiadó
Budapest, 1990
Felelős kiadó: a Természettudományi Múzeum főigazgatója
Megjelent: 9,29 A/5 ív terjedelemben
Készült a Múzsák Közművelődési Kiadó nyomdájában
12 089/90

Anthrop. Hung. XXI. 1990.

Conspectus materiarum

JÁNOS NEMESKÉRI

(1914-1989)

ANTHROPOLOGIA HUNGARICA
XXI. 1990 p. 5-10

The beginning of modern trends in Hungarian anthropology In memoriam of J. Nemeskéri (1914-1989)

By

T. TÓTH

(Received October 17, 1989)

The modern trends of natural historic (physical) anthropology took shape some seventy years ago. The activities of the International Institute of Anthropology (IIA, 1920-1937) and the subjects of the first three international anthropological-ethnological congresses (London 1934, Copenhagen 1938, Brussels 1948) (COMAS 1956) provided an indisputable basis for this statement. By 1950 all the fundamental aspects of the possible and necessary activity emerged and the conditions were laid down for the creative work up to our days. The subjects of further eight international congresses of anthropology confirmed this. Between 1930 and 1940 the favourable simultaneity of Hungarian and international tendencies ensured the predominance of the dualism of adaptation and originality in the activities of an enthusiastic group of students and research workers (research students, assistants and principal assistants) in the Institute of Anthropology of the Faculty of Arts, Pázmány Péter University, Budapest. The doctoral theses and papers of Irma Allodiatorisz, Erzsébet Stein, Miklós Fehér, Imre Lipp, Pál Lipták, Mihály Malán and János Nemeskéri are all of a high methodological as well as taxonomical level in analyzing the craniological and somatological aspects of their subjects. The late János Nemeskéri scientific consultant of the Demographic Research Institute of the Central Statistical Office was one of the most energetic members of this scientific group when choosing a creative path of life for himself.

We may form a vivid picture of an important period of our discipline's history when outlining the results he achieved in the first part of his career (between 1937 and 1965).

János Nemeskéri was born in Budapest, 9th April 1914. He was a student at the Faculty of Arts of the Pázmány Péter University, Budapest. At that time he was already a research student of the Institute of Anthropology (1934-1936). The subject of his doctoral thesis was the anthropology of Hajdus (1938). At the same time he became a member of the staff of the Anthropological Collection in the Hungarian Ethnographical Museum (1937-1939). Then he continued his work as Curator of the Craniological Collection in the Archaeological Collection of the Hungarian National Museum until the end of 1944. He played an important role in removing collection from the National Museum to the Hungarian Natural History Museum. He was the person who obtained the support of the authorities for the move. His energetic interdisciplinary organizing aptitude realized the establishment of an independent department (Anthropological Department) in this museum, that became extraordinarily rich by obtaining the skeletalized remains of nine thousands individuals. In recognizing his scientific activity he was awarded the scientific degree of candidate of biological sciences. He worked out extensive international connections as the head of the Anthropological Department in the years 1945-1965. These were reflected in the successful organization of two Hungarian anthropological symposia (1959, 1967). He played an important part in the organization of two permanent anthropological exhibitions (1955, 1962) of the Hungarian Natural History Museum. There he demonstrated some partial methodical results (palaeopathology, palaeoserology). He was keenly interested in the morphological characteristics of living ethnic groups as well as in that of skeletalized populations already at the beginnings of his vocation. One of his outstanding merits is the publishing of the scientific journal Crania hungarica, the journal of the Anthropological Department, first published in 1956. He was the editor of the first six volumes of Crania hungarica (Anthropologica hungarica from 1962). He made a significant contribution to the 9th Meeting of the Hungarian Biological Association (Budapest 1970) by representing anthropology of the wide circle of Hungarian biologists. Between 1952 and 1957 he headed the Anthropological Subject-Committee of the Hungarian Academy of Sciences. He was the secretary of the Anthropological Section of the Hungarian Biological Association in the years 1954-1957. The starting period exerts a determining influence on every creative path of life and so did the 1930-1940s for him. He was already committed to anthropology as a student, and his wide-ranging interdisciplinary interests became clearer and clearer from 1932.

On the 27th of September 1945 he qualified as a private docent with the theme "The anthropology of the peoples of the Danubian Basin in the migration period" at the Faculty of Arts of the Pázmány Péter University. As a member of Corona Archaeologica (1945-1948) he delivered lectures on the following subjects: "The anthropology of the Conquering Hungarians" (20th June, 1945), "The anthropological constitution of the Copper Age Man in Hungary" (31st January, 1947), "The Scythians on the territory of Hungary" (30th April, 1948). He initiated the presentation of the Anthropological Department of the Natural History Museum with the title "Anthropology of historic ethnic groups in the territory of Hungary" (28th May, 1948) in this creative intellectual circle. His concepts, formulated in his research student years, were delivered in these lectures. He worked as a lecturer of the Department of Anthropology at the Pázmány Péter University in the years 1946-1947 and at the Faculty of Arts of the Eötvös Loránd University in Budapest between the years 1952 and 1963.

János Nemeskéri had strong ties with a very significant period of anthropology world-wide. In 1934 J. B. S. Haldane was speaking with acknowledgement of the craniological activity of the English school, especially of comparative statistical analysis of Morant and his colleagues in his plenary lecture (Anthropology and Human Biology) at the First International Congress of Anthropological and Ethnological Sciences. In 1938 E. Sjöwall was lecturing on the connections of anthropology and palaeopathology at the Second International Congress of Anthropological and Ethnological Sciences in Copenhagen. Ten years later (Brussels, 1948) R. Hartweg analyzed the links existing between anthropology and odontology at the Third International Congress of these sciences (COMAS 1956, p. 298). János Nemeskéri was among the participants of the Copenhagen Congress. However, his field of interest became known at the Brussels Congress having announced a lecture with the title "Lés éléments orientaux dans le matériel anthropologique hongrois de l'age préhistorique et de la grand migration", though he was not able to deliver it (COMAS 1956, p. 287). There was a very important lecture by co-authors Marc R. Sauter and Hélèn Kaufman on some seroanthropological correlations of the Genevan female population at the Brussels Congress. (The complete text of this lecture was published in Arch. Julius Klaus Stiftung 24. 1949, p. 479-496, in Zurich.) The inspiring and innovative effects of these three congresses on the scientific activity of the anthropologists debuting in the 1930s cannot be questioned. It is sufficient to point out the methodical and measurement technical problems as well as those of palaeontology and human evolution, genetics, craniology and osteology, somatology and taxonomy, biotypology and serology, demography (life span, etc.) from the subjects of these congresses (COMAS 1956). All these had stimulating effects on the research activities of scientists. The quarter century long (1912-1938) work of G. M. Morant and his colleagues deserves our special attention in this respect. They had systematically arranged a considerable osteological material and they significantly improved the craniometrical techniques. Simultaneously with English biometricans Rudolf Martin's Zurich school succeeded in obtaining outstanding results while uncompromisingly representing the natural historic character of anthropology. János Nemeskéri was helped in the field of methodology and in his selection of suitable working hypothesis - already very complicated in that times - by his early study-tours, by his consultations with Theo Mollison, Robert Routil and Joseph Weninger as well as by his acquaintance with the important theoretical-taxonomical publications of the 1930s (e.g. the Cro-Magnon type from the Neolithic to the present, PERRET 1938; the craniological types of East-Europe, BUNAK 1932a, b; the theoretical papers of HUG, BREITINGER and LEBZELTER 1935-1940). The development of Nemeskéri's interest for palaeopathology and palaeodemography was determined by the research activities of Angel, Ackerknecht and Vallois. From 1948 he paid special attention to the ethnogenetic investigations carried out successfully by Soviet anthropologists in that time (DEBETS 1948). In 1955 it was Nemeskéri who called the attention of our scholars to the theoretical and practical work of Trofimova, Levin, Debets, Tsheboksarov and Ginsburg when outlining the anthropological composition of the 10-11th centuries inhabitants of Hungary in his first significant attempt to provide a synthetic report on the topic at the Archaeological Congress organized by the Hungarian Academy of Sciences in 1955. The importance of ethnogenetic investigations was stressed by him in his lectures at the University at the end of the 1940s. He analyzed the anthropological problems of Aeneolithic and Copper Age populations of Hungary at the Fifth International Prehistoric-Protohistoric Congress (Hamburg, 1958) where he analyzed the palaeopathological peculiarities of 50 skeletons as a supplement to the general picture of taxonomic mosaicity.

Craniology and somatology were decisive factors with special attention to the problems of taxonomy according to the double principle of adaptation and originality in the first decades of Nemeskéri's research work. We have to mention that the "Europid brachycran" concept was first used by him in Hungarian scientific literature. It seems to be synonymous with the Pamirian (Pamiro-Ferganean, Central Asiatic Interfluvial) type according to the morphological complex outlined in his works. A similar tendency is reflected by his lectures delivered in Hungary and abroad between 1937 and 1959 as well as in his approximately 50 papers published before 1965. The classical investigation of the skeletal remains from Gallen Priory in Ireland, published by Howells in 1941 was well known to him. Though knowing these results or even on their inspiration Nemeskéri neglected the primary methodical function of taxonomy and he chose palaeobiological reconstruction as his primary aim. It was the reason why he backed the complete excavation of sites (Alsónémedi, Fiad - Kérpuszta, Halimba, Zalavár, Keszthely - Dobogó, Tiszapolgár - Basatanya, Mezőcsát).

His attention turned towards the informative possibilities of demography, pathology and serology considering recent and historical populations. He started out in this direction in 1939 when he won the prize of the Institute of Hungarology for preparing the investigations to be carried out on the inhabitants of the village Ivád in County Heves. There he applied the same programme as in his investigations done in Rétköz and Bodrogköz. The results of this part of his activities were published in a number of papers written with co-authors Richárd Backhausz, György Acsády, Géza Gáspárdy, László Harsányi, Imre Lengyel, Andor Thoma and Hubert Walter. A short theoretical summary of the palaeobiological reconstruction was presented by him at the Sixth International Congress of Anthropological and Ethnological Sciences in Paris in 1960. He called attention to the problem of palaeodemography at the previous congress in Philadelphia (1956). He gave an analysis of the possibilities of the endogamy-consanguinity correlations at the Isolate-Symposium in Eger in 1964. He attempted to improve the accuracy of age and sex determination (in collaboration with L. Harsányi).

János Nemeskéri initiated the adaptation of modern trends under very complicated social conditions. He ensured the realization of his programme in the years before 1965 and so he formed and established his own personal scientific character in the first decades of his activities. With his aptitude to modern trends he managed to stay in the inspirative-innovative main stream of our science even in the last decades of his career spanning a whole epoch. János Nemeskéri's activity constitutes a significant chapter in the history of Hungarian anthropology. His personality will survive in the memory of all his colleagues and scholars. Nemeskéri's lasting research creativity materialized first of all in his papers. His affection for the Classic Latin World could be symbolized with Vergilius's words: *Semper honos nomenque tuum laudesque manebunt* (Aeneis I/609).

REFERENCES

ACSÁDI, Gy. & NEMESKÉRI, J. (1970): History of human life span and mortality. - Academic Press, Budapest, 356 pp.

BACKHAUSZ, R. & NEMESKÉRI, J. (1955): Résultats des recherches séro-anthropologiques effectuées au Bodrogköz (Hongrois Nordest). - Journ. Gen. Hum., 4: 219-233.

BACKHAUSZ, R. & NEMESKÉRI, J. (1961): Häufigkeit der ABO-Blutgruppen und des D-Faktors in Ungarn. - Zschr. Morph. Anthr., 51: 103-115.

BREITINGER, E. (1935): Zur Beurteilung der Streuung in der anthropologischen Methodik. - Anthrop. Anz., 12: 180-185.

BREITINGER, E. (1937): Zur Berechnung der Körperhöhe aus den langen Gliedmassenknochen. - Anthrop. Anz., 14: 249-274.

BREITINGER, E. (1938a): Zur Trepanation in der Frühbronzezeit. - Anthrop. Anz., 15: 73-77.

BREITINGER, E. (1938b): Gruppenrisse vom Hirnschädel. - Anthrop. Anz., 15: 298-319.

BREITINGER, E. (1938c): Zur Differentialdiagnose zwischen nordischen und mittelländischen Schädeln. - Verhandl. d. Deutsch. Ges f. Rassenforschung, 9: 113-122.

BREITINGER, E. (1939a): Die Berechnung der Streuung zusammengesetzter Gruppen. - Anthrop. Anz., 16: 107-111.

BREITINGER, E. (1939b): Die Skelette aus den submykenischen Gräbern. - In: Kraiker, W. & Kübler, K., Kerameikos, 1, Die Nekropolen des 12. bis 10. Jahrhunderts. Berlin: 223-255.

BREITINGER, E. (1939c): Die Brandreste aus den protogeometrischen Amphoren. - In: Kraiker, W. & Kübler, K., Kerameikos, 1, Die Nekropolen des 12. bis 10. Jahrhunderts. Berlin: 257-261.

BREITINGER, E. (1940a): Beiträge zur Rassengeschichte Bayerns, 1. Die Schädel aus dem frühbronzezeitlichen Hockerfriedhof bei Nähermemmingen, Bez. Amt Nördlingen. - Mannus, 31/4, Leipzig: 483-537.

BREITINGER, E. (1940b): Die Glockenbecherleute in Bayern. - Verhandl. d. Deutsch. Ges. f Rassenforschung, 10: 57-64.

BREITINGER, E. (1953): La Misurazione della Capacitá Cranica. - In: Standard. Anthr. Synthét. (S. A. S.) (Bologna), 27-28: 1-44.

BREITINGER, E. (1957): Zur Phyletischen Evolution von Homo sapiens. - Anthrop. Anz., 21: 62-83.

BUNAK, V. V. (1923): Des variations d'inclination du bassin avec l'age et leur signification morphologique. - Anthropologie (Praha), 3: 242-245.

BUNAK, V. V. (1925): Einige Daten über die Isohämagglutination bei verschieden en asiatischen Stämmen. - Arch. f. Rassen- und Gesellschaftsbiologie, 14/3: 316-318.

BUNAK, V. V. (1926): Classement des Types de la teinte des yeux et des cheveux. - Inst. Internat. d'Anthropologie. 2-e Session, 1924, Prague. Paris: 200-275.

BUNAK, V. V. (1928a): Sur la nécessité et sur les principes de l'unification de la méthode de determination des charactères déscriptivs en anthropologie. - Inst. Internat. d'Anthropologie. 3-e Session, 1927, Amsterdam. Paris: 277-282.

BUNAK, V. V. (1928b): Caractères morphologiques des jumeaux. Les jumeaux uni- et bivitellines. - Inst. Internat. d'Anthropologie. 3-e Session, 1927, Amsterdam. Paris: 41-46.

BUNAK, V. V. (1932a): Material zur Aussonderung anthropologischer Typen unter der Bevölkerung Ost-Europas. - Zschr. Morph. Anthr., 30: 442-503.

BUNAK, V. V. (1932b): Craniological Types of the East slavic Kurgans. - Anthropologie (Praha), 10: 273-310.

COMAS, J. (1956): Historia y Bibliografia de los Congresos Internacionales de Ciencias Antropológicas: 1865-1954. - Inst. de Hist., d'Univ. Nac. Aut. de Mexico, 494 pp.

DEBETS, G. F. (1948): Paleoantropologiya SSSR [Paleoantropology of Soviet Union]. - Nauka (Moskva): 391 pp. (in Russian)

GÁSPÁRDY, G. & NEMESKÉRI, J. (1960): Paleopathological studies on Copper Age skeletons from Alsónémedi. - Acta Morph. Acad. Sci. Hung., 9: 103-119.

HALDANE, J. B. S. (1934): Anthropology an Human Biology. - I. Congr. Int. des Sci. Anthrop. et Ethnol. (London): 53-64.

HARSÁNYI, L. & NEMESKÉRI, J. (1964): Über Geschlechtsdiagnose and Skelettfunden. - Acta Med. Leg. Soc. (Liège), 17: 51-55.

HARTWEG, R. (1948): Anthropologie et Odontologie. - III. Congr. Int. des Sci. Anthrop. et Ethnol. (Bruxelles) (after Comas 1956)
HOWELLS, W. W. (1941): The Early Christian Irish: The Skeletons at Gallen Priory. - Proc. Roy. Irish Acad. (Dublin), 46 C 3: 103-219.
HUG, E. (1940): Die Schädel der frühmittelalterlichen Gäber aus dem soluthurnischen Aargebiet in ihrer Stellung zur Reichengräberbevölkerung Mitteleuropas. - Zschr. Morph. Anthr., 38: 359-528.
LEBZELTER, V. (1937): Eine rassenkundliche Übersichtsaufnahme des Burgenlandes. - Mitteil. d. Anthrop. Ges. Wien, 67: 294-350.
LENGYEL, I. & NEMESKÉRI, J. (1963): Application of biochemical methods to biological reconstruction. - Zschr. Morph. Anthr., 54: 1-56.
LENGYEL, I. & NEMESKÉRI, J. (1964): Über die Blutgruppenbestimmung an Knochen mit Hilfe der Fluoreszenz-Antikörperhöhe Methode. - Homo, 15: 65-72.
LENGYEL, I. & NEMESKÉRI, J. (1965): Investigation on the chemical composition of aged human bones belonging to recent and subfossil periods. - Proc. Int. Cognr. Gerontology, pp 141-146.
MOLLISON, Th. (1938): Spezielle Methoden anthropologischer Messung. - Abderhaldens Hdb. biol. Arbeitsmeth., Berlin - Wien: pp. 523-682.
NAGY, T. (1947): Beszámoló a Corona Archeologica működéséről [Report to the Functioning of Corona Archeologica]. - Antiquitas hung. (Budapest), 1: 106-108.
NAGY, T. (1948): Beszámoló a Corona Archeologica működéséről [Report to the Functioning of Corona Archeologica]. - Antiquitas hung. (Budapest), 2: 219-220.
NEMESKÉRI, J. (1938): Adatok a hajduk antropológiájához [On the anthropology of Hajdus]. - Budapest: 1-54.
NEMESKÉRI, J. (1943): Az embertan és a magyar őstörténet [On the anthropology and the Hungarian prehistory]. - In: Ligeti, L., A magyarság őstörténete [The Hungarian prehistory], Budapest: 223-239.
NEMESKÉRI, J. (1955): Le constitution anthropologique de la population du X^{e} et XI^{e} siècles en Hongrie. - In: Conférence Archéol. de l'Académie Hongroise des Sci., Budapest: 291-310.
NEMESKÉRI, J. (1961a): Der äneolithische und kupferzeitliche Mensch in Ungarn. - Bericht über den V. Int. Kongr. für Vor- und Frühgeschichte, 1958 (Hamburg): 599-601.
NEMESKÉRI, J. (1961b): Fifteen Years of Anthropological department of the Hungarian Natural History Museum (1945-1960). - Annls hist.-nat. Mus. natn. hung., 53: 669-675.
NEMESKÉRI, J. (1962): Problèmes de la reconstruction biologique en anthropologique historique. - VI^{e} Congr. Int. des Sci. Anthrop. et Ethnol. (1960), Paris: 669-675.
NEMESKÉRI, J. & ACSÁDI, Gy. (1960): La paléodemographie base nouvelle de l'analyse anthropologique. - Vth Int. Congr. Anthr. Ethol. Sci. (1956), Philadelphia: 692-697.
NEMESKÉRI, J. HARSÁNYI, L. (1959): Die Bedeutung paläopathologischer Untersuchungen für die historische Anthropologie. - Homo, 10: 203-226.
NEMESKÉRI, J., HARSÁNYI, L. & ACSÁDI, Gy. (1960): Methoden zur Diagnose des Lebensalters von Skelettfunden. - Anthr. Anz., 24: 70-95.
NEMESKÉRI, J. & LENGYEL, I. (1963): Újabb biológiai módszerek a történeti népességek rekonstrukciójában (Further biological methods in the reconstruction of the historical populations). - Biol. Orv. Tud. Oszt. Közl., 6: 333-357.
NEMESKÉRI, J. & LENGYEL, I. (1976): Neolithic skeletal finds. - In: Gimbutas, M. (ed.), Neolithic Macedonia as reflected by excavation at Anza, South-east Yugoslavia. California University Press, Los Angeles, pp: 375-410.
NEMESKÉRI, J. & THOMA, A. (1961): Ivád: An isolate in Hungary. - Acta Gen., 11: 230-250.
PERRET, G. (1938): Cro-Magnon Typen vom Neolithikum bis heute. - Zschr. Morph. Anthr., 37: 1-101.
SAUTER, M-R. & KAUFMANN, H. (1960): Quelques Corrélations Sero-Anthropologiques dans la Population Feminine de Genève. - III. Congr. Int. des Sci. Anthrop. et Ethnol. (1948), Bruxelles, Tervuren: 206-208.
SCHLAGINHAUFEN, O. (1960): Mitteilungen über die hellfarbigen Brachykephalen der heutigen Bevölkerung der Schweiz. - III. Congr. Int. des Sci. Anthrop. et Ethnol. (1948), Bruxelles, Tervuren: 208-210.
SJÖVALL, E. (1939): Die Beziehungen der Palaeopathologie zur Anthropologie. - II. Congr. Int. des Sci. Anthrop. et Ethnol. (1938), Copenhagen: 122-123.
TÓTH, T. (1971): Twenty-five years (1945-1970) of the Anthropological Department Hungarian Natural History Museum. - Anthrop. hung., 10: 5-30.

TÓTH, T. (1980-1981): The Anthropological Department in the history of Hungarian anthropology. - Anthrop. hung., 17: 109-121.
TÓTH, T. (1986): Anthropology of postglacial historic populations. - Anthrop. hung., 19: 5-10.
WALTER, H. & NEMESKÉRI, J. (1967a): Demographical and Sero-Genetical Studies on the population of Bodrogköz (NE Hungary). - Human Biol., 39: 224-240.
WALTER, H. & NEMESKÉRI, J. (1967b): The role of geographical isolation for micro-evolutionary processes in man. Observations in Hungary. - Anthrop. Anz., 30: 142-148.
WALTER, H. & NEMESKÉRI, J. (1969): Populationsgenetische Untersuchungen im Bodrogköz (NO-Ungarn). - Wiss. Zeits. d. Humboldt-Universität zu Berlin, Math.-Nat. Reihe, 18/5: 885-891.
WALTER, H., NEUMANN, S. & NEMESKÉRI, J. (1965): Populationsgenetische Untersuchungen über die Verteilung von Hämoglobin S und Glucose-6-Phosphat-Dehydrogenasemangel im Bodrogköz (Nordost Ungarn). - Humangenetik, 1: 651-657.
WALTER, H., NEUMANN, S. & NEMESKÉRI, J. (1968): Investigation on the occurrence of Glucose-6-Phosphat-Dehydrogenase deficiency in Hungary. - Acta Genet, 18: 1-11.
WALTER, H. & NEMESKÉRI, J. (1972): Population genetic investigations in the Bodrogköz area of NE-Hungary. - In: Törő, I. & al. (eds), Advances in the biology of human populations, Budapest: 329-343.

N o t e - Nemeskéri's papers published between 1938 and 1965 are listed by Irma Allodiatorisz (Bibliographie der Anthropologie des Karpatenbeckens, 1958, Budapest) and T. Tóth (1980-1981; see in the References of the present paper).

Author's address: DR. TIBOR TÓTH

Anthropological Department
Hungarian Natural History Museum
Budapest, Bajza u. 39.
H-1062
HUNGARY

ANTHROPOLOGIA HUNGARICA
XXI. 1990 p. 11-24

Analysis of tooth morphotypes of Neogene Hominoids

By

L. KORDOS

(Received June 28, 1990)

Abstract. In order to obtain a correct interpretation of the phylogenetic relations of Rudapithecus hungaricus from the Rudabánya locality (Hungary) 72 M_3 tooth morphotypes of Hominoids and Hominids from Africa, Europe and Asia were analyzed. The joint evaluation of five characteristics (cingulum, fovea anterior, extra conulus between the Med and End, and the End and Hld, and fovea posterior) have been accomplished. Similar morphotypes could be found with the African Early and Middle Miocene and the European Middle Miocene Great Apes. However, these differ from the Eurasian Turolian Hominoids which are similar with each other. Probably the method elaborated for the Hominoids cannot be directly applied for the Hominids. With 1 table and 4 figures.

A fundamental problem of the Eurasian Hominoids' study is the African connection and the separation of Dryopithecus and Sivapithecus. Obtaining a better knowledge on the phylogenetical position of the Rudapithecus hungaricus of Rudabánya is also a part of these questions. The morphotype analysis of the teeth seems to be a useful method already widely applied in the Vertebrate micropaleontology. This study deals with the third lower molar because it has been suggested that the name Rudapithecus hungaricus is a synonym denomination for the Dryopithecus brancoi (KELLEY & PILBEAM 1986, BEGUN 1988). The holotype of the Dryopithecus brancoi is a left M_3 (BRANCO 1898). For this purpose the present author elaborated the method of analysis of M_3 between 1987-1990 and he applied it for the Neogene Hominoids available for him. The author wishes to express his thanks for the kind help of Professor BEGUN (Washington D.C. and Toronto), J. Franzen (Frankfurt am Main), R. Potts (Washington D.C.), H. Tobien (Mainz) and A. Walker (Baltimore) who made it possible for him to visit their collections and to study the originals or casts.

MORPHOLOGY OF M_3

The lower third molar is an antero-posteriorly elongated tooth (Fig. 1). On its anterior side a facette or concave surface develops when in contact with the second molar. It is generally narrow and no facette develops in posterior direction. The tooth is two-rooted. Three main cusps (Protoconid, Hypoconid and Hypoconulid) can be found on the buccal side while two (Metaconid, Entoconid) on the lingual side. On the anterior buccal side a cingulum may occur which is generally considered phylogenetically important. Between the two anterior cusps a crest may occur with one or more fossae in front of it. The crest from the hypoconid towards the basis of the tooth never reaches the metaconid, and that is why there is no closed trigonid. Crest connection is frequent between the hypoconid and entoconid, which sometimes results a closed posterior fovea. The main cusps are in parallel contact with the tooth margin, constituting a continuous cone system with the incisions. Conoluses may often appear among the main cusps making the tooth-crown pattern more varied. These latter features facilitate the study of the structure of tooth-crown even in case of eroded items.

METHODOLOGY OF THE ANALYSIS

In the course of the morphotype analysis not only one feature (e.g. the presence or absence of the cingulum) but the joint occurrence of the largest number of morphological characteristics should be considered. Variation within morphotypes is provided by the tooth samples collected from the same layer of the same locality disregarding the fact that they are classified into different systematic units on the basis of different anatomical features. The former taxonomical results, in given cases, may coincide with the predominance of morphotypes. In the course of the morphotype analysis of the lower third molar's tooth-crown the following eight characteristics were studied:

1. The shape of the masticatory surface (rectangle, oval, posteriorly narrowing)

Form of the tooth-crown cannot be classified within the three basic groups since transitional shapes frequently occur. The last tooth in the row proved to be such a unique feature that it excluded the possibility of drawing general conclusions. That is why this characteristic will not be discussed in the present study any more.

2. The cingulum (present or absent)

The presence of the cingulumn meeting indicates phylogenetically evaluable change. Its occurrence is extremely frequent in layers of geologically earlier periods (from the Oligocene to Upper Miocene) while the tooth type without the cingulum is predominant in case of the Upper Miocene Hominoids. The development or absence of the cingulum may not be related to changes in size and shape of the tooth.

3. The fovea anterior (missing, or one or two are present)

Most frequently it develops if a lingo-buccally elongated fovea is closed by the anterior cingulum (or tooth margin) and the crest is between proto- and metaconid. This proved to be predominant in almost all cases but double anterior fovea may also appear. The fovea anterior as a marginal variation is missing when the axial fossa of the anterior side is dychotomic. This feature in itself indicates no phylogenetical trend but only changes in predominance within the population.

4. The crest between the proto- and metaconid (continuous or interrupted)

The crest connecting the proto- and metaconid is interrupted in 90% of the cases by a fissure between the fovea anterior and the talonid basin. Since this variation cannot be evaluated it will not be discussed subsequently.

5. The conulus(es) between the meta- and entoconid (present or absent)

In more than half of the cases one or more extra conuluses appear. The extra conulus is more frequent in the earlier Hominoids (Lower and Middle Miocene) than in the younger ones (Upper Miocene). It indicates a tendency of simplification in the tooth pattern.

6. The conulus(es) between the entaconid and hypoconulid (present or absent)

It indicates the same tendency of simplification as for the extra conulus between the meta- and entoconid. However, there is no close connection between the appearance of the extra conulus between the Med-End and the End-Hld.

7. The position of the protoconid as related to the axis of the tooth (half, quarter and margin)

The termination of the position of the protoconid as related to the axis strongly depends on the erosion of the tooth, and that is why the morphotype is unsuitable for evaluation.

8. The fovea posterior (present or absent)

It develops by the approaching or closing in of the hypoconulid and entaconid. Its presence or absence in itself is not a definitive characteristic. It is generally missing form geologically younger M_3 tooth finds. It indicates a simplification of the tooth structure which is not in positive correlation with the fovea anterior.

Out of the above 8 morphotype features 5 may be suitable for the joint morphological characterization of the tooth. Code numbers have the following meaning from left to right: cingulum - fovea anterior - Med-End conulus - End-Hld conulus - fovea posterior (Fig. 2).

Accordingly, the morphotype code of the right lower third molar of the holotype of Proconsul africanus is 12112 where cingulum is present (1), the fovea anterior is developed (2), there is extraconulus between the meta- and entaconid (1), and also between the entaconid and hypoconulid (1), and the fovea posterior is missing (2).

When analyzing the morphotypes the following objective criteria were kept in mind:

1. The finds studied are only samples.
2. The selection of the 8 morphological characters was carried out in an empirical manner, thus it may be subjective.
3. The variation of the five characters chosen for further evaluation is objective.
4. When creating the code describing one single item the cingulum, the presentation (showing) of one phylogenetically most charcateristic change was placed to the first position and the others followed in anatomical order. In other words, the teeth described by identical codes belong to the same morphological structure.

72 lower third molar morphotypes were analyzed. They are chronologically ranging from the Oligocene Aegyptopithecus till the Pleistocene Homo habilis (Table 1, Fig. 1). Only a part of the total number of finds could be studied. Especially the Proconsul, and certain Asian Hominoids of the last ten years are missing. However, the data indicate trends that make the preliminary publication of the results necessary.

THE MORPHOTYPES OF HOMINOIDS AND HOMINIDS

The morphotype codes of the finds summarized according to their chronology in Table 1 are presented by the taxa in Fig. 3. The lower third teeth of the taxa show the following features. The Oligocene Aegyptopithecus zexius with its primitive cone system strongly differs from the M_3 of the Miocene African Hominoids, though, at the same time it already agrees with Turkanopithecus and certain Dryopithecus morphotypes. Morphotype 12222 of Aegyptopithecus cannot be found among the Proconsuls according to the data obtained so far. The lower third molar morphotypes of Proconsul africanus and Proconsul major differ only in the presence (Pr. africanus) or in the absence (Pr. major) of the fovea anterior. At the same time, the morphotypes of the other studied items indicate an overlapping between the two species. The morphotype of the single Pr. nyanzae tooth can be well distinguished from the other two species due to the lack of extra conulus. The cingulum is present in all three cases. Though morphotypes of the Afropithecus and Turkanopithecus have cingula, they are different because the Afropithecus does not have extra cones. Morphotype similarity can be found among Afropithecus, Proconsul africanus and Pr. major based on these features, while it can also be established between Turkanopithecus and Pr. nyanzae.

The morphotype of the 'Sivapithecus africanus' sharply differs from the other African Miocene Hominoids. No cingulum is present and a character combination occurs that could not be ascertained in the Proconsul, Afropithecus and Turkanopithecus finds. At the same time, the morphotype 22122 of 'Sivapithecus africanus' also appears in the material from Pasalar, and with Dryopithecus rhenanus, Rudapithecus, and the apes from Sivalik.

The European Middle Miocene Dryopithecus belongs to the same morphotype range as the majority of the African Hominoids with cingulum on each teeth. Difference of the two groups is manifested in the pattern of the tooth crown. The Lartet type and the Lerida specimen of Dryopithecus fontani is more complicated, and the Dryopithecus darwini also belongs to this group. The morphology of the lower third molar of Harle's Dryopithecus fontani of St. Gaudens and the Sivapithecus occidentalis from the Can Vila locality is simpler. Extremely broad and independent morphotype variations are observed in the Pasalar material (ANDREWS & TOBIEN 1977).

The most frequent is the morphotype 13112 that could not be found in case of any other taxa. Its unique characteristics can be seen in the development of the double fovea anterior. The Pasalar morphotypes with cingulum but without fovea anterior, though having extra conulus, as well as specimens without cingulum being identical morphotype with the 'Sivapithecus africanus' variations indicate that several morphotypes are present. However, the specimens' division for Rama- and Sivapithecus, does not coincide with the groups of different morphotypes.

Both M_3 teeth of the Ouranopithecus from Macedonia are sharply different from those of any other Late Neogene Hominoids. The cingulum is present, the fovea anterior is missing and the teeth display a complicated pattern. The same morphotype occurs only in the holotype of the Proconsul major and in the Pasalar material.

The European Upper Miocene Hominoids including Rudapithecus hungaricus have no cingulum and their morphotype frequency has two peak values, showing, on the one hand, the complicated, and on the other, the simpler patterns. However, it is interesting that remains of the same species from the same locality appear in both morphotype groups (Hispanopithecus, Rudapithecus). Contrary to the Pasalar finds the morphotype variation of the specimens belonging to this group is small.

The Siwalik Hills finds that had been formerly classified into different taxa (Sivapithecus indicus, Rudapithecus punjabicus, Brahmapithecus thorpei, Dryopithecus sivalensis, Dr. frickae, Dr. cautkey) present their frequency maximum in case of the same morphotypes as Late Miocene European Hominoids. The peaks of the maximums show only a slight shift of morphotypes. The peak shifted from the European morphotype 22121 to 22122 refers to the lack of fovea posterior. In another case the peak was received from the European 22221 to the 22222, i.e. the fovea posterior was reduced again.

So far the determination of the morphotype of the 7 Hominids lower third molar has been performed (Table 1) of which each specimen is different. Cingulum can be found with Australopithecus (Sterkfontein, 526) and with Homo habilis remains of Olduwai (OH-4 and OH-27). A morphotype without cingulum was also found (OH-13) in this latter locality. No morphotype of the Hominids coincides with the morphotype peaks of the Hominoids. It would be too early to draw further conclusions due to the insufficient number of available data. However, it is probable, that the characters used for the Hominoids cannot be directly applied for the Hominids.

PHYLOGENETIC ANALYSIS OF THE HOMINOIDEA MORPHOTYPES

The analysis of tooth morphology is the soundest and most useful method in the 200-year history of Vertebrate paleontology. Its application is especially fruitful where the morphological structure changes rapidly, characteristically, on species level, and the changed can be placed in phylogenetic line. However, the speed of the morphotype evolution is slow and the pattern of the tooth crown is unified in the majority of cases of the large mammals. The teeth of Primates belong to this group and that is why the following theoretical questions must be answered in the course of this analysis:

1. How do the morphological characters change during evolution?
2. Does the population of a species have a significant morphotype version, or a definite marker on species level?
3. Are there morphological succession lines and do they coincide with bio-phylogenetic results?

In the course of the joint evaluation of the studied five factors (cingulum, fovea anterior, appearance of the extra conulus between the meta- and entoconid and hypoconulid, respectively, fovea posterior) it can be clearly seen (Fig. 3) that the cingulum is present with the primitive species, in case of the Hominoids, and later the number of specimens with cingulum is gradually decreasing and finally completely disappears by the Late Neogene. I.e. the cingulum is not a definite marker on species level but a general, transpecific feature of the evolution of Hominoids.

Since the presence or absence of the cingulum is the fundamental factor (1st digit) in the arrangement of the five-character M_3 morphotype code, the populations can be divided into two well-distinguishable groups. Cingulum is characteristic for almost all Miocene African Hominoids, for the Dryopithecus from the Badenian, for the majority of the finds from Pasalar and for the Ouranopithecus. However, it is missing from 'Sivapithecus africanus', and from the Turolian Hominoids of Europe and those of Siwalik. This way it is probable that when comparing the five-character morphotypes (Fig. 3) otherwise similar morphotypes can be separated from each other.

The second and fifth characters refer to similar morphological features, i.e. the presence of the anterior and posterior foveae, respectively. Basically the same relation systems can be observed as in case of the joint application of the five factors. Only the holotype of Pr. major differs from the others among the Proconsul species. The Afropithecus (simpler) and the Turkanopithecus (more complicated) are different morphotypes. The European Badenian Dryopithecus belongs to the same range as the majority of the Proconsuls. The Pasalar population is extremely varied also in this respect because its majority belongs to the most complicated category. The European Turolian Hominoids belong to the morphotype characterized by fovea on the anterior and posterior side. A part of the Siwalik finds also belongs here, however, the majority has fovea anterior while the posterior one is missing. The Ouranopithecus a marginal version as well as two finds from Siwalik and two from Pasalar have no fovea. Our conclusion is that the appearance or lack of the anterior or posterior fovea are not trend-like definitive evolutional features as is the cingulum. Statistically they are characteristic of the Hominoids of a given locality but they are not markers on the species level. These two features together are suitable for observing the trend of change in tooth morphology (simplification or complication) in case of succession lines considered to be continuous and they are also suitable to create a hypothesis concerning the improbability of succession.

The 3rd and 4th of the five characters of the code reflect the appearance of the extra conulus, i.e. how complicated is the pattern of the tooth crown. Based on these two factors, the analyses of the Hominoids show the same characteristic features as characters 2 and 5. A more important difference is that the variation scale of the Pasalar material is smaller, while that of the Siwalik finds is significantly greater than in case of the fovea anterior and posterior. The appearance of the extra consulus greatly differs from the formerly interpreted features in the case of the two Ouranopithecus teeth. No direct connection can be proved between the appearance of the posterior extra conulus and that of the posterior fovea. They are completely independent from each other. Finally a comparison was made to show the difference from a selected predominant morphotype.

The richest material comes from Siwalik where the five-character morphotype shows a well-distinguishable predominance peak (22122). Among the Hominoids this population is the youngest, so in principle, it means the evolved final stage of the evolutionary line. The diagram of morphotype variation (Fig. 4) shows rather average values, excluding the 'cingulum-effect' but basically the results are the same.

Now the following answers can be given to our questions:

1. Among the 5 analyzed morphological features the disappearance (reduction) of the cingulum is a general, evolutionary phenomenon with the Hominoids that is not or hardly influenced by the factors influencing the population. Contrary to the cingulum the other four characteristics, do not change in a trend-like manner but depend on given impacts determining the population. That is why they are suitable for studying succession lines.

2. The lower third molar of the Hominoids does not coincide with categories differentiated on the generic and species level by other characteristics. An excellent example is that the morphotypes of Sivapithecus and Rudapithecus do coincide, while they differ in several skull characteristics. The morphotypes developed on the individual level while the variations on the population level. The speed of evolutionary change of morphotypes is so slow that it is on a higher than generic but lower than familiar level.

3. The morphotypes of the third molar of Hominoids show definite evolutionary lines and their termination. Based on the above paragraph these changes are manifested in higher than generic level trends.

On the basis of morphotype analysis the following succession lines and relations can be supposed:

- The Proconsul species form one morphotype group, their morphological successors are the Afropithecus and Turkanopithecus, followed by the Middle Miocene Dryopithecus.
- The Pasalar Hominoids cannot be considered homogenous, though indicate an African origin comprising specialized forms.
- The Ouranopithecus is completely different from the other Hominoids and has morphotype relations only with the Proconsuls.
- The European Turolian 'Dryopithecus' (Dr. brancoi, Dr. rhenanus, Hispanopithecus, Dryopithecus from Can Llobateres, Rudapithecus) form a joint morphotype group differing only slightly from the Hominoids of Siwalik (Sivapithecus).

If the interpretation of the morphotype succession lines is correct the Hominoids emigration starting out from Africa some 10 - 15 myrs ago to Europe and then to Eurasia can be clearly seen which makes the re-evaluation of the higher systematic units necessary.

REFERENCES

ANDREWS, P. & TOBIEN, H. (1977): New Miocene locality in Turkey with evidence on the origin of Rudapith and Sivapithecus . - Nature, 268: 699-701.

BEGUN, D. R. (1988): Catarrhine phalanges from the Late Miocene (Vallesian) of Rudabánya, Hungary. - Human Evol., 17: 413-438.

BRANCO, W. (1898: Die menschenähnlichen Zähne aus dem Bohnerz der schwbischen Alb. - Jahrb. Ver. Va Nath. Württemberg, 54: 1-144.

KELLEY, J. & PILBEAM, D. (1986): The Dryopithecines: Taxonomy, comparative anatomy, and phyloge Miocene Large Hominoids. - In: Comparative Primate biology. Vol. 1: Systematics, evolution, and anat Alan R. Liss. Inc. pp. 361-411.

Author's address: DR. LÁSZLÓ KORDOS

Hungarian Geological Institute
Budapest, Népstadion út 14.
H-1143
HUNGARY

Table 1 List of the analyzed Hominoids and Hominids morphotypes of M_3

Taxa	Inventory N°	Locality	Left--Right	Morphotype code
1. Aegyptopithecus zeuxis	YPM 23975	Fayum	left	12222
2. Proconsul africanus	CMH.102	Rusinga	right	12112
3. Proconsul major	KNM-LG 452	Koru	right	12112
4. Proconsul major	Holotype,	Songhor	right	11112
5. Proconsul major	KNM-SO 396	Songhor	left	12111
6. Proconsul nyanzae	KNM-RU 1947	Rusinga	left	12221
7. Afropithecus turkanensis	KNM-17010	Kalidorr	right	12112
8. Afropithecus turkanensis	KNM-16840	Kalidorr	right	12111
9. Turkanopithecus kalabolensis	KNM-16950E	Kalidorr	right	12222
10. 'Sivapithecus africanus'	-	Rusinga	left	22122
11. Dryopithecus fontani	Harle publ.	St. Gaudens	left	12222
12. Dryopithecus fontani	Lartet publ.	St. Gaudens	right	12121
13. Dryopithecus fontani	Lartet publ.	St. Gaudens	left	12121
14. Dryopithecus fontani	-	Can Vila	left	12222
15. Dryopithecus fontani	-	Can Llobatres	left	22121
16. Dryopithecus fontani	-	Lerida	left	12121
17. Dryopithecus darwini	Holotype	Neudorf	left	12122
18. 'Sivapithecus occidentalis	-	Can Vila	left	12221
19. Sivapithecus sp.	BP-1	Pasalar	left	11112
20. Sivapithecus sp.	BP-2	Pasalar	right	12122
21. Sivapithecus sp.	BP-7	Pasalar	left	22122
22. Sivapithecus sp.	BP-15	Pasalar	right	21112
23. Sivapithecus sp.	BP-4	Pasalar	right	13112
24. Sivapithecus sp.	BP-6	Pasalar	right	13112
25. Sivapithecus sp.	BP-3	Pasalar	right	13112
26. Ramapithecus sp.	BP-12	Pasalar	right	12212
27. Ramapithecus sp.	BP-11	Pasalar	right	13112
28. Ramapithecus sp.	BP-9	Pasalar	left	13112
29. Ramapithecus sp.	BP-8	Pasalar	left	13112
30. Ouranopithecus macedoniensis	Holotype, RP154	Ravin de la Pluie	right	11112
31. Ouranopithecus macedoniensis	RP156	Ravin de la Pluie	right	11212
32. Sivapithecus indicus	13833	Chinji	right	22122
33. Sivapithecus indicus	9930	Khaur, 317	left	22212
34. Sivapithecus indicus	13836	Chinji	left	22221
35. Sivapithecus indicus	9899	Khaur, 260	right	22211
36. Sivapithecus indicus	AMNH 19413	Hasnot	left	22122
37. Sivapithecus indicus	13828	Hari	left	21122

Table 1 (Continuation)

Taxa	Inventory N^{o}	Locality	Left-Right	Morphotype code
38. Sivapithecus indicus	GSP 6160	Khaur, 226	right	21122
39. Sivapithecus indicus	YPM 13814	Hasnot	left	22122
40. Sivapithecus indicus	4735	Khaur, 182	right	22112
41. Sivapithecus indicus	6759	Khaur, 221	left	22122
42. Sivapithecus indicus	GSP 4875/4622	Khaur, 182	left	21121
43. Sivapithecus indicus	GSP 11707	Khaur, 317	right	22222
44. Sivapithecus indicus	GSP 15000	Kaulial, 410	left	22222
45. Sivapithecus indicus	8926	Khaur, 182	right	22121
46. Sivapithecus indicus	11537	Sethi Nagri, 311	left	22121
47. Sivapithecus indicus	AMNH 19412	Hasnot	left	22221
48. Brahmapithecus thorpei	YPM 13814, Holotype	Hasnot, 81	left	22122
49. Ramapithecus punjabicus	D.118	Siwalik	right	22222
50. Dryopithecus sivalensis	YPM 13806, Holotype	Dhok Pathan	right	22222
51. Sivapithecus indicus	Holotype, YPM 13875	Upper Chinji	right	22112
52. Dryopithecus giganteus	Holotype, D.175	Nagri Zone	right	22121
53. ? Dryopithecus sp.	BMNH M.13367	Salt Range	left	22111
54. Dryopithecus frickae	Holotype, AMNH 19413	Hasnot	left	22221
55. Dryopithecus cautley	Holotype, YPM 13828	Siwalik	left	22122
56. Hispanopithecus laeitanus	Holotype	La Tarumba	left	22221
57. Hispanopithecus laeitanus	-	Can Vila	left	22221
58. Hispanopithecus laeitanus	-	La Tarumba	left	22121
59. Dryopithecus brancoi	Holotype	Salmendingen	left	22222
60. Dryopithecus rhenanus	Schlosser, 1902.T.1.f.6.	Melchingen	left	22121
61. Dryopithecus rhenanus	Schlosser, 1902.T.1.f.7.	Melchinge	right	22121
62. Rudapithecus hungaricus	RUD-2	Rudabánya	right	22122
63. Rudapithecus hungaricus	RUD-16	Rudabánya	right	22121
64. Rudapithecus hungaricus	RUD-17	Rudabánya	right	22121
65. Rudapithecus hungaricus	RUD-19	Rudabánya	left	22221
66. Australopithecus afarensis	AI.288-li 'Lucy'	Hadar	right	22111
67. Australopithecus africanus	Sts.526	Sterkfontein	right	12111
68. Australopithecus africanus	-	Makapansgat	right	21221
69. Homo habilis	OH-40	Olduway	left	11222
70. Homo habilis	OH-13	Olduway	right	23212
71. Homo habilis	OH-27	Olduway	right	12112
72. Sinanthropus pekinensis	131	Zhoukoudien	right	22212

Fig. 1 a-c The 72 M_3 teeth of Hominoids and Hominids included into the morphotype analyses. The numbers agree with those of Table 1.

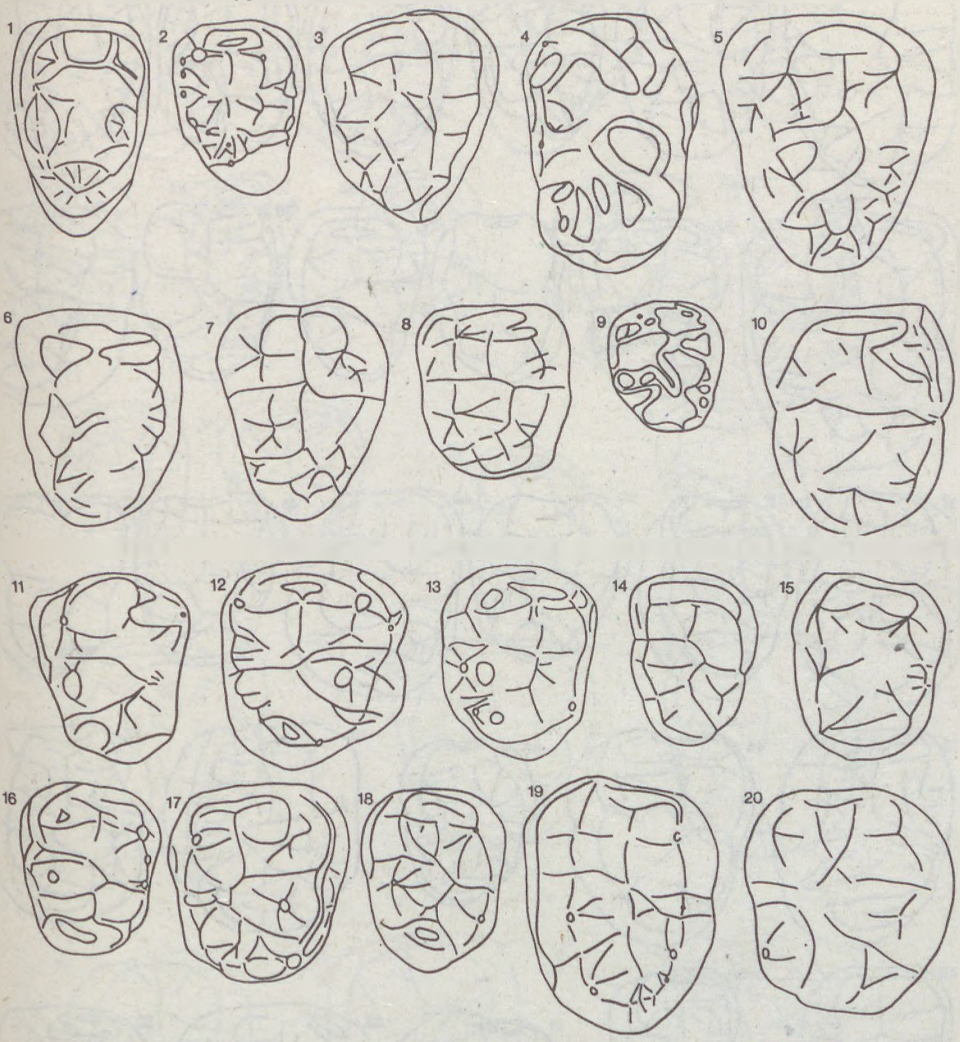


Fig. 1a

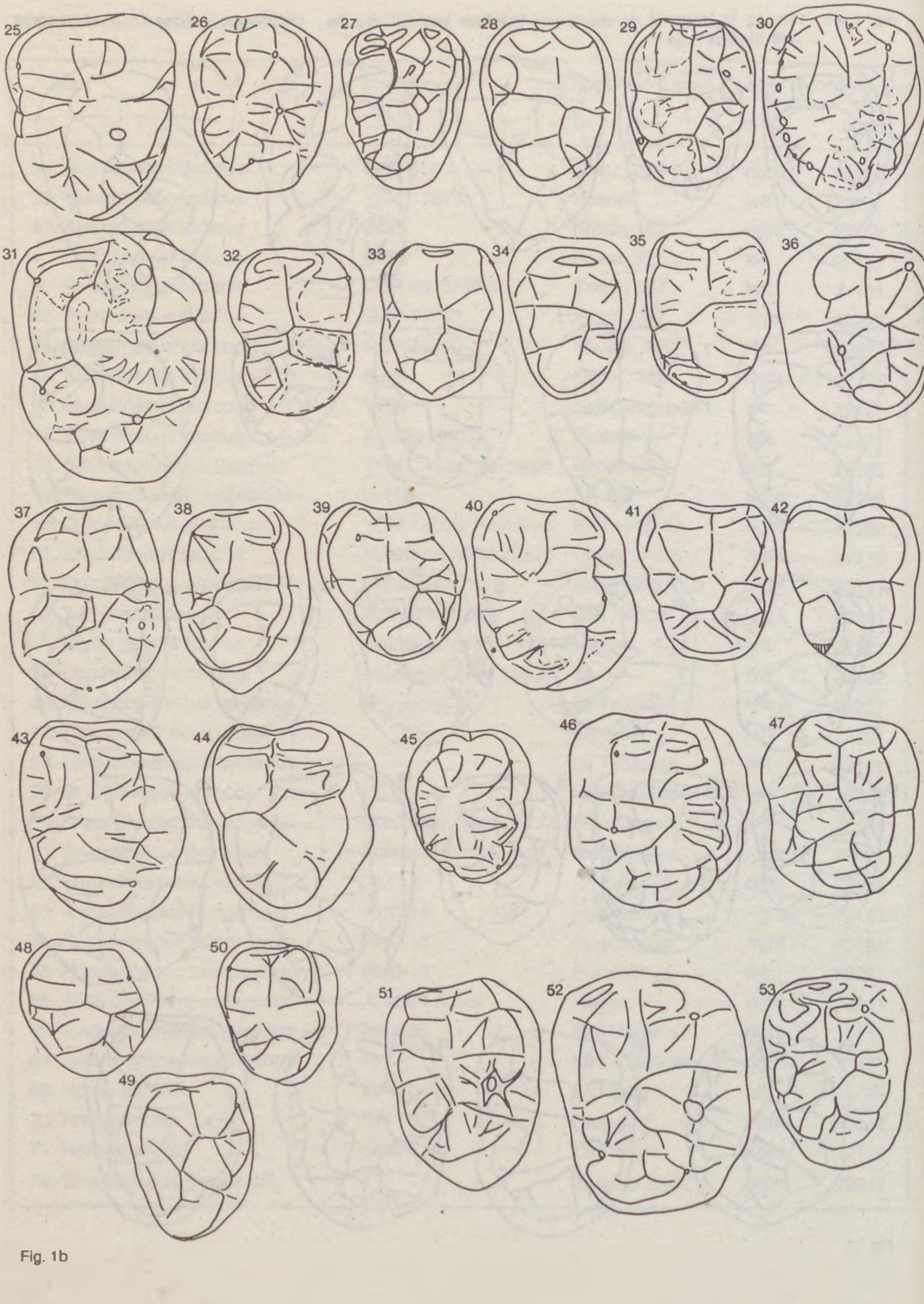

25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
50
49
51
52
53

Fig. 1b

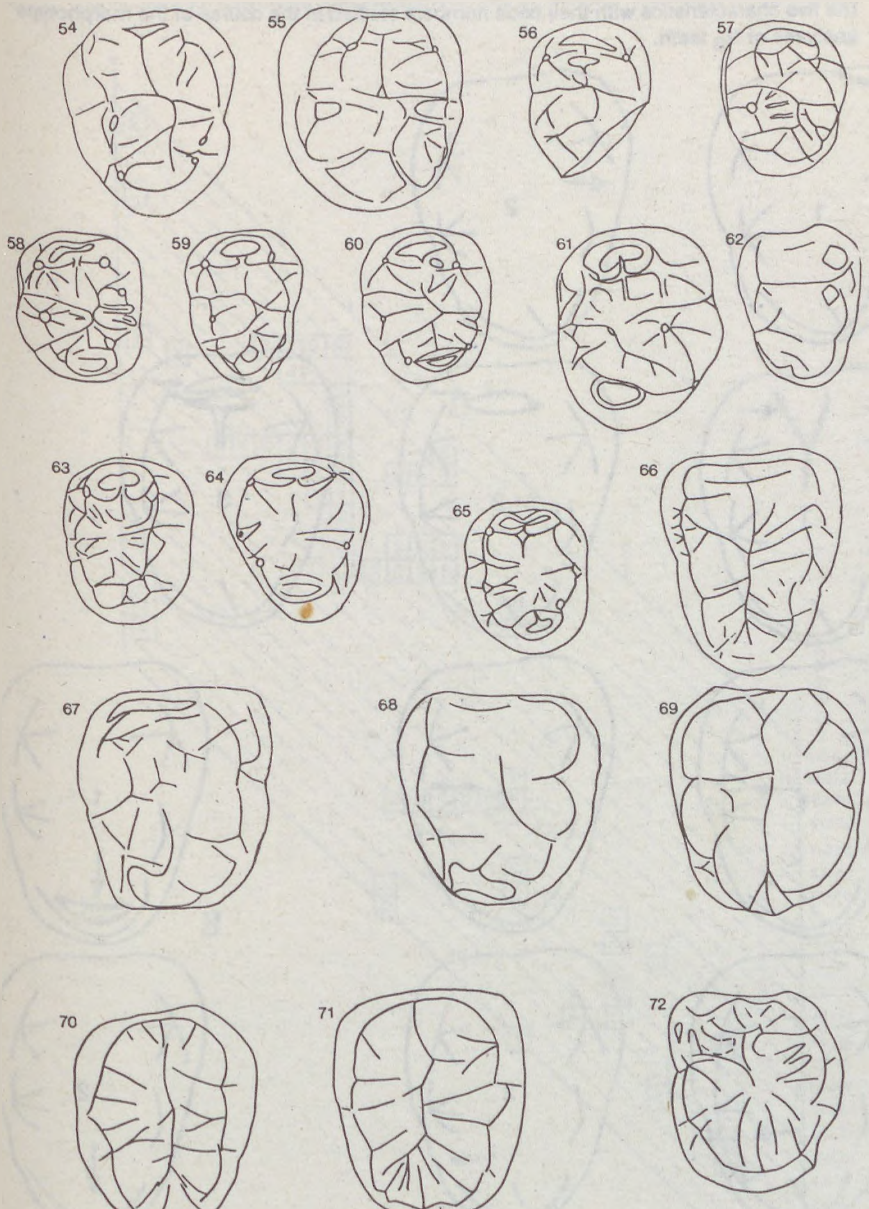
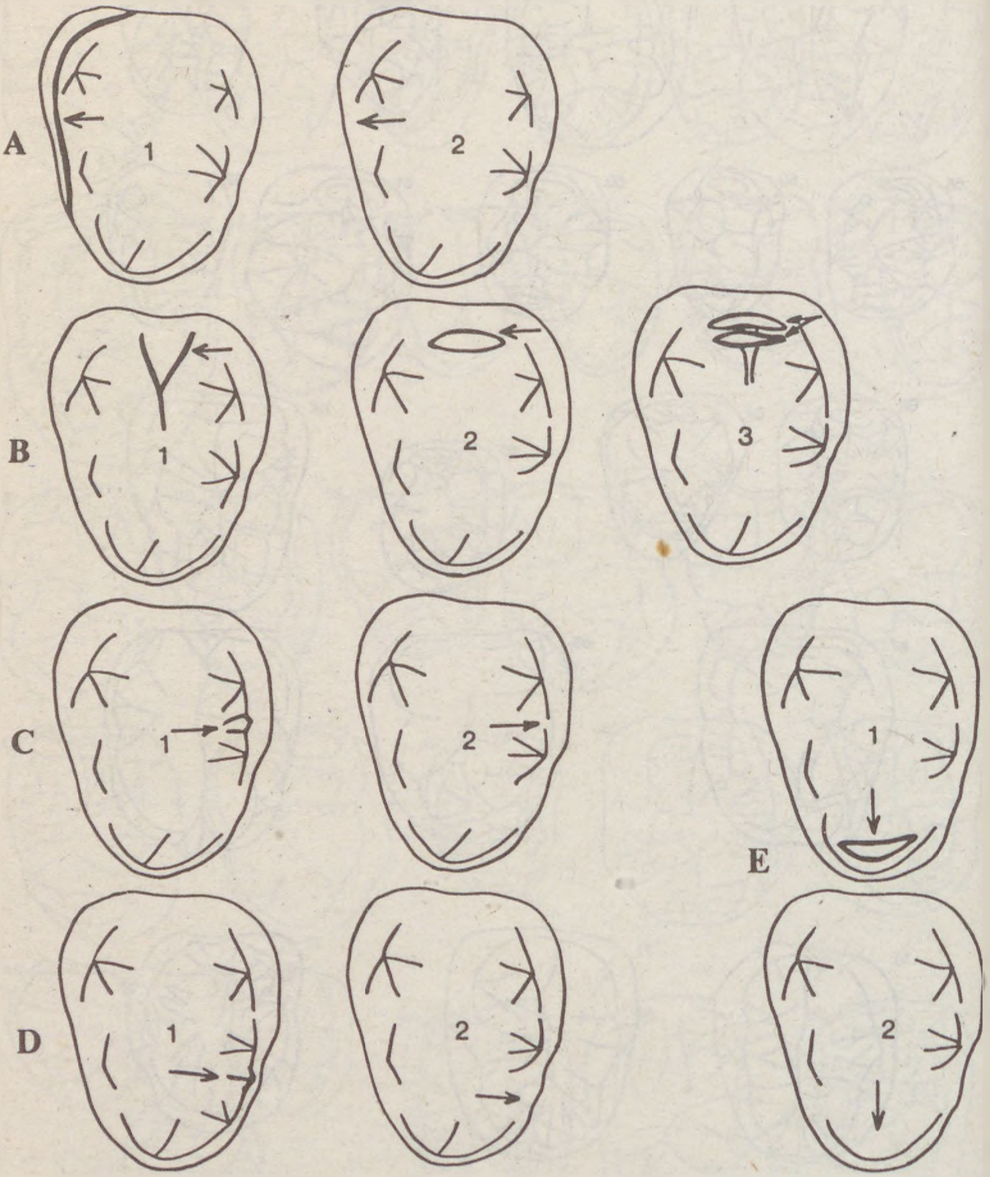


Fig. 1c

Fig. 2 The five characteristics with their code numbers studied in the course of the morphotype analyses of M_3 teeth.



A = cingulum present (1) or absent (2)
B = fovea anterior missing (1) there is one (2), there are two (3)
C = extra conulus between the meta- and entoconid: present (1) absent (2)
D = extra conulus between the entoconid and hypoconulid: present (1) absent (2)

Fig. 3 The five-character morphotypes of the analyzed Hominoids and Hominids according to their chronological position

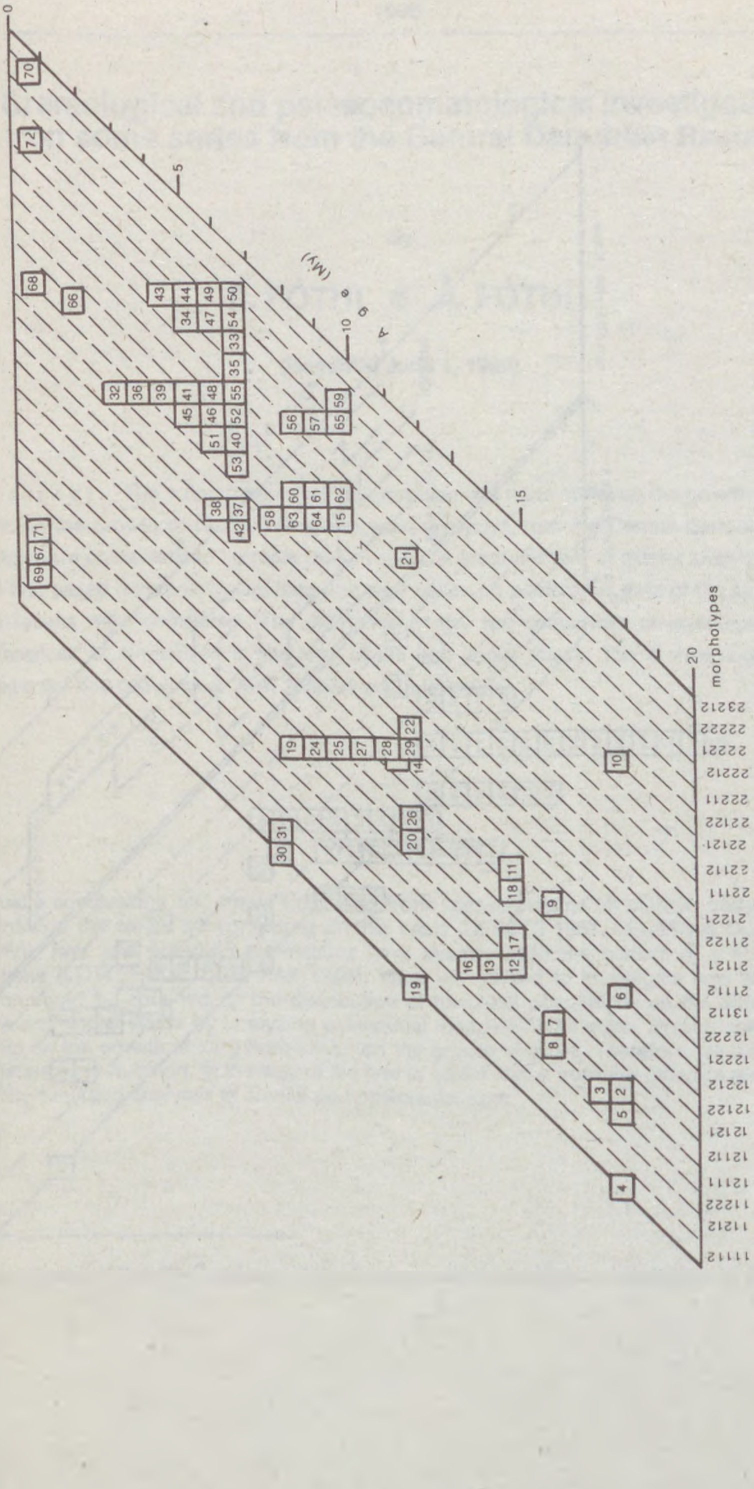
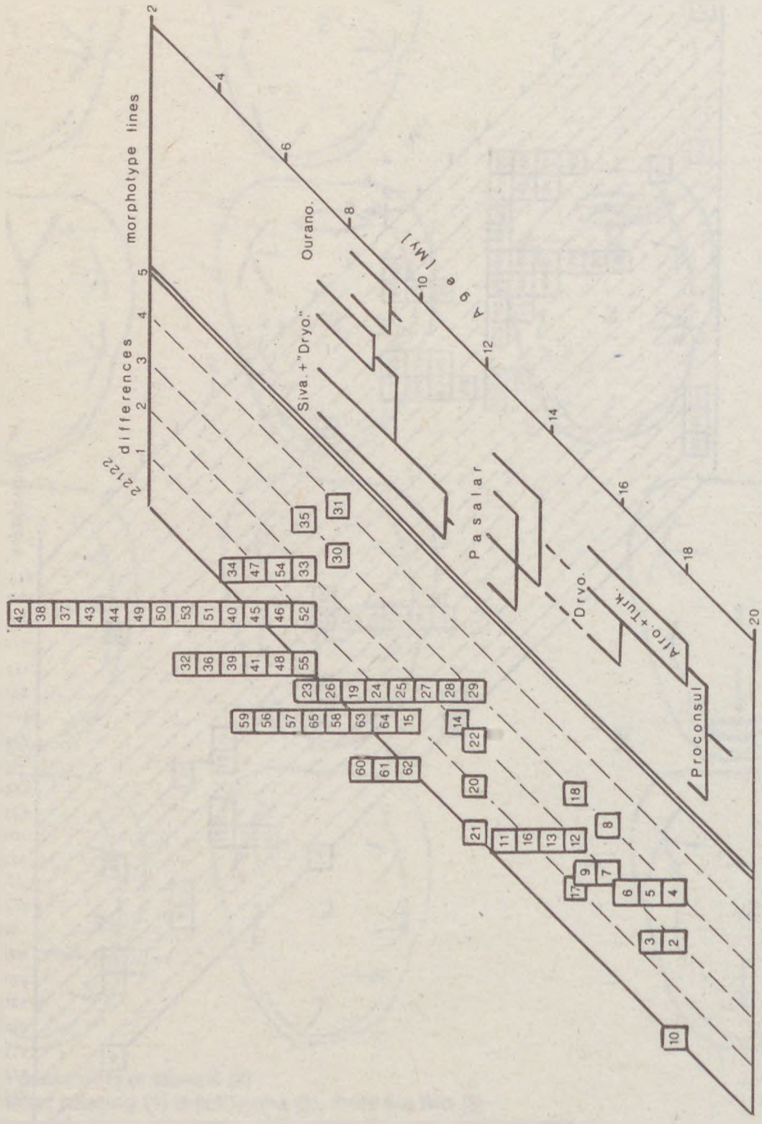


Fig. 4 The number of the characters the other populations differ from the predominant morphotype of the M_3 of Siwalik (22122). On the right side the supposed phylogenetic relations are shown based on morphotype analyses (more details in the text).



A N T H R O P O L O G I A   H U N G A R I C A
XXI. 1990 p. 25-32

Craniological and palaeosomatological investigation on some series from the Central Danubian Basin*

By

E. FÓTHI & Á. FÓTHI

(Received June 1, 1990)

A b s t r a c t . The authors assumed that nutrition has more effect on the growth of long bones than on the growth of skulls. Ten series were analyzed from the Central Danubian Basin. The series were characterized by male mean values. A great number of cluster analyses was carried out first based on craniological data and later based on postcranial data of the same series and the results were compared. The difference of the two sequences of investigation indicated differences or similarities in the way of life and social status. The archaeological data also supported this conclusion. With 3 tables and 2 figures.

INTRODUCTION

Usually conclusions are drawn from long bone measurements on stature, body weight, body proportions and the series are compared on this basis (DEBETS 1967, DEBETS & DURNOVO 1971, TÓTH 1986). Avar and Arpadian populations have already been the subject of a number of such investigations (LOTTERHOF 1976, PAP 1986). What we wanted to investigate was what additional information could be obtained on the distribution of historical populations on the differences of the way of life and social status by analyzing postcranial measurements alone. Presumably nutrition has more effect on the growth of long bones than on the growth of skulls. Therefore, we can conclude on some differences in nutrition, in the way of life and in social status from the different results produced by parallelly executed analyses of cranial and postcranial data.

* Paper presented at the 6th Congress of the European Anthropological Association in Budapest, 1988.

MATERIAL AND METHODS

Comparative analyses were carried out on the material of ten series excavated in the Central Danubian Basin (Fig. 1). The first eight series belong to the Avar period, the last two are Arpadians. The same cluster analyses were executed with three different data sets. The series were characterized by male mean values. The first series of examinations was based on 9 skull measurements (MARTIN 1, 5, 8, 9, 17, 45, 48, 52, 54). Craniological mean values were taken from the original publications (Table 1). The next sequence of examinations was based on 6 long bone measurements (MARTIN Humerus 1, 7, Femur 1, 8, Tibia 1, 10b). Postcranial mean values of the Avar samples were taken by FÓTHI while those of the Arpadian Age series were also utilized from the original publications (Table 2). In general examinations were based on the data of right-hand side long bones. At the end postcranial indices were applied for the same purpose (robusticity indices of humerus, femur and tibia). Stature and body weight were calculated according to the formula of DEBETS & DURNOVO (1971). Finally, the so-called Livi index was also calculated. (Table 3).

The ever present problem of historical anthropology emerged: the application possibilities of multivariate statistical methods for relatively small samples. As cranial and body constitution can be described only with a large number of measurements, we had to adhere to the use of a large number of variables.

Hierarchic cluster analysis was applied for classifying the series. The essence of our method of analysis is to execute a great number of different nature hierarchic cluster analyses that can check up and complement each other. We did not apply the usual statistic methods for establishing joining links among population groups - because of the small number of samples and the great number of variables. We accepted only those results which kept on occurring in the various cluster analysis dendograms as a tendency. The dendograms were analyzed with special attention to the nature of the methods applied.

Four different types of distance were utilized: Euclidean, Minkowski, Chebisev (or Maximum) and Mahalanobis (DURAN & ODELL 1974). Cluster distances were also established in four different ways: nearest neighbour, furthest neighbour, group average and centroid methods (JAMBU & LEBEAUX 1983). The data were either transformed in the 0-1 interval or standardized (expectable value 0, spread 1). Approximately two hundred cluster analyses were performed. We introduce some of them in brief.

RESULTS

Distribution of the series analyzed is shown in Figure 1. We wanted to get answers for two questions:

1. Are there any regional differences among the samples?

2. How do the results of the analysis of postcranial absolute measurements and indices coincidence with those of cranial analysis?

The first series of examinations was based on 10 skull measurements. When applying 0,1 data transformation, nearest neighbour method and Euclidean distance we obtained two groups (Fig. 2a). The same dendrogram occurred with Minkowski distance and the same again with the Maximum distance (Fig. 2b) which is completely different from the previous ones.

The next series of clustering was based on the same data but was produced by an absolutely different strategy. It was the furthest neighbour method with Euclidean (Fig. 2c), Minkowski and Maximum methods (Fig. 2d). These dendrograms presented a surprising coincidence of results. Dendograms made by group average and centroid methods produced no new results when compared to the previous ones. All of them concurred with some of the figures already presented. When transforming data by standardization we arrived at the same results again. Based on them we may say that Homokmégy, Üllő I and II formed a closed homogeneous group. Series 1 (Alattyán) was loosely connected to them. Fészerlak, Környe, Szabolcs, Toponár and Tiszalök made up another coherent, though looser cluster. Tiszavasvári was markedly different from the others.

At this point we could accept this configuration of series as a well-founded one but the indefinite results yielded by the Mahalanobis distance made us to carry out some further examinations.

The number of variables was reduced to four (MARTIN 1, 8, 17, 48) and we have redone the previous series of analysis. Quite independently from the data transformation, distance measure and the group distance used the same results occurred again. The dendrograms produced by Mahalanobis distance with Minkowski (Fig. 2e) and Maximum methods (Fig. 2f) were essentially the same as all the others. But taking into account the relatively small number of elements and the large number of variables it was not a surprise. We had no reliable variance-covariance matrix (VAN VARK 1984). The variance-covariance matrix estimated on the basis of the present sample contains a good number of uncertainties that decreases with the reduction of the number of variables.

In the next step we tried to establish what kind of information could be derived from the analysis of long bone measurements. Applying standardized data, group average method, Minkowski (Fig. 2g) and Maximum distances (Fig. 2h) it is obvious that six series are in a group. Series 1 and 10 form another loose but characteristic group. The position of series 5 (Tiszavasvári) seems to be peculiar both in cranial and in postcranial analyses. But it is not a surprise because Tiszavasvári was an early Avar population. The separate standing of series 6, Toponár, deserved attention. On the basis of craniological clusterings Toponár is similar to the Transdanubian series and Arpadian ones. Archaeological finds indicated remarkably different social standing for these cemeteries. For example Fészerlak consisted of poor common people while Toponár was the burial place of a privileged Avar noble community and its servants. This difference was also evident in the long bone measurements. Toponár was characterized by the longest and most developed postcranial material of the whole sample.

At the end some words about the application possibility of the postcranial indices. Certain characteristics of the populations could be read out from these when presenting them in a linear way. The main virtue of indices - especially indices of stature and body weight - is their descriptiveness. However, postcranial indices neither separately nor together seem to be able to serve as a basis for the classification of populations. Cluster analyses carried out according to postcranial indices produced the possible widest variations of results.

DISCUSSION

We know all too well that it is very hard to establish validity of cluster analysis. Nevertheless, by utilizing the great number of hierarchic cluster analyses of different nature that can supplement and check up one another, some markedly outlined conclusions could be drawn even from relatively small samples.

When answering the questions put at the beginning we state that there are regional differences among the samples analysed. We found two characteristic groups. One of them is made up by the three Transdanubian and the two Arpadian samples. The other group contains three samples from the region between the rivers Danube and Tisza. Series 1 (Alattyán) was loosely connected to them. Tiszavasvári did not belong to any groups.

Skull measurements presented a more characteristic image than long bone measurements did. Populations living under similar social conditions were relatively closer to each other in their body constitutions than in cranial configurations. On the other hand populations leading different way of life were more markedly classified by their body constitutions than by their cranial configurations. The differences between the results of cranial cluster analyses and those of postcranial ones seem to indicate the differences in the way of life and diets. It seems to be the case even when archaeological finds do not produce clear evidences for it.

REFERENCES

DEBETS, G.F.(1967): Essai de determination du poids des hommes vivants d'apres les dimensions des os longs. - VII[e] Congr. Int. des Sci. Anthrop. et., Moscou, 3 aôut 1964, II. 243-250.

DEBETS, G.F. & DURNOVO, Y.A. (1971): Long bones from Eneolithic burial grounds in Turkmenia (in Russian). - Sov. Etnogr., 1: 26-35.

DURAN, B.S. & ODELL, P.L. (1974): Cluster analysis (A Survey). - Springer Verlag, Berlin, Heidelberg, New York: 137 pp.

FÓTHI, E. (1988): The anthropological investigation of the Avar-age cemetery of Fészerlak. - Anthrop. hung., 20: 31-53.

JAMBU, M., & LEBEAUX, M-O. (1983): Cluster analysis and data analysis. - North-Holland Publishing Company, Amsterdam, New York, Oxford: 322 pp.

LIPTÁK, P. (1955): Recherces anthropologiques sur les ossements avares des environs d'Üllő. - Acta Archaeol., 6: 231-316.

LIPTÁK, P. (1957): La population de Homokmégy-Halom dans l'époque des Avars. - Anthrop. közl., 4: 25-42.

LOTTERHOF, E. (1974): Some data to the anthropology to the population of North Plain in the Arpadian Age. - Anthrop. hung., 13: 87-122.

LOTTERHOF, E. (1976): On the problem of gracilization in the Central Danubian Basin, I. - Annls hist.-nat. Mus. natn. hung., 68: 323-332.

PAP, I. (1982): Anthropological investigation of the Arpadian Age population of Szabolcs-Petőfi utca. - Anthrop. hung., 17: 65-107.

PAP, I. (1986): Some data on the palaeosomatology of 10-12th century Hungarians. - Annls hist.-nat. Mus. natn. hung., 78: 329- 337.

TÓTH, T. (1971) The cemetery of Környe (6th-7th c.). - In: Salamon, A. & Erdélyi, I., Das völkerwanderungszeitliche Gräberfeld von Környe. Studia Arch. V., Academic Press, Budapest, pp. 153-184.

TÓTH, T. (1986): Homo sapiens' groups in the Palaeometallic and Neometallic biosphere. - Annls hist.-nat. Mus. natn. hung., 78: 319-328.

VAN VARK, G.N. (1984): On the determination of Hominid affinities. - In: W.W. Howells & van Vark, G.N. (eds), Multivariate statistical methods in physical anthropology - P. Reidel Publishing Company. Dordrecht, Boston, Lanchester: 433 pp.

WENGER, S. (1952): Contributions a l'anthropologie des avars en Hongrie (le cimetière d'Alattyán - Tulát). - Annls hist.-nat. Mus. natn. hung., 2: 205-212.

WENGER, S. (1972): Anthropological examination of the osteological material deriving from the Avar period cemetery at Tiszavasvári (Hungary). - Anthrop. hung., 11: 5-81.

WENGER, S. (1974): On the anthropological problems of the Avar-age populations in the Southern Transdanubia (in Hungarian) - Anthrop. hung., 13: 5-86.

Authors' addresses:

DR. ERZSÉBET FÓTHI
Anthropological Department
Hungarian Natural History Museum
Budapest, Bajza u. 39.
H-I062
HUNGARY

DR. ÁKOS FÓTHI
Eötvös Loránd University
Budapest, Bogdánfy utca 10.
H-1117
HUNGARY

Table 1 Skull measurements of the series

Series	MARTIN N° 1	5	8	9	17	45	48	52	54
1. Tiszavasvári (WENGER 1972)	181.8 (21)	105.0 (6)	147.9 (20)	101.1 (19)	141.7 (6)	142.3 (6)	73.5 (15)	35.6 (11)	27.1 (10)
2. Környe (TÓTH 1971)	187.2 (8)	106.9 (8)	137.7 (8)	94.9 (14)	135.8 (8)	129.6 (6)	68.6 (14)	32.4 (14)	25.1 (14)
3. Üllő I. (LIPTÁK 1955)	181.8 (54)	100.2 (23)	143.8 (52)	95.4 (45)	130.3 (23)	132.6 (33)	71.6 (43)	32.8 (40)	25.6 (36)
4. Üllő II. (LIPTÁK 1955)	181.5 (28)	100.0 (19)	144.8 (27)	98.1 (27)	130.0 (19)	134.2 (23)	69.9 (23)	31.6 (26)	25.32 (21)
5. Alattyán (WENGER 1957)	185.4 (97)	101.7 (48)	147.7 (106)	98.5 (110)	130.5 (61)	136.4 (68)	69.4 (89)	34.1 (88)	26.4 (87)
6. Fészerlak (FÓTHI 1988)	184.5 (33)	102.8 (32)	138.4 (35)	97.4 (35)	136.8 (32)	133.9 (26)	68.9 (32)	32.1 (34)	24.7 (34)
7. Toponár (WENGER 1974)	188.0 (31)	102.6 (29)	139.9 (32)	98.3 (29)	137.7 (30)	133.7 (19)	69.3 (27)	34.4 (26)	25.7 (24)
8. Homokmégy (LIPTÁK 1957)	181.9 (32)	100.9 (30)	145.2 (33)	97.4 (36)	133.2 (30)	134.3 (29)	72.2 (31)	33.1 (35)	25.0 (33)
9. Tiszafüred (TÓTH, unpubl.)	183.5 (11)	105.2 (10)	138.9 (11)	97.3 (11)	137.2 (10)	135.9 (10)	72.2 (11)	32.9 (11)	24.6 (11)
10. Tiszalök (LOTTERHOF 1974)	187.7 (27)	106.2 (13)	140.8 (27)	100.8 (28)	138.3 (17)	128.4 (5)	69.2 (12)	33.2 (21)	24.4 (15)
11. Szabolcs (PAP 1981)	183.1 (23)	101.7 (16)	139.2 (22)	96.2 (24)	133.0 (18)	134.1 (9)	69.9 (16)	32.6 (17)	24.6 (19)

Figure 1 Geographical distribution of the series. The sequence of the series is the same as in Table 1

Table 2 Absolute measurements of long bones

Series	MARTIN Nº					
	H1	H7	F1	F8	T1	T10b
1. Tiszavasvári* (6-7th c.)	329.4 (5)	67.2 (9)	438.3 (6)	91.4 (9)	351.4 (5)	77.8 (11)
2. Környe* (6-7th c.)	335.0 (3)	62.7 (6)	461.0 (6)	89.1 (7)	368.6 (8)	73.9 (9)
3. Üllő I.* (7-8th c.)	328.4 (4)	62.5 (13)	446.5 (12)	88.1 (14)	355.4 (5)	71.4 (11)
4. Üllő II.* (7-8th c.)	331.9 (8)	63.6 (15)	438.8 (20)	88.8 (21)	357.2 (10)	71.2 (18)
5. Alattyán* (7-8th c.)	325.1 (62)	65.9 (69)	445.9 (77)	90.9 (77)	359.2 (69)	73.7 (76)
6. Fészerlak* (8th c.)	331.5 (21)	63.1 (28)	447.8 (27)	89.3 (25)	368.0 (20)	73.2 (30)
7. Toponár* (8th c.)	332.1 (26)	63.7 (34)	461.4 (34)	90.8 (33)	379.6 (29)	74.9 (30)
8. Homokmégy* (8-9th c.)	325.4 (19)	63.7 (21)	448.7 (25)	88.6 (27)	361.2 (17)	72.9 (20)
9. Tiszafüred** (10th c.)	330.6 (23)	66.3 (28)	453.0 (23)	90.8 (27)	367.6 (22)	76.6 (28)
10. Tiszalök*** (11th c.)	326.8 (21)	65.3 (23)	451.7 (18)	91.0 (19)	365.6 (15)	76.1 (18)
11. Szabolcs** (10-12th c.)	326.8 (12)	63.5 (41)	459.6 (20)	87.7 (45)	369.2 (15)	72.5 (45)

* FÓTHI unpublished, ** PAP 1986, *** LOTTERHOF 1976

Table 3 Stature, body weigth and postcranial indices

Series	Stature	Weight	Livi index	Humerus 7:1	Femur 8:2	Tibia 10b:1
1. Tiszavasvári* (6-7th c.)	164.8 (9)	66.3 (6)	24.5 (6)	20.3 (5)	20.8 (6)	21.1 (5)
2. Környe* (6-7th c.)	168.9 (9)	63.1 (5)	23.4 (5)	18.7 (3)	19.9 (6)	20.2 (8)
3. Üllő I.* (7-8th c.)	166.1 (10)	56.7 (4)	23.3 (4)	19.3 (4)	20.0 (12)	20.0 (5)
4. Üllő II.* (7-8th c.)	165.2 (15)	62.7 (9)	23.9 (9)	19.3 (8)	19.8 (20)	20.1 (10)
5. Alattyán* (7-8th c.)	165.8 (72)	64.2 (69)	24.1 (68)	20.2 (62)	20.5 (77)	20.5 (69)
6. Fészerlak* (8th c.)	167.1 (24)	62.3 (17)	23.7 (17)	18.9 (21)	20.0 (22)	20.0 (23)
7. Toponár* (8th c.)	170.7 (31)	65.2 (26)	23.8 (26)	19.2 (26)	19.8 (33)	19.8 (29)
8. Homokmégy* (8-9th c.)	166.9 (23)	63.1 (19)	23.9 (19)	19.7 (19)	20.0 (25)	20.6 (17)
9. Tiszafüred** (10th c.)	170.9 (22)	69.5 (22)	24.1 (22)	20.0 (23)	20.2 (22)	20.7 (22)
10. Tiszalök*** (11th c.)	166.8 (13)	65.4 (13)	24.2 (13)	20.0 (21)	19.4 (18)	20.8 (15)
11. Szabolcs** (10-12th c.)	168.9 (12)	64.1 (12)	23.7 (12)	19.3 (12)	19.7 (20)	19.7 (15)

* FÓTHI unpublished, ** PAP 1986, *** LOTTERHOF 1976

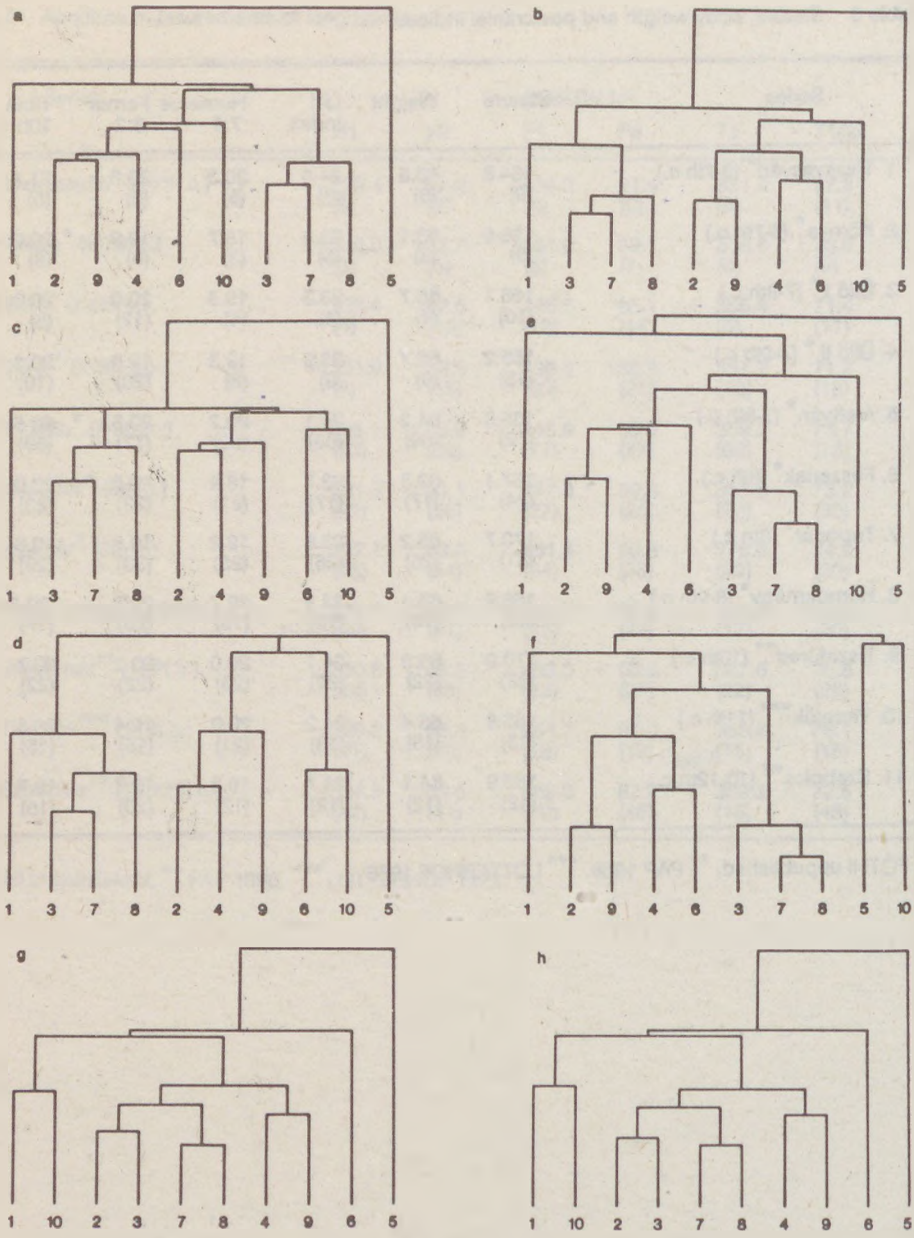


Figure 2 Dendrograms produced by different types of clustering (for details see text)

ANTHROPOLOGIA HUNGARICA
XXI. 1990 p. 33-53

Anthropological studies on an early Avar period population at Bačko Petrovo Selo (Yugoslavia) Part 2: Analysis of the data

by

K. ÉRY

(Received June 24, 1990)

Abstract. The present study gives a short analysis of an Avar age population from the turn of the 6th/7th centuries. With 12 tables and 8 plates.

MATERIAL AND METHODS

The Archaeological Department of the University of Beograd has completely unearthed, under the leadership of Prof. Jovan KOVAČEVIĆ, a cemetery from the early Avar period at Bačko Petrovo Selo (Péterréve, Vojvodina), on the banks of Csík-ér. The bone remains of 100 individuals could be preserved from the 137 graves. The garchaeological and anthropological finds of the cemetery were deposited in the collection of the Municipal Museum and Gallery of Bečej.

The skeletal measurements of the adults have been published in the previous volume of Anthropologia hungarica (ÉRY 1988). This paper gives a short analysis of the data.

Age determination was made according to the 'Recommendations' by FEREMBACH & al. (1979). 22 features were used for sex definition according to the ÉRY, KRALOVÁNSZKY & NEMESKÉRI (1963) method. The analyses were based on the mean sigmas and class-categories by ALEKSEEV & DEBETS (1964). Distance analysis was made by the PENROSE (1954) method using ten measurements of the skull (MARTIN 1, 8, 9, 17, 40, 45, 48, 51, 52, 54) and then standardized according to THOMA's mean sigmas (1978).

AGE AND SEX FEATURES

The basic age and sex data of the individuals can be read from Table 1. Their distribution according to age groups and sex is given in Table 2, while 22 sexual features of males and females are listed in Table 3. In the light of the above data the sample can be characterized in the following:

a/ The number of 0-year-old individuals is disproportionally low among the unearthed skeletons (3%). It means that the graves of the deceased infants were either destroyed, or they were not buried in the cemetery. A further 45, altogether 48 dead infants should have been present in the cemetery if the number of 0-year-old individuals was reconstructed according to the 5th level of the Eastern type mortality model of COALE & DEMÉNY (1964) (there the life expectancy at birth is 28.6 years).

b/ The number of women exceeds that of men by 42% among the adults. This rate may be explained by the fact that much more women died between 15 and 24 years than expected. In an exogamous marriage system women who died due to perinatal diseases, were soon replaced by others. This way the sex ratio of the living population should be in balance, while at the same time the ratio of the women buried in the cemetery was disproportionally raised.

METRIC AND MORPHOLOGICAL FEATURES

The parameters of measurements and indices of the female and male skulls can be read in Tables 4 and 5, while those of the skeletal bones in Table 6.

There is no significant discrepancy between the two sexes regarding their mixture according to the standard deviation values. The average standard deviation of 38 skull measurements of males is 7.56, that of females is 6.61. The average standard deviation of 56 skeletal measurements is 8.69 in case of males, 7.05 in case of females. A greater than 1% standard deviation of significance was found with the greatest width (M 8) and skull index (M 8:1) of males and with the skull index of females.

The majority of the 13 length measurements of the skull fell within the 'medium' range with both sexes. The 'long' class contained only the neurocranium, the base of the skull, the maxilla, the palate and the jaw of males and only the palate of females. The majority of the 13 width measurements of the skull belonged to the 'wide' range with males, and to the 'medium' class with females. Most of the 6 height measurements fell within the 'medium' class with both sexes. 'Low' average value was found mostly on the upper face with both sexes. Accordingly, the skulls of the Bačko Petrovo Selo population belong to the medium and long, medium and wide, medium and low categories, as far as the measurements are concerned. The cranium is medium long and low (mesocran, chamaecran), the upper face is wide and low (euryen, chamaekonch) according to the indices.

The body height, calculated according to PEARSON's method, was 'medium' in average with both sexes, though there is a high stature male group, too.

The morphological features of skulls are given in Table 7. Starting from the sexes it can be said that the majority of the examined 13 features show either identical frequency, or such a discrepancy which is a natural indication of sexual dimorphism. The only thing worth mentioning is the greater frequency of alveolar prognatism with females, which may reveal taxonomic differences of the two sexes.

The anomalies of some non-metric features of the skeleton are displayed in Table 8. We may add that the frequency of sutura metopica is 7.7% (2/26) with children above 2 years, and it is 7.1% (6/84) compared to the whole of the population. It can also be read from the table that the examined features of the humerus and the femur are more frequent on the left side, as revealed by the combined values of the two sexes.

Furthermore the material contained os incae bi- or tripartitum, os bregmaticum, os japonicum, condylus tertius stem, torus mandibularis, 13 dorsal and 4 lumbal vertebrae.

Special attention is to be given to the extremely high frequency of spondylolysis in the population of Bačko Petrovo Selo. As it has already been described in details, I would like to present only its frequency in 4th to 17th century series published since that time in East Central Europe (ÉRY 1974).

The frequency of the anomaly in Bačko Petrovo Selo held its first place even when compared to 17 other series, as it can be seen in Table 9. The sexual divergence of the anomaly is the only difference from the material known till 1974. Namely, spondylolysis is more frequent with females than with males in the majority of the analyzed series. The causes of spondylolysis are manifold. The Bačko Petrovo Selo material seems to support that the greater loading of the vertebrae is one of them. This population belonged to the first two generations of the mounted nomadic Avar population arriving in the Carpathian Basin from the East. Consequently, riding must have played an important role in their way of life.

TAXONOMICAL SKETCH

The specific combination of features made the taxonomical grouping of the population possible only in a broader sense. 75% of the examined individuals belong to the dolicho-mesocran Europoid group, characterized mostly by low (chamaecran) crania, low and broad faces, protruding noses, angular orbits, and relatively gracile jaws (Table 10). Their stature ranged from short to tall (Plate 1: male, Grave N° 51; Plate 2: male, Grave N° 78; Plate 5: female, Graves N° 129; Plate 6: female, Grave N° 46/a). There is a smaller group of Europoid brachycran individuals (Plate 3: male, Grave N° 37; Plate 7: female, Grave N° 86). There are also two protomorphic persons with slight Andronovo features among the males (Plate 4: male, Grave N° 44). Mongoloid features could be noted only on three females and one child. (Plate 8: female, Grave N° 134).

PATHOLOGY

Macroscopically observable pathological changes are rare and they are not really severe.

Fractures were found on two males (one on a rib, the other one on the collar-bone) and on two females (one on the ulna, and another on a rib). Contused skull wounds could be detected on two males, 6 females and one infant.

Articular deformations (spondylosis, arthrosis deformans) were present on two thirds of the males and on nearly half of the females in slight or moderate forms. Deformation of the hip joint (luxatio coxae congenita) was present on three females.

Premature ossification of the sagittal suture could be detected on two infants and on two males. The right side sutura squamosa of a woman totally disappeared in the parietal bone as if no independent temporal bone would have existed.

Osteoporosis of both parietal bones of one child and cribra orbitalia of one 4-year-old child indicate blood disorders.

Renal calculus was found among the bones of a juvenile woman. It is 38 x 38 mm large, its surface is rough.

Caries could be seen on the teeth of 1.1% of males (5/441), and of 5.9% (30/514) of females. There was no caries on deciduous teeth. The frequency of tooth loss during the lifetime was 10.1% with males (79/715) and 15.6% (158/1012) with females. Abscessus could be observed on the maxilla or the mandible of 5 males and 9 females.

ANALOGIES OF THE POPULATION

The origin of the cranial form of the Bačko Petrovo Selo population could be detected with the help of PENROSE distance analysis (1954). The analysis was made only on males. However, it is valid for the entire population, since the features of males and females do not differ essentially.

85 series were treated in the comparative analysis based on ten measurements of the skull. The Avar period (6th to 8th centuries) was represented by 30 samples, the Merovingian period (5th to the 8th centuries) by 8 samples, the Frankish-Slavic period (9th century) by 7 samples, ad the population from the territory of the USSR (7th century B.C. to the 10th century A.D.) by 40 samples (Table 11).

By the results of the analyses the Bačko Petrovo Selo population is totally different from the Avar population of the Carpathian Basin known until now, regarding the 1% significance limit ($Cp^2 < 0.198$), and bears resemblance to only two of the 85 series. These two series represent the Sauromatian - Sarmatian period (700 B.C. to 200 A.D.) and culture in archaeological sense, the population of West Kazakhstan and partly that of the area between the Lower Volga and the South Ural (Table 12). Accordingly it seems to be justified, that the Bačko Petrovo Selo population appearing in the southern part of the Great Plain of the Carpathian Basin in the last third of the 6th century and displayed the culture of the early Avars, came from the above defined territory. In this respect the anthropological analysis of the Bačko Petrovo Selo population yielded valuable information on population history, as well.

SUMMARY

The mounted nomadic population appearing on the southern edge of the central plain of the Carpathian Basin around 570 A.D., must have been a descendant of the Sauromatian-Sarmatian population of the West Kazakhstani steppe. According to the archaeological finds they used their cemetery until 630, i.e. for two or three generations.

Men and women had similar appearances. Most of them belonged to the Europoid great race with long or medium long and low skulls, with low and broad faces, with protruding noses, with medium, sometimes high statures. Their health status was satisfactory. A greater mortality rate could be established for young women, probably due to perinatal complications. The most frequent anomaly is the spondylolysis on the lumbar vertebrae in this population, possibly as a result of an equestrian way of life.

The total of the anthropological features of the Bačko Petrovo Selo population is different not only from the contemporary population of the Carpathian Basin of the 6th to 7th centuries, but also from that of the population of the 8th to 9th centuries. Consequently it may be supposed, that populations of similar features, which came to the Carpathian Basin during the Avar period, did not represent great masses.

A c k n o w l e d g e m e n t. I wish to express my sincere thanks to Ms Katalin SIMÁN for translating the text and to Mr Levente SZEPSI-SZÜCS for making the photos.

REFERENCES

AKIMOVA, M. S. (1964): Materialy k antropologii rannikh bolgar. - In: GENING, V. A. & KHALIKOV, A. H., Rannie bolgary na Volge - Moscow, pp. 177-196.

AKIMOVA, M. S. (1968): Antropologiya drevnego naselenija Priuraliya. - Nauka, Moscow, 118 pp.

AKIMOVA, M. S. (1973): Antropologicheskie materialy iz Tankeevskovo mogilnika. - Voprosy Antrop., 45: 15-29; see also: Studia archaeol. 1978 (Budapest), pp. 223-236.

ALEKSEEV, V. P. (1958): Paleoantropologiya Altaya epokhi zheleza. - Sov. Antrop., 1: 45-49.

ALEKSEEV, V. P. (1959): Antropologiua Saltovskovo mogilnika. - Kratkie Soobsch. Inst. Etnogr., 31: 86-87.

ALEKSEEV, V. P. (1961): Paleoantropologiya Chakassy epokhi zheleza. - Sbornik Mus. Antrop. Etnogr., 20: 238-327.

ALEKSEEV, V. P. & DEBETS, G. F. (1964): Kraniometriya. - Nauka, Moscow, 128 pp.

BARTUCZ, L. & FARKAS, GY. (1957): Zwei Adorjáner Gräberfelder der Awarenzeit aus anthropologischem Geschichtspunkte Betrachtet. - Acta biol., 3: 315-347.

BOTTYÁN, O. (1975): Pókaszepetk kora-avarkori temetőjének antropológiai értékelése (Anthropologische Auswertung des Pókaszepetker Friedhofes aus der Frühawaren Periode). - Anthrop. hung., 14: 5-56.

COALE, A. J. & DEMÉNY, P. (1966): Regional Model Life Tables and Stable Populations. - Princeton Univ. Press, New York, XIII, 871 pp.

ÉRY, K. (1966): The osteological data of the 9th century population of Ártánd. - Anthrop. hung., 7: 85-114.

ÉRY, K. (1974): A spondylolisthesis gyakorisága egy avar kori populációban (Frequency of spondylolisthesis in a 6th century population from Yugoslavia). - Anthrop. közl., 18: 49-54.

ÉRY, K. (1981): Anthropologische Analyse der Population von Tokod aus dem 5. Jahrhundert. - In: Mócsy, A. (ed), Die spätrömische Festung und das Gräberfeld von Tokod. Academic Press, Budapest, pp. 223-263.

ÉRY, K. (1982): Balkáni eredetű török kori népesség csontmaradványai Dombóvár határából (The osteological remains of a Turkish Period Balkan population in the vicinity of Dombóvár). - Béri Balogh Ádám Múz. Évk. (Szekszárd), 10-11: 225-298.

ÉRY, K. (1985): Embertani vizsgálatok Tác-Margittelep késő római kori népességén (Anthropological studies on a late Roman Period population of Tác-Margittelep). - Manuscript

ÉRY, K. (1988a): Anthropological studies on an early Avar period population at Bačko Petrovo Selo (Yugoslavia). Part 1: Individual metric data - Anthrop. hung., 20: 55-66.

ÉRY, K. (1988b): Embertani vizsgálatok három 9. századi nyugat-magyarországi népességen (Anthropological investigations on three 9th century populations from West-Hungary). - Manuscript

ÉRY, K. (1989): Embertani vizsgálatok Zalakomár-Lesvári dűlő avar kori népességén (Anthropological studies on an Avar period population from Zalakomár-Lesvári dűlő). - Manuscript

ÉRY, K., KRALOVÁNSZKY, A. & NEMESKÉRI, J. (1963): Történeti népességek rekonstrukciójának reprezentációja (A representative reconstruction of historic population). - Anthrop. közl., 7: 41-90.

FABRIZII, S. & REUER, E. (1975-1977): Die Skelette aus dem frühmittelalterlichen Gräberfeld von Pitten, p. B. Neunkirchen. - Mitt. Präh. Kom. ÖAW, 17-18: 175-233.

FEREMBACH, D., SCHWIDETZKY, I. & STLOUKAL, M. (1979): Recommandation pour determiner l'âge et la sexe sur le squelette. - Bull. Mém. Soc. Anthrop., 13: 7-45.

FERENCZ, M (1980-1981): Some data to the palaeoanthropology of the Avar Period's population in Hungary. - Anthrop. hung., 17: 23-64.

FERENCZ, M. (1982-1983): The Avar-age cemetery at Solymár. - Anthrop. hung., 18: 9-41.

FIRSHTEIN, B. V. (1970): Sarmaty nizhnego Povolzhya v antropologicheskom osveshchenii. - In: TOT, T. A. & FIRSHTEIN, B. V., Antropologicheskie dannye k voprosu o velikom pereselenii narodov avary i sarmaty. - Nauka, Leningrad, 69-201.

FÓTHI, E. (1988): The anthropological investigation of the Avar-age cemetery of Fészerlak. - Anthrop. hung., 20: 31-53.

GINZBURG, V. V. & FIRSHTEIN, B. V. (1958): Materialy k antropologii drevnego naselenia Zapadnogo Kazakhstana. - Sbornik Mus. Anthrop. Etn., 18: 390-427.

GINZBURG, V. V. & TROFIMIVA, T. A. (1972): Paleoantropologiya Srednei Asii. - Nauka, Moscow, 371 pp.
HANÁKOVÁ, H. & STLOUKAL, M. (1966): Staroslovanské pohřebiště v Josefově. - Rozpravy ČAV, 76: 1-57.
HANÁKOVÁ, H., STLOUKAL, M. & VYHNÁNEK, L. (1976): Kostry ze slovanski-avarského pohřebiště ve Virtu. - Sbornik Nár. Muz. v Praze, 32B: 57-113.
HANÁKOVÁ, H., STANA, C. & STLOUKAL, M. (1986): Velkomoravské pohřebiště v Rajhradě. - Nár. Muz. v Praze, 171 pp.
JAKAB, J. (1978): Antropologická analýza pohrebiska z 9-10. storočia v Nitre pod Zoborom. - Slov. Arch., 26: 127-148.
KASIMOVA, R. M. (1960): Antropologicheskie issledovania cherepov iz Mingechaura. - Nauka, Baku, 133 pp.
KONDUKTOROVA, T. S. (1972): Antropologiya drevnego naselenia Ukrainy. - Nauka, Moscow, 154 pp.
KONDUKTOROVA, T. S. (1977): Scythian descendants on the Lower Dnieper-River according to the anthropological material from the Nikolaevka-Kazatskoe cemetery. - Antropologie (Praha), 15: 185-232.
KONDUKTOROVA, T. S. (1984): Paleoantropologicheskie materialy iz Mayatskogo mogilnika. In: PLETNEVA, S. A. (ed), Mayatskoe gorodishche. - Nauka, Moscow, pp. 200-236.
KŐHEGYI, M. & MARCSIK, A. (1971): The Avar-age cemetery at Sükösd. - Acta ant. et arch., 14: 87-94.
LEBZELTER, V. (1957): Beschreibung der Skelettreste von Tiszaderzs. - Crania hung., 2: 3-59.
LIPTÁK, P. (1954): Kecel-környéki avarok (Les avares environs de Kecel). - Biol. közl., 2: 159-180.
LIPTÁK, P. (1955): Recherches anthropologiques sur les ossements avares des environs d'Üllő. - Acta arch. hung., 6: 231-316.
LIPTÁK, P. (1957): Homokmégy-Halom avarkori népessége (La population de Homokmégy - Halom dans l'époque des Avars). - Anthrop. közl., 4: 25-42.
LIPTÁK, P. (1974): Anthropological analysis of the Avar-Period population of Szekszárd - Palánkpuszta. - Acta biol., 20: 199-211.
LIPTÁK, P. (1983): Avars and Ancient Hungarians. - Akadémiai kiadó, Budapest, 208. pp.
LIPTÁK, P. & MARCSIK, A. (1966): Szeged-Kundomb avarkori népességének embertani vizsgálata (An anthropological examination of the Avar-Age population of Szeged-Kundomb). - Anthrop. közl., 10: 13-56.
LIPTÁK, P. & VÁMOS, K. (1969): A 'Fehértó-A' megnevezésű avar kori temető csontvázanyagának embertani vizsgálata (Anthropologische Untersuchung des Skelettmaterials des awarenzeitlichen Gräberfeldes von 'Fehértó-A'). - Anthrop. közl., 13: 3-30.
PENROSE, L. S. (1954): Distance, Size and Shape - Annals of Eugenics, 18: 337-343.
RÖSING, F. W. (1975): Die fränkische Bevölkerung von Mannheim-Vogelstang (6.-7.Jh) und die Merowingerzeitlichen Germanengruppen Europas - Biol. Diss. (Hamburg), 248 pp.
ŠTEFANČIĆ, M. (1987): Anthropological analysis of the old Croat necropolis Nin-Ždrijac in reference to the Slav Settlement in the Balkans. - Sbornik Nár. Muz. v Praze, 18B: 131-139.
STLOUKAL, M. & HANÁKOVÁ, H. (1966): Anthropologie der Slawen aus dem Gräberfeld in Noyé Zámky. - Slov. Arch., 14: 167-204.
STLOUKAL, M. & HANÁKOVÁ, H. (1974): Antroplogický výzkum pohřebiště ze 7.-8. stoleti v Želovcích. - Slov. Arch., 22: 129-188.
STOUKAL , M. & VYHNÁNEK, L. (1976): Slováné velkomoravskych Mikulčic. - Akademia, Praha, 207 pp.
SZILVÁSSY, J. (1980): Die Skelette aus dem awarischen Gräberfeld von Zwölfaxing in Niederösterreich. - Anthrop. Forsch. (Wien), 3: 1-138.
THOMA, A. (1978): Distance et forme entre greupes. - Bull. Mém. Soc. Anthrop., 5, XIII: 15-22.
THURZO, M. (1969): Antropologicky rozbor kostrového pohrebiška 'Lupka' v Nitre. - Ac. rer. nat. Mus. nat. slov., 15: 77-153.
THURŽO, M. (1984): Metrische Merkmale der menschlichen Skelettreste aus dem slawisch-awarischen Gräberfeld (7.-9.Jh u.Z.) in Košice-Sebastovce (Bez. Košice-Stadt), Ostlowakei. - Acta insterdisc. arch., 3: 86-262.
TÓTH, T. (1962): Le cimetière de Csákberény provenant des débuts de l'époque avars (VI^{e} et VII^{e} siècles). - Annls hist.-nat. Mus. natn. hung., 54: 521-549.

VÁMOS, K. (1973): 'Szeged-Makkoserdő' avarkori népességének embertani vizsgálata (Anthropological examination of the Avar Age population at 'Szeged-Makkoserdö'). - Anthrop. közl., 17: 29-39.

VLADÁROVÁ-MOJZISOVÁ, S. & HANULIK, M. (1970): Die Kraniologie des slawisch-awarischen Gräberfeldes in Nové Zámky. - Acta Fac. rer. nat. Univ. Comen., Anthrop., 15: 191-211.

VYHNÁNEK, L. & STLOUKAL, M. (1977): Spondylolyse. Problematik und Vorkommen im altslawischen Knochenmaterial. - Studie ČSAV, 2: 1-123.

WENGER, S. (1966): Anthropologie de la population d'Előszállás-Bajcsihegy provenant des temps avars. - Anthrop. hung., 7: 115-206.

WENGER, S. (1968): Data to the anthropology of the Avar Period of Transdanubia. - Anthrop. hung., 8: 59-96.

WENGER, S. (1974): Déldunántúl avarkori népességének embertani problémái (On the anthropological problems of the Avar age population in the Southern Transdanubia). - Anthrop. hung., 13: 5-86.

WENGER, S. (1976-1977): Analyse anthropologiques de nouvelles découvertes de Keszthely (Transdanubie) provenant de l'époque avare. - Anthrop. hung., 15: 125-190.

ZINEVICH, G. P. (1971): K antropologii mogilnika vozle s Zavetnoe v Krymu. - Mat. Antr. Ukrainu, 5: 111-121.

ZINEVICH. G. P. (1973): Antropologicheskie materialy srednevekovykh mogilnikov yugo-zapadnogo Kryma. - Nauka, Kiev

Author's address: DR. KINGA ÉRY

Anthropological Department
Hungarian Natural History Museum
Budapest, Bajza utca 39.
H-1062
HUNGARY

Table 1 Individual sex and age data

Serial Nº	Grave Nº	Sex	Degree of sexuality	Number of sex traits	Age	Criteria of aging: O	S	H	F
1	8	M	+0.83	12	30-60	3	-	-	-
2	10	M	+0.16	12	40-80	4	-	-	-
3	16	M	+1.08	12	40-80	4	-	-	-
4	32	F	-1.00	2	23-x	-	-	-	-
5	34	M	+0.50	12	30-60	2	-	-	-
6	37	M	+0.63	22	50-54	4	3	2	2-3
7	38	Ch	-	-	2-3		dentition		
8	39	Ch	-	-	3-4		length of bones		
9	40	Ch	-	-	8-9		dentition		
10	41	Ch	-	-	1.5-2		length of bones		
11	42	Ch	-	-	7-8		dentition		
12	43	F	-0.83	12	53-59	1	-	3	3-4
13	44	M	+0.65	20	32-36	1	1-2	2-3	2-3
14	45	F	-0.91	12	55-61	1	4	-	4-5
15	46/a	F	-1.04	22	18-20		ossification		
16	46/b	Ch	-	-	2-3		dentition		
17	47	F	-0.85	20	50-54	3	3	2-3	2-3
18	48	Ch	-	-	1-2		length of bones		
19	49	M	0.00	14	37-46	1	3	-	-
20	50	F	-1.33	9	40-60	1	3	-	-
21	51	M	+0.95	21	37-43	2	2-3	-	2-3
22	52	Ch	-	-	8-9		dentition		
23	54	M	+0.80	21	46-50	4	2-3	2-3	2-3
24	55	F	-0.47	19	17-18		ossification		
25	56	Ch	-	-	0.5-1.5		dentition		
26	57	M	+1.13	22	51-55	3	3	3	2-3
27	58	CH	-	-	10-11		length of bones		
28	59	F	-0.21	19	64-70	5	-	4	4
29	60	F	-0.13	15	65-71	4	-	4	5
30	62	F	-0.20	5	50-54	2	3-4	3	3
31	63	Ch	-	-	1-2		dentition		
32	64	F	-0.4	22	30-34	1	2	1-2	2
33	65	F	-1.00	10	18-20		ossification		
34	66	Ch	-	-	7-8		dentition		
35	67	Ch	-	-	8-9		dentition		
36	68/a	M	+1.09	22	49-53	4	3	2	2
37	68/b	Ch	-	-	0-1		dentition		
38	69	M	+1.06	17	40-60	4	-	2-3	-
39	70	Ch	-	-	7-8		dentition		
40	71	M	+0.31	22	52-56	4	3	3	2-3
41	72	F	-0.68	22	45-49	1	3	2-3	3
42	73	Ch	-	-	6.5-7.5		dentition		
43	74	M	+1.26	19	66-72	5	4	3-4	4
44	76	F	-0.33	18	67-71	4	4-5	4	4-5
45	77	F	-0.83	18	19-21		ossification		
46	78	M	+0.59	22	40-44	3	2-3	2	2-3
47	79	M	+0.47	17	47-53	2	-	2-3	3
48	80	Ch	-	-	8-9		length of bones		
49	81	F	-0.42	22	56-60	4	3-4	3-4	4
50	82	M	+1.00	19	40-44	3	2-3	2	2-3

Table 1 (Continuation)

Serial Nº	Grave Nº	Sex	Degree of sexuality	Number of sex traits	Age	Criterions of aging O	S	H	F
51	83	Ch	-	-	4-5		dentition		
52	84	M	+0.05	17	17-18		ossification		
53	85	Ch	-	-	6-7		dentition		
54	86	F	-1.11	17	19-21		ossification		
55	87	Ch	-	-	0.5-1.5		dentition		
56	88	M	+0.57	19	49-53	4	3	2	2
57	90	F	-0.90	22	62-66	3	4	3-4	3-4
58	91	Ch	-	-	0.5-1.5		dentition		
59	92	F	-0.76	17	20-24		ossification		
60	93	F	-0.73	15	15-16		ossification		
61	94	F	-0.50	12	44-53	2	3	-	4
62	95	Ch	-	-	12-14		length of bones		
63	96	F	-0.33	15	48-52	1	3	3-4	4
64	97	F	-0.72	18	63-67	3	4	4	4
65	98	M	+0.80	21	51-55	3	3	2-3	3
66	99	F	-0.14	14	53-59	4	-	2-3	3
67	100	F	-0.60	15	52-56	3	3	3	3
68	101	Ch	-	-	0-1		dentition		
69	102	Ch	-	-	1.5-2.5		dentition		
70	103	M	+0.70	18	21-25	1	1	1	1
71	104	Ch	-	-	2-3		dentition		
72	105	Ch	-	-	3-4		dentition		
73	106	Ch	-	-	0.5-1.5		dentition		
74	107	M	+0.33	12	46-52	2	3	2	-
75	108	F	-0.89	19	60-64	2	4	4	3
76	109	Ch	-	-	10-12		dentition		
77	110	F	-0.04	21	66-70	5	4	3	4
78	111	Ch	-	-	12-14		dentition		
79	112	F	-1.18	22	54-58	4	3	3-4	3
80	113	Ch	-	-	newborn		dentition		
81	115	M	+0.40	22	42-46	4	3	2	2
82	116	Ch	-	-	3-4		dentition		
83	117	Ch	-	-	5.5-6.5		dentition		
84	118	F	-0.66	15	19-23		ossification		
85	119	F	-0.71	21	55-59	3	3-4	3	3
86	120	F	-1.11	18	67-71	4	4	4	4-5
87	121	Ch	-	-	1.5-2.5		dentition		
88	122	Ch	-	-	11-12		dentition		
89	123	M	+1.00	1	23-x	-	-	-	-
90	124	Ch	-	-	5.5-6.5		dentition		
91	125	Ch	-	-	6.5-7.5		dentition		
92	126	M	+0.50	14	49-55	3	3	2	-
93	127	F	-0.74	19	30-34	1	1	3	2
94	128	M	+1.00	5	35-55	-	-	-	2-3
95	129	F	-0.68	22	49-53	2	3	3	3
96	130	Ch	-	-	1-2		length of bones		
97	132	F	-0.33	6	40-60	-	-	-	(3)
98	133	F	-0.50	16	51-57	-	3	3	3
99	134	F	-1.00	17	55-59	1	3	3-4	4
100	Sporad.	F	-0.16	12	30-60	3	-	-	-

Table 2 Age and sex distribution

Age groups	Bačko Petrovo Selo Dead number (D_x)	percentage (d_x)	percentage (corrected) (d_x)	Model Life-table "East 5" (COALE & DEMÉNY) (d_x)
		Both sexes		
0	3.0 (+45.0)	3.00	33.10	33.42
1- 4	17.0	17.00	11.72	11.31
5- 9	12.0	12.00	8.28	2.73
10-14	5.0	5.00	3.45	1.36
15-19	5.2	5.20	3.59	1.89
20-24	4.8	4.80	3.31	2.50
25-29	1.2	1.20	0.83	2.61
30-34	3.0	3.00	2.07	2.75
35-39	2.5	2.50	1.72	2.97
40-44	5.6	5.60	3.86	3.13
45-49	6.2	6.20	4.28	3.34
50-54	14.2	14.20	9.79	3.82
55-59	8.6	8.60	5.93	4.55
60-64	4.1	4.10	2.83	5.37
65-69	5.5	5.50	3.79	5.93
70- x	2.1	2.10	1.45	12.32
Total:	100.0 (+45.0)			
		Males		
15-19	1.0	3.85		3.52
20-24	0.9	3.46		4.96
25-29	0.4	1.54		4.82
30-34	1.2	4.62		5.11
35-39	1.9	7.31		5.88
40-44	4.6	17.69		6.71
45-49	3.7	14.23		7.45
50-54	7.8	30.00		8.22
55-59	1.7	6.54		9.18
60-64	1.2	4.61		10.19
65-69	0.9	3.46		10.97
70- x	0.7	2.69		22.99
Total:	26.0			
		Females		
15-19	4.2	11.35		3.83
20-24	3.9	10.54		4.81
25-29	0.8	2.16		5.38
30-34	1.8	4.87		5.60
35-39	0.6	1.62		5.71
40-44	1.0	2.70		5.58
45-49	2.5	6.76		5.68
50-54	6.4	17.30		6.75
55-59	6.9	18.65		8.63
60-64	2.9	7.84		10.79
65-69	4.6	12.43		12.18
70- x	1.4	3.78		25.06
Total:	37.0			

Table 3 Degree of sexualization of the examined traits (18 - x years of age)

Sex traits	Males N	Males M	Females N	Females M
Cranial traits:				
1. Tuber frontale et parietale	21	+0.96	32	-0.41
2. Glabella, arcus superciliaris	23	+0.70	32	-0.75
3. Processus mastoideus	23	+1.17	32	-0.34
4. Protuberantia occipitalis externa	22	+0.45	28	-0.43
5. Squama occipitalis	20	+0.35	27	-0.33
6. Margo supraorbitalis	23	+0.74	29	-0.90
7. Arcus zygomaticus	19	+0.42	23	-1.17
8. Facies zygomaticus	24	+1.04	30	-0.90
9. Corpus mandibulae	20	+0.25	24	-0.21
10. Protuberantia mentalis	23	+0.30	30	-0.30
11. Angulus mandibulae	23	+0.30	29	-0.37
12. Caput mandibulae	23	+0.43	28	-0.82
Mean:		+0.59		-0.58
Post-cranial traits:				
13. Pelvis major	9	+1.33	18	-0.56
14. Pelvis minor	9	+0.89	18	-1.11
15. Angulus subpubicus	16	+0.56	20	-1.10
16. Foramen obturatum	14	+0.93	20	-0.85
17. Incisura ischiadica major	16	+1.25	28	-0.86
18. Ischio-pubic index	12	+0.58	12	-1.17
19. Cotylo-ischiadic index	15	+1.60	22	-0.73
20. Sacrum	13	+0.69	18	-0.78
21. Caput femoris	18	+1.83	29	-0.41
22. Linea aspera	19	+0.11	30	-0.63
Mean:		+0.98		-0.82

Table 4 Parameters of the male crania (18 - x years of age)

MARTIN Nº	N	M	V_{min} - V_{max}	s	S.R.
1	20	186.6	174-201	7.56	123.9
5	15	104.8	97-114	5.40	131.7
8	17	144.7	134-161	8.11	162.2++
9	21	99.7	91-109	5.06	115.0
10	19	121.1	112-130	4.67	97.3
12	13	115.3	107-127	6.61	146.9
17	14	133.4	122-144	5.54	113.1
20	16	114.1	109-120	3.14	78.5
23	16	535.8	515-566	15.74	110.1
25	13	372.3	360-398	11.48	88.3
26	19	126.7	117-138	6.46	105.9
27	19	129.5	118-141	6.85	86.7
28	14	117.1	102-127	6.87	93.5
29	19	111.9	104-122	5.12	111.3
30	19	116.8	107-129	5.77	94.6
31	14	96.5	91-108	5.13	100.6
38	16	1479.8	1369-1681	92.52	82.6
40	14	101.1	91-108	5.87	119.8
43	20	108.3	103-119	4.76	123.6
45	17	137.2	129-151	6.69	131.2
46	18	96.7	90-107	4.79	101.9
47	15	118.7	111-129	6.26	89.4
48	21	68.0	60-75	3.76	91.7
51	21	43.9	39-48	2.23	123.9
52	21	33.0	29-37	2.25	118.4
54	20	26.2	24-29	1.54	85.6
55	21	51.8	46-57	3.06	105.5
60	14	56.7	51-63	3.47	123.9
61	16	64.9	57-67	2.53	79.1
62	15	49.8	45-55	2.91	103.9
63	17	43.1	38-47	2.33	87.9
65	14	120.5	114-128	4.29	75.3
66	15	104.0	96-117	5.86	93.0
68/1	19	111.0	98-120	6.88	132.3
69	19	30.5	27-34	2.12	74.4
72	14	84.4	80-92	3.65	125.9
75/1	13	30.2	20-40	4.71	102.4
79	20	124.4	115-135	5.45	85.2
8: 1	17	77.7	70.3- 90.9	5.42	169.4++
17: 1	13	71.3	66.5- 82.3	4.28	138.1
17: 8	13	92.4	85.1-100.0	5.86	133.2
20: 1	16	61.1	57.4- 68.0	2.63	105.2
20: 8	16	79.6	75.0- 84.3	3.37	102.1
9: 8	17	68.9	63.8- 73.2	2.67	80.9
47:45	13	87.6	76.2-100.0	6.66	125.7
48:45	15	50.4	43.0- 56.8	3.77	119.7
52:51	21	75.2	67.4- 85.4	5.15	103.0
54:55	20	50.5	45.6- 58.0	3.62	88.3
61:60	14	114.3	103.3-122.6	6.91	97.3
63:62	15	87.0	77.4- 93.8	5.22	74.6

++ = Significantly high S.R. ($P < 1\%$)

Table 5 Parameters of the female crania (18 - x years of age)

MARTIN Nº	N	M	V_{min} - V_{max}	s	S.R.
1	20	174.5	159-184	6.87	118.5
5	17	99.2	94-107	4.01	102.8
8	19	138.9	129-149	5.65	117.7
9	24	94.0	88-103	3.81	88.6
10	19	117.4	108-131	5.61	122.0
12	16	110.1	100-118	4.27	99.3
17	16	126.7	120-135	4.01	85.3
20	18	108.7	102-113	3.32	87.4
23	16	506.8	484-525	12.16	88.8
25	15	355.0	331-385	14.36	114.9
26	26	123.1	107-133	6.08	103.1
27	23	121.5	106-140	9.08	119.5
28	15	111.9	100-120	5.14	72.9
29	25	108.5	97-115	4.71	107.1
30	23	108.9	95-124	7.31	123.9
31	15	92.9	85-100	4.57	93.3
38	17	1290.1	1150-1374	64.58	64.3
40	13	94.7	86-103	5.23	111.3
43	25	102.4	95-110	4.09	112.1
45	14	126.5	116-139	6.79	141.5
46	22	91.2	81-103	4.98	111.9
47	19	109.3	99-121	5.36	82.5
48	22	63.6	55-70	3.62	95.3
51	23	41.9	38-46	1.86	109.4
52	21	32.5	29-36	1.60	84.2
54	21	24.7	19-27	2.12	124.7
55	23	48.4	42-54	2.87	106.3
60	21	52.1	47-59	3.60	133.3
61	20	60.6	55-65	3.02	100.7
62	14	46.2	42-51	2.69	101.5
63	20	39.3	31-46	3.13	122.8
65	18	118.8	105-129	7.05	130.6
66	17	93.8	82-107	7.43	128.1
68/1	22	101.2	96-116	4.99	99.8
69	22	27.2	23-33	2.42	94.9
72	14	85.5	81-91	3.28	113.1
75/1	12	27.1	22-34	3.12	67.8
79	23	126.0	113-140	6.43	100.5
8: 1	18	79.1	72.3- 93.7	5.31	165.9 ++
17: 1	14	71.8	66.9- 76.7	3.08	99.4
17: 8	15	91.6	85.3-100.8	3.90	88.6
20: 1	17	62.0	58.7- 70.4	2.74	109.6
20: 8	18	78.1	71.5- 84.3	3.02	91.5
9: 8	19	67.8	61.1- 73.1	3.36	101.8
47:45	12	86.1	73.3- 93.6	6.13	115.7
48:45	13	49.7	40.7- 55.1	3.87	122.9
52:51	20	77.6	69.8- 85.0	4.70	94.0
54:55	20	51.9	43.2- 59.5	4.39	107.1
61:60	18	116.0	101.7-129.8	8.51	119.9
63:62	12	83.4	68.9- 93.0	7.93	113.3

++ = Significantly high S.R. ($P < 1\%$)

Table 6 Parameters of the male and female post-cranial bones (18 - x years of age)

MARTIN N°		Males				Females			
		N	M	s	V_{min} - V_{max}	N	M	s	V_{min} - V_{max}
Clavicula	1 R	15	150.3	5.94	140-162	19	136.5	6.86	125-147
	L	13	153.6	5.33	147-165	17	139.8	7.67	125-153
	6 R	19	39.9	3.14	37-48	24	33.3	2.31	29-39
	L	15	40.1	3.86	35-48	21	33.5	3.01	29-41
Humerus	1 R	15	326.1	18.99	300-355	23	299.7	13.85	280-331
	L	15	324.5	18.85	299-353	20	296.5	14.06	274-323
	2 R	17	322.4	17.00	294-346	22	296.2	14.59	276-330
	L	14	321.0	18.92	293-352	21	292.7	13.68	268-317
	4 R	15	66.2	4.30	50-73	23	56.0	3.55	50-62
	L	14	65.1	4.62	57-71	18	56.4	3.87	49-63
	7 R	18	70.4	3.76	63-78	29	58.3	3.67	51-69
	L	19	68.4	3.63	60-75	26	57.4	3.69	50-68
	10 R	16	50.1	2.57	46-55	23	41.4	2.04	39-47
	L	15	49.5	1.81	46-52	18	41.1	1.97	38-44
Radius	1 R	16	246.1	13.22	224-262	21	225.2	11.07	209-245
	L	15	244.2	14.25	220-261	19	220.4	11.54	203-243
Ulna	1 R	11	267.2	13.64	248-282	18	244.1	10.44	231-269
	L	11	265.9	13.95	245-285	10	242.3	10.84	227-264
Femur	1 R	16	446.1	23.35	399-474	25	409.8	14.55	383-441
	L	13	450.0	26.65	393-480	24	409.7	18.32	370-440
	2 R	16	442.1	22.90	396-469	24	406.5	15.11	379-438
	L	12	447.3	26.28	393-474	23	406.6	17.96	370-438
	6 R	20	30.6	2.93	25-36	29	25.8	1.95	23-30
	L	19	30.6	2.83	25-36	27	25.6	1.78	23-30
	7 R	20	29.8	1.85	25-33	29	26.2	1.71	24-30
	L	19	29.8	1.50	26-32	27	26.4	1.97	23-30
	9 R	19	34.4	1.98	31-38	29	31.8	2.14	28-35
	L	17	35.1	1.52	32-38	27	32.1	1.92	28-35
	10 R	19	28.0	2.17	22-32	29	23.9	2.05	20-27
	L	17	28.0	1.73	24-31	27	24.0	2.07	21-29
	19 R	17	49.8	3.00	44-55	29	42.5	2.15	38-46
	L	13	49.3	3.28	43-55	24	42.7	2.24	38-47
	21 R	16	82.9	3.17	78-89	22	73.5	3.84	64-81
	L	18	82.8	3.42	77-89	20	73.7	3.18	69-82
Tibia	1 R	17	361.2	18.66	325-388	23	330.0	15.89	304-357
	L	17	361.2	19.85	320-388	23	330.7	17.17	303-362
	1/b R	17	359.6	19.68	321-390	24	329.0	16.75	300-359
	L	18	361.4	20.10	317-388	24	330.3	17.46	301-357

Table 6 (Continuation)

MARTIN Nº		Males N	M	s	V_{min} - V_{max}	Females N	M	s	V_{min} - V_{max}
Tibia	3 R	17	78.3	2.66	73-84	21	69.7	3.13	65-75
	L	17	78.0	3.12	73-86	21	69.0	3.12	64-74
	8/a R	20	34.8	2.02	30-38	27	29.5	2.28	25-34
	L	20	34.6	2.01	32-38	26	30.1	1.94	26-34
	9/a R	20	27.1	2.26	23-32	27	22.8	2.11	16-27
	L	20	27.5	2.37	24-33	26	22.8	1.88	20-27
Fibula	1 R	12	353.2	21.38	313-378	13	321.1	13.51	302-347
	L	12	351.8	19.82	313-381	13	327.7	13.38	298-351
Sacrum	2	9	104.9	7.34	93-113	13	95.2	9.48	80-111
	5	14	117.4	7.58	103-131	19	114.1	5.78	91-126
Pelvis									
Ischium Length	R	10	104.4	5.42	95-110	11	90.6	5.11	80-97
	L	11	99.9	5.94	88-108	11	85.3	3.80	78-90
Pubis Length	R	10	104.2	5.96	93-110	11	99.8	5.88	93-112
	L	11	99.4	6.02	88-107	12	92.6	6.07	82-103
Index	R	10	100.1	1.44	96.9-101.9	11	109.4	6.76	95.0-115.9
	L	11	99.2	3.36	95.3-108.1	11	109.8	5.59	100.0-118.1
Cotylo Breadth	R	17	39.7	2.59	35-45	19	33.8	3.32	29-40
	L	13	39.4	2.75	35-43	19	34.4	3.31	28-39
Inc.isc. major Breadth	R	15	31.6	5.28	22-38	19	41.3	6.48	30-59
	L	13	33.5	7.50	22-46	18	43.8	5.20	36-58
Index	R	15	129.4	25.70	100.0-190.9	19	83.1	11.77	61.2-110.0
	L	13	123.5	32.80	95.5-195.4	18	78.9	9.37	62.1-92.7
Claviculo-Humeral Index	R	14	46.7	2.98	40.8-52.4	16	46.2	2.68	42.1-50.4
	L	12	48.3	3.25	42.3-53.6	16	47.9	2.51	43.1-52.7
Radio-Humeral Index	R	14	76.1	1.95	72.5-78.7	15	75.6	2.54	70.6-79.0
	L	12	76.4	2.01	74.1-80.1	15	75.9	2.06	72.5-78.7
Tibio-Femoral Index	R	14	80.9	1.28	78.5-82.6	20	81.6	2.32	77.1-84.7
	L	10	80.8	1.60	78.3-82.8	20	81.6	1.99	77.0-84.7
Stature (acc.to PEARSON)		20	165.9	4.61	156.8-172.0	31	153.7	3.39	147.5-160.3

Table 7 Descriptive characters of the cranium

Characters	Males N	Males M	Females N	Females M
Cranial form in norma verticalis				
ellipsoid	3	15.8	1	3.7
ovoid	8	42.1	14	51.9
spheroid	2	10.5	3	11.1
spheno-birsoid	5	26.3	4	14.8
pentag.-rhomboid	1	5.3	5	18.5
Cranial form in norma occipitalis				
bomb-shaped	7	35.0	8	33.3
cuneiform	2	10.0	3	12.5
house-shaped	11	55.0	13	54.2
Profile of the forehead				
straight	-	-	2	6.3
moderately sloped	12	50.0	25	78.1
strongly sloped	12	50.0	5	15.6
Profile of the occiput				
bathrocran	2	8.7	1	3.3
curvoccipital	14	60.9	18	60.0
mod. curvoccipital	4	17.4	5	16.7
planoccipital	3	13.0	6	20.0
Form of the orbita				
rounded	3	12.5	7	24.1
rectangular	11	45.8	8	27.6
subrectangular	10	41.7	14	48.3
Depth of the nasal root				
deep	17	74.0	4	12.9
medium	5	21.7	15	48.4
shallow	1	4.3	12	38.7
Form of the nasal ridge				
straight	8	40.0	8	38.1
convex	8	40.0	10	47.1
concave	1	5.0	2	9.5
concavo-convex	3	15.0	1	4.8
Form of the nasal bones according to MARTIN				
1	15	75.0	22	84.6
1/a	1	5.0	-	-
2	1	5.0	2	7.7
3	2	10.0	-	-
3/a	-	-	2	7.7
4	1	5.0	-	-
Margin of apertura piriformis				
anthropine	17	70.8	30	96.8
infantile	-	-	1	3.2
fossa praenasalis	7	29.2	-	-
Protuberance of spina nasalis anterior according to BROCA				
1-2	5	23.8	12	46.2
3	8	38.1	5	19.2
4-5	8	38.1	9	34.6

Table 7 (Continuation)

Characters	Males N	Males M	Females N	Females M
Form of the alveolar arch				
parabolic	14	82.4	17	65.4
elliptic	3	17.6	7	26.9
parallel	-	-	2	7.7
Development of the alveolar prognathie				
none	16	72.7	12	44.4
moderate	6	27.3	11	40.8
strongly devel.	-	-	4	14.8
Development of fossa canina				
filled	3	12.5	4	13.3
moderate	10	41.7	15	50.0
deep	8	33.3	7	23.4
very deep	3	12.5	4	13.3

Table 8 Frequency of non-metric traits and some anomalies

Traits and anomalies		Males N	Males %	Females N	Females %	Together N	Together %
Cranium							
Sutura metopica		1/23	4.4	3/35	8.6	4/58	6.9
Ossa wormiana		14/23	60.9	12/26	46.2	26/49	53.1
Os epiptericum	R	4/18	22.2	2/19	10.5	6/37	16.2
	L	1/12	8.3	1/16	6.3	2/28	7.1
Torus palatinus		3/25	12.0	7/29	24.1	10/54	18.1
Post-cranium							
Humerus:							
perforatio	R	0/17	-	5/26	19.2	5/43	12.6
fossae olecrani	L	2/16	12.5	6/26	23.1	8/42	19.1
Femur:							
trochanter	R	7/18	38.9	8/24	33.3	15/42	35.7
tertius	L	4/18	22.2	14/27	51.9	18/45	40.0
crista hypo-	R	11/20	55.0	13/29	44.8	24/49	49.0
trochanterica	L	14/20	70.0	11/28	39.3	25/48	52.1
fossa hypo-	R	5/20	25.0	9/29	31.0	14/49	28.6
trochanterica	L	7/20	35.0	11/28	39.3	18/48	37.5
Vertebral column:							
atlas, closed sulcus arteriae		4/18	22.2	0/19	-	4/37	10.8
sacralisation		2/18	11.1	1/28	3.6	3/46	6.5
lumbalisation		3/18	16.7	4/27	14.8	7/45	15.6
spina bifida		2/17	11.8	1/27	3.7	3/44	6.8
spondylolysis		7/17	41.2	8/28	28.6	15/45	33.3

Table 9 Frequency of spondylolysis in various populations

Series	Males N	Males %	Females N	Females %	Together N	Together %
Bačko Petrovo Selo, 6-7th c.	7/17	41.2	8/28	28.6	15/45	33.3
Velké Hosteradky, 11-12th c.*	1/9	11.1	3/10	30.0	4/19	21.1
Zelovce, 7-8th c.*	10/55	18.2	17/75	22.7	27/130	20.8
Zalaszabar, 9th c. (ÉRY 1988b)	3/9	33.3	2/15	13.3	5/24	20.8
Virt, 7-8th c.*	2/12	16.7	7/35	20.0	9/47	19.1
Josefov, 9th c.*	1/16	6.3	7/27	25.9	8/43	18.
Tokod, 5th c. (ÉRY 1981)	5/22	18.5	2/16	12.5	7/43	16.3
Zalakomár, 8-9th c. (ÉRY 1989)	5/55	9.1	9/48	18.8	14/103	13.6
Garabonc I-II, 9th c. (ÉRY 1988b)	3/26	11.5	4/27	14.8	7/53	13.2
Nové Zámky, 8th c.*	3/28	10.7	3/22	13.6	6/50	12.0
Dombóvár, 16-17th c. (ÉRY 1982)	3/50	6.0	7/57	12.3	10/107	9.3
Ábrahám, 11th c.*	1/25	4.0	2/14	14.3	3/39	7.7
Tác, 4-5th c. (ÉRY 1985)	2/60	3.3	7/77	9.1	9/137	6.6
Bilina, 10-13th c.*	1/33	3.0	2/21	9.5	3/54	5.6
Libice, 9-11th c.*	3/52	5.8	2/42	4.8	5/94	5.3
Mikulcice 1-6, 9th c.*	18/298	6.0	6/196	3.1	24/494	4.9
Znojmo, 11-13th c.*	0/29	-	2/31	6.5	2/60	3.3
Mean:	68/796	9.5	90/741	12.2	158/1542	10.3

* VYHNÁNEK & STLOUKAL 1977

Table 10 Taxonomic distribution

Groups	Males N	Males %	Females N	Females %	Together N	Together %
Europoids:						
dolicho-mesocran group	14	66.7	25	80.6	39	75.0
brachycran group	5	23.8	3	9.7	8	15.4
protomorphic group	2	9.5	-	-	2	3.9
Europo-mongoloids:	-	-	3	9.7	3	5.8

Table 11 Generalized Penrose distances between Bačko Petrovo Selo and other series
- Males -

Series	Cp^2
Avar period (600 - 800 A.D.)	
Carpathian Basin:	
Adorján, 6th farm (BARTUCZ & FARKAS 1957b)	1.262
Alattyán (WENGER 1957)	0.431
Artánd (ÉRY 1966)	0.494
Csákberény (TÓTH 1962)	0.592
Előszállás (WENGER 1966)	1.094
Homokmégy (LIPTÁK 1957)	0.927
Kaposvár - Fészerlak (FÓTHI 1988)	0.557
Kecel I. (LIPTÁK 1954)	0.838
Kékesd (WENGER 1968)	0.739
Keszthely - city cemeteries (WENGER 1976-77)	0.448
Kiskőrös - Város-alatt (LIPTÁK 1983)	0.795
Košice - Šebastovče (THURZO 1984)	0.835
Nové Zámky I-II (STLOUKAL & HANÁKOVÁ 1966, VLADÁROVÁ, MOJZOŠOVÁ & HANULIK 1970)	0.601
Pókaszepetk (BOTTYÁN 1975)	1.329
Solymár (FERENCZ 1982-83)	0.618
Sükösd (KŐHEGYI & MARCSIK 1971)	0.645
Szeged - Fehértó "A" (LIPTÁK & VÁMOS 1969)	0.839
Szeged - Kundomb (LIPTÁK & MARCSIK 1966)	0.389
Szeged - Makkoserdő (VÁMOS 1974)	0.633
Szekszárd - Palánk (LIPTÁK 1974)	0.742
Szentes - Kaján (WENGER 1955)	0.954
Tiszaderzs (LEBZELTER 1957)	1.088
Toponár (WENGER 1974)	0.562
Üllő I (LIPTÁK 1955)	1.017
Üllő II (LIPTÁK 1955)	0.968
Vác - Gravel quarry (FERENCZ 1980-81)	0.399
Virt (HANÁKOVÁ, STLOUKAL & VYHNÁNEK 1976)	0.522
Želovce (STLOUKAL & HANÁKOVÁ 1974)	0.532
Zwölfaxing (SZILVÁSSY 1980)	0.586
Dalmatia:	
Nin - Ždrijac (ŠTEFANČIČ 1987)	1.284
Meroving period (500 - 700 A.D.)	
Western Europe:	
Anderten (cit. RÖSING 1975)	0.701
Bonaduz (cit. RÖSING 1975)	1.209
Jura (cit. RÖSING 1975)	0.711
Mannheim (RÖSING 1975)	0.885
Nusplingen (RÖSING 1975)	0.838
Solothurn (cit. RÖSING 1975)	0.578
Weingarten (cit. RÖSING 1975)	0.886
West-Franken (RÖSING 1975)	0.637
Frankish-Slavic period (800 A.D.)	
Carpathian Basin:	
Garabonc I (ÉRY 1989b)	0.555
Nitra - Lupka (THURZO 1969)	1.027
Nitra - Zobor (JAKAB 1978)	
Moravian Basin:	
Josefov (HANÁKOVÁ & STLOUKAL 1966)	0.642
Mikulčice 1-4 (STLOUKAL & VYHNÁNEK 1976)	0.678
Rajhrad (HANÁKOVÁ, STANA & STLOUKAL 1986)	0.483
Austria:	
Pitten (FABRIZII & REUER 1975-76)	0.652

Table 11 (Continuation)

Series	Cp^2
Soviet Union:	
Tagar I. Minusinsk Basin, 700-600 B.C. (ALEKSEEV 1961)	0.280
Tagar II. Minusinsk Basin, 600-500 B.C. (ALEKSEEV 1961)	0.431
Tagar III. Minusinsk Basin, 400-300 B.C. (ALEKSEEV 1961)	0.572
Tashtyk, Minusinsk Basin, 200 B.C. - 100 A.D. (ALEKSEEV 1961)	0.880
Scythian period, Altaic Mts, 500–00 B.C. (ALEKSEEV 1961)	0.464
Sarmatian period. Altaic lowland, 200 B.C.-200 A.D. (ALEKSEEV (1958)	0.781
Turcic nomads, Altaic highlands, 700-1000 A.D*	1.335
Turcic nomads, Altaic lowland, 700-1000 A.D.*	0.615
Early Saka culture, Kazakhstan, 500-400 B.C.*	0.342
Late Saka culture, Lake Aral, 400-200 B.C.*	0.459
Saka and Early Usune culture, Kirghizia, 500-400 B.C.*	0.659
Usune culture, Irtish River, 300 B.C.-200 A.D.*	0.732
Usune culture, Kirghizia, 300 B.C-100 A.D.*	0.615
Usune culture, Kazakhstan, 300 B.C.-100 A.D.*	0.644
Nomadic culture, South Tadzhikistan, 200 B.C.-100 A.D.*	0.672
Tuz Gyr, South of Lake Aral. 100 A.D.*	0.627
Sauromatian culture, West Kazakhstan, Lower Volga River, Ural Mts, 700-400 B.C. (GINZBURG & FIRSHTEIN 1958)	0.169
Sarmatian culture, West Kazakhstan, 400 B.C.-100 A.D.*	0.137
Sarmatian culture, Lower Volga River, 400 B.C.-100 A.D. (FIRSHTEIN 1970)	0.396
Sarmatian culture, Middle Volga region, 400 B.C.-100 A.D. (FIRSHTEIN 1970)	0.302
Sarmatian culture, Ural Mts, 400 B.C.-100 A.D. (FIRSHTEIN 1970)	0.250
Sarmatian culture, Ukraine, 400 B.C.-300 A.D. (KONDUKTOROVA 1972)	0.518
Kamyshly Tamak, B'elaya River, 200 B.C.-100 A.D.**	0.758
Lower Kama River (Cheganda and the Mazunino group), 200 B.C.- 500 A.D.**	0.599
Upper Kama River (Mitinsk and Demenki), 200-400 A.D.**	0.205
Cheptsa River (Polom and Mydlanshai), 700-800 A.D.**	0.641
Birsk, B'elaya River, 400-600 A.D.**	0.768
Bolshie Tarkhany, Middle Volga River, 700-800 A.D.**	0.515
Tankeeva, Middle Volga River, 800-1000 A.D.**	0.738
Mingechaur VI, Azerbaisdzhan, 100-600 A.D. (KASIMOVA 1960)	0.696
Verkhne Saltovo, Upper Donets River, 700-800 A.D. (ALEKSEEV 1959)	0.720
Mayatskoe, Lower Don region, 800 A.D. (KONDUKTOROVA 1984)	0.751
Scythian culture, North of the Black Sea, 500-300 B.C. (KONDUKTOROVA 1972)	0.485
Nikolaevka Kazatskoe, Lower Dnepr River, 300 B.C.-200 A.D. (KONDUKTOROVA 1977)	0.711
Zolotaya Balka, North of the Azov Sea, 300 B.C.-200 A.D. (KONDUKTOROVA 1972)	0.697
Neapol, Crimea, 300 B.C.-200 A.D. (KONDUKTOROVA 1972)	0.876
Zavetnoe, Crimea, 100-200 A.D. (ZINEVICH 1971)	0.441
Skalistoe, Crimea, 300-800 A.D. (ZINEVICH 1973)	0.568
Chernakhovian culture, Middle Dnepr River, 100-300 A.D. (cit. KONDUKTOROVA 1972)	1.060
Chernakhovian culture, Moldavia, 200-300 A.D. (cit. KONDUKTOROVA 1972)	0.752

* (cit. GINZBURG & TROFIMOVA 1972), ** (AKIMOVA 1968).

Table 12 Main data of Bačko Petrovo Selo and the two similar series
- Males -

MARTIN Nº	Bačko Petrovo Selo Early Avar culture Vojvodina, Yugoslavia 570 - 630 A.D. M	Sarmatian culture West Kazakhstan Region 400 B.C. - 200 A.D. M	Sauromatian culture West Kazakhstan Lower Volga, Ural Region 700 - 400 A.D. M
1	186.6	185.6	184.8
5	104.8	104.1	106.2
8	144.7	145.9	144.7
9	99.7	99.6	99.4
17	133.4	132.7	134.5
40	101.1	100.7	101.4
45	137.2	138.2	138.0
48	68.0	71.5	71.1
51	43.9	44.2	44.0
52	33.0	33.2	33.7
54	26.2	26.4	25.7
55	51.8	53.0	52.2
8: 1	77.7	78.9	78.1
17: 1	71.3	72.1	73.1
17: 8	92.4	90.1	93.4
9: 8	68.9	68.3	69.0
48:45	50.4	52.4	51.7
52:51	75.2	75.1	77.0
54:55	50.5	49.6	48.7

Explanation of plates:

Plate 1	Grave No	51	Male
Plate 2	Grave No	78	Male
Plate 3	Grave No	37	Male
Plate 4	Grave No	44	Male
Plate 5	Grave No	129	Female
Plate 6	Grave No	46/a	Female
Plate 7	Grave No	86	Female
Plate 8	Grave No	134	Female

Plate 1

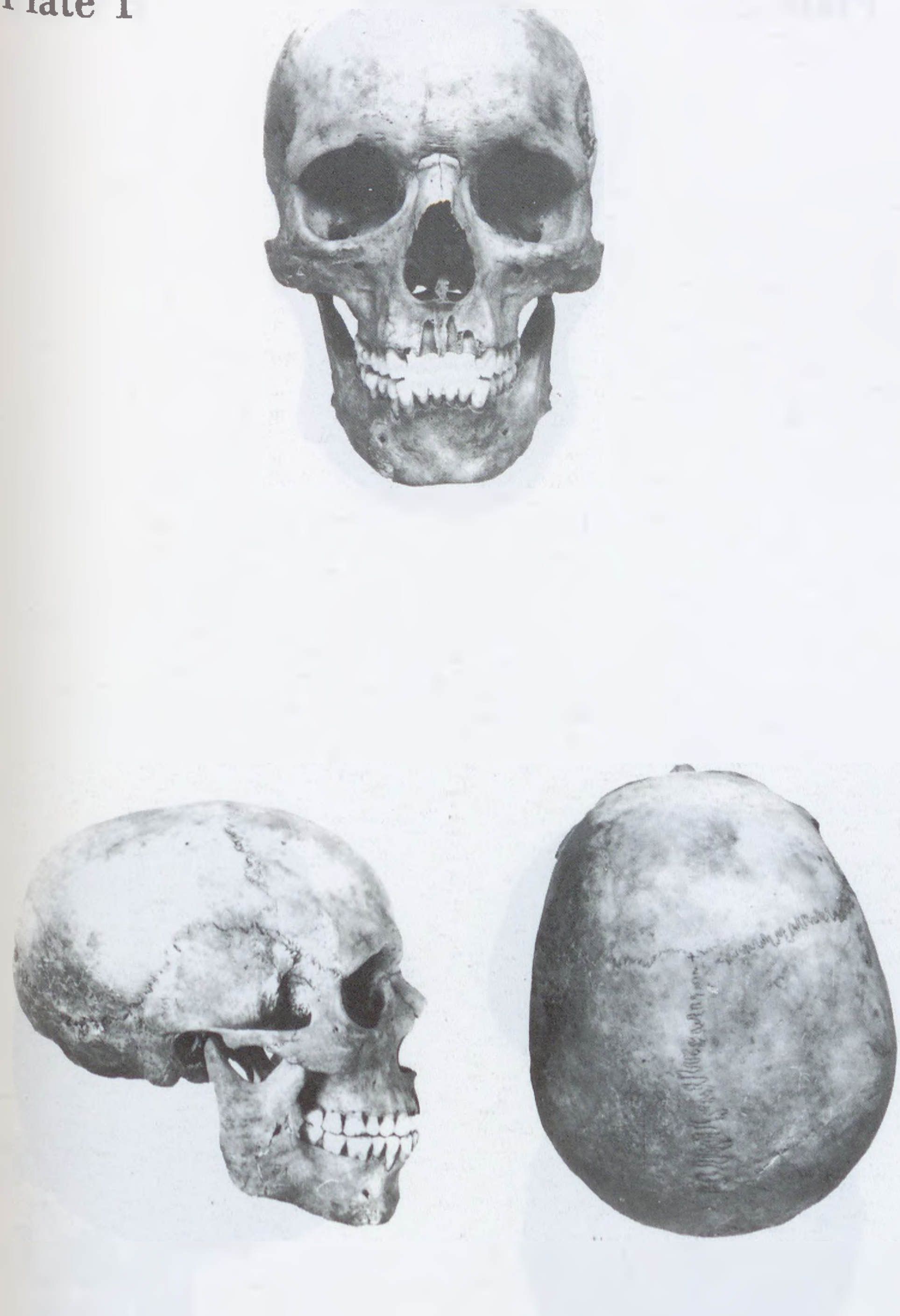


Plate 2

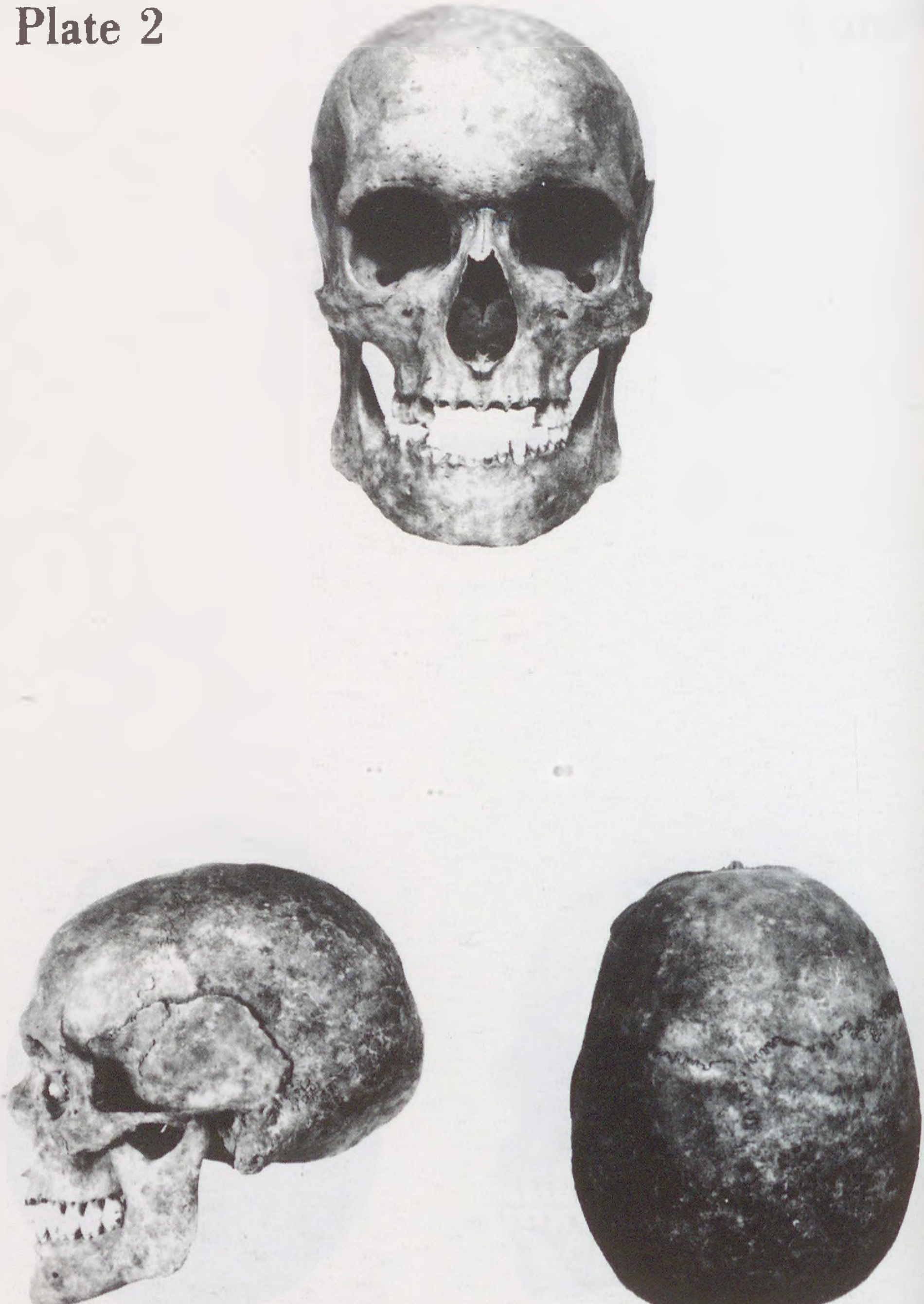


Plate 3

Plate 4

Plate 5

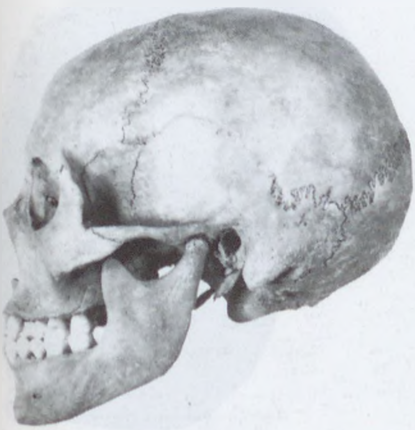


Plate 6

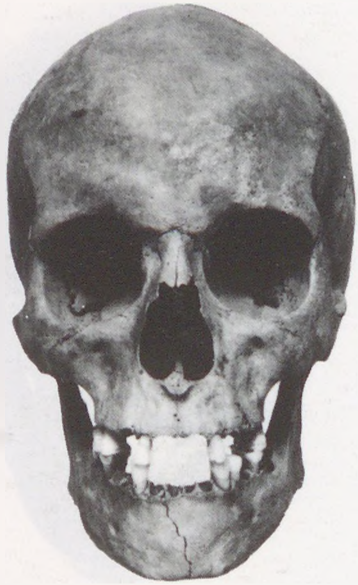


Plate 7

Plate 8

ANTHROPOLOGIA HUNGARICA
XXI. 1990 p. 55-68

Anthropological investigation of the Avar period population of Kaba

By

M. FERENCZ

(Received June 2, 1990)

Abstract. The author examines the osteological material of 139 graves from the 8th century cemetery of Kaba. A general anthropological characterization of the series, secondary taxonomical analysis and comparison to other Avar period series are given. With 8 tables, 4 figures and 3 plates.

Some graves were found during earth moving between the villages Kaba and Tetétlen (Tiszántúl) close to the Kavicsos road. Having finished the work an archaeological excavation began, led by Ibolya NEPPER, archaeologist of the Déry Museum of Debrecen in 1974. The graves date from the Avar period (8th century). They were mostly north-south and in some cases northwest-southeast and northeast-southwest orientated. The rate of disturbing was found to be almost 50 percent. The cemetery was rich in archaeological finds. The graves of two harnessed horses were also dug up (NEPPER 1982).

The anthropological material of 139 graves was taken to the Department of Anthropology, József Attila University, Szeged.

METHODS APPLIED

The age at the time of death was determined on the basis of bone changes during life time (FARKAS 1972). Age groups were classified according to MARTIN & SALLER's categories (1957). Sexes were identified by the anatomical characteristics demonstrating sexual dimorphism. The cranial measurements were taken by MARTIN's method (1928). The averages of measurements and indices (M), the range of variations (V_{min}-V_{max}) and standard deviation (s) were also determined. DEBETS's categories were applied in the classification of anthropometrical characteristics (ALEXEEV & DEBETS 1964). LIPTÁK's taxonomical system (1954a, 1965, 1969) was used in the analysis of secondary taxonomical characteristics. Stature was determined by the method of BREITINGER (1938) and BACH (1965). Comparative examinations were carried out by the distance-calculations of PENROSE (1954), by applying ALEXEEVA's (1966) special indices and evaluating the secondary taxonomical analysis.

GENERAL CHARACTERIZATION

The osteological material is fragmentary. The 139 graves yielded 113 skulls of 51 males, 44 females and 18 undeterminable skulls (Inf I, Inf II). The number of the well preserved, measurable skulls is only 17 (15.0%), of 9 males and 8 females. There are 96 (85.0%) fragmentary, unmeasurable skulls (42 male and 36 female and 18 undeterminable skulls). However, I carried out the possible morphoscopical examinations on the fragmentary material, too.

Summarizing the partial results we can see that 8 (7.1%) skulls belong to the age group Inf I, while 10 (8.8%) belong to the age group Inf II. This is only 15.9% of all the skulls. 9 (8.0%) skulls could be determined as juvenile. There are 51 (45.1%) males and 44 (38.9%) females in this series. 7.8% of the males died in juvenile age, 43.2% in adult age and 47.1% in mature age, while one of them (1.9%) survived to reach senium age. 5 females (11.4%) died in juvenile age, 32 females (72.7%) in adult age, while only 7 females (15.9%) lived to mature age probably as a result of illnesses related to maternity (Table 1).

ANTHROPOLOGICAL ANALYSIS

Brain-cases of males are medium long, medium wide, high according to the mean-values. However, there is only one medium wide skull, the others are divided into two groups: 5 skulls are wide or very wide, 3 are narrow or very narrow. Two groups can be separated according to the cranial index: there are 5 brachycranic or hyperbrachycranic skulls and there are 3 dolichocranic and hyperdolichocranic specimens. Otherwise the male skulls are hypsicranic, akrocranic (akrocranic and metriocranic groups), eurymetopic (there are 4 hypereurymetopic and 4 metriometopic skulls). Facial skeletons have the following characteristics: narrow zygomatic arc, wide or narrow bizygomatic arc (there are two groups). Faces are medium (there are some low faces too), upper faces are low or medium high. Orbits are narrow and low or medium high. Nasal apertures are wide in one group and narrow in the other group and they are medium high. Facial skeletons are euryprosopic and euryen. Orbit is mesoconch or hypsiconch, nose is chamaerrhin, palate is mesostaphylin or brachystaphylin.

Females: Brain-cases are divided into two groups according to the mean-values: half of the measurable skulls is short and the other halfis medium long. Otherwise they are wide and high. They are brachycranic, hypsicranic, mesocranic and metriometopic by the indices. However, there is a stenometopic and an eurymetopic group besides the metriometopic skulls. Facial skeletons are characterized by narrow or wide zygomatic arcs (in equal rates) with medium bizygomatic breadth. The faces are high, upper faces are medium high. Orbits are medium wide - narrow (in equal proportions) and medium high. Nasal apertures are narrow or medium wide and medium high (but there is also a low and a high group). Facial skeletons are mesoprosopic, mesen. Orbits are hypsiconch (but there is a chamaeconch group). Noses are mesorrhine, palates are hyper-brachystaphyline, according to the indices (Table 2).

The majority of the male skulls' circumference is pentagonóid in norma verticalis. Glabella is generally markedly developed. Degrees 3 and 4 are the most frequent. Protuberantia occipitalis externa is medially developed. Fossa canina is medium deep or shallow. The group of those with very shallow fossa canina is significant. Spina nasalis anterior is medially developed, usually of degrees 2 or 3. Alveolar prognathism is mostly moderate but it is expressed in some cases.

Females' skulls circumference is pentagonoid in the majority of cases in norma verticalis. There are some ovoid skulls too. Glabella is weakly developed, degrees 1 and 2 are the most frequent. Protuberantia occipitalis externa is weakly developed, degrees 1 and 0 are the most frequent. Fossa canina is medium deep or shallow. Spina nasalis anterior is moderately developed, most frequently of degree 2. Alveolar prognathism is moderate or expressed (Table 3).

Stature of males is medium tall (medium tall - medium - tall are the most frequent categories) calculated by BREITINGER's method. I was able to calculate the stature of 19 male skeletons. Stature of females is also medium tall on the basis of BACH's method. Besides the medium tall category the number of the medium and tall individuals is also significant. The stature of 13 females could also be calculated.

Individual measurements of males are summarized in Table 4, those of females in Table 5.

I found an expressed difference between the two sexes. The bones of males are robust, their cranial walls are thick. The cranial and skeletal measurements are large, their mandibulae are strong. The bones of females are gracile. Their cranial walls are thin. Both the cranial and the skeletal measurements are small.

The third molars of two male skulls (Grave Nos. 16 and 145) are pin-teeth. These teeth of the skull of Grave No. 145 fell out post mortem, but one of them is well preserved with the individual of Grave No. 16 (Plate 1).

TAXONOMICAL ANALYSIS

Secondary morphotaxonomical examination was carried out on 15 well preserved skulls (Table 6). Our series is Europid. Cromagnoid characteristics are displayed most frequently. 5 males and 2 females belong to this group. The CrA group is represented by the male skull of Grave No. 29. Nordoid type characteristics can be observed on 1 female (Grave No. 122) skull (CrA-n). The face is narrower on this skull. The male of Grave No. 125 bears CrB features. These characteristics are mixed with other ones (CrB-x) on 2 skulls (Grave No. 145, male; Grave No. 63, female). There are two undeterminable Cromagnoid (Cr-x) male skulls (Graves No. 148, 16) (Plates 2 and 3).

Brachycrans: The males of Graves No. 35 and 117 bear Dinarian race (d) characteristics. The Pamirián race (p) is represented by one female skull (Grave No. 14). These features are mixed with others on the male skull of Grave No. 118 (p-x). The male skull of Grave No. 146 and the female skull of Grave No. 45 belong to the undeterminable brachycrans because of their fragmentary condition.

The Nordoid group is represented by 2 female individuals (Grave Nos. 108 and 141).

The Mediterraneans are absent from our cemetery. However, their absence may be explained by the low number of well preserved skulls.

COMPARATIVE ANALYSIS

I compared the osteological material of Kaba to 10 Avar period series from the 6th to 9-10th centuries. The selection of the series was principally dictated by their geographic locations.

Comparative taxonomical analysis

The Kaba cemetery is not a typical Avar period cemetery. Cromagnoids and brachycrans are present in equal proportions. The series of Ártánd and Tiszavasvári indicate similarity to our cemetery in this respect. Szeged - Makkoserdő, Szeged - Kundomb and Szarvas - Kákapuszta cemeteries are analogous to ours on the basis of the frequency of the more important taxa. However, there are two important differences, namely, that Mongoloids and Mediterraneans were not found in our cemetery. The lack of Mediterraneans may be explained by the great number of fragmentary skulls, which are unsuitable for taxonomical analysis.

The PENROSE method

The "generalized PENROSE distance" (D_p^2) - produced by the joint calculation of 12 measurements - reveals the individual distances of each series from our cemetery (PENROSE 1954) (Table 7).

The males of Kaba are very far from all the comparative series. It suggest that they have arrived later to this territory (FÓTHI, E. & PAP, I. 1990). Szentes - Kaján is relatively close to Kaba, but the value of Dp^2 is quite high: 9.47. The other values are above 10. The males of Ártánd are the farthest from the males of Kaba (21.27).

The females of Kaba are more similar to the other Avar period female series than the males. The females of Szentes-Kaján (3.60) and Tiszavasvári (4.45) are the closest to them. Szeged - Makkoserdő (5.62) is still relatively close. The females of Jánoshida (10.47) are the most different from those of Kaba but even they are more similar than most of the male series are to the males of Kaba.

The special indices of ALEXEEVA

Ten Avar period series were examined (Table 8). The males of Kaba show a relative similarity to the males of Szeged - Makkoserdő, Szentes - Kaján and Tiszavasvári on the basis of the correlation of skull height-breadth-length and of upperface-skull height (Fig 1). The females of Szarvas - Kákapuszta and Tiszavasvári display the greatest similarity to the females of Kaba. They are closer to our series than the similar male series to the males of Kaba (Fig 3).

On the basis of the correlations of cranial height-orbital height and of nasal breadth-facial breadth the male series does not present any similarity to the comparative cemeteries (Fig 2). Kecel, Szeged - Kundomb and Szeged - Makkoserdő are the most similar to the female series of Kaba in the case of females. Tiszavasvári is far from Kaba since the value of the nasal breadth-facial breadth is higher (Fig 4).

In concluding we may establish that the series of Tiszavasvári and Szeged - Makkoserdő are the closest to the series of Kaba.

SUMMARY

When summarizing the results of the comparative examinations the male group of Kaba is not in fact similar to any other male series of the chosen comparative cemeteries. The males of Szentes - Kaján and Tiszavasvári are the most similar by ALEXEEVA's indices. Szentes - Kaján is relatively close to our males on the basis of the PENROSE distance. This dissimilarity springs from the fact that the characteristics of the male skulls of Kaba are: brachycranic, hypsicranic, akrocranic and eurymetopic, namely they are short, high and wide, not typical for the average Avar " cemeteries.

The females of Kaba show the greatest similarity to the series of Szentes - Kaján, Tiszavasvári and Szarvas - Kákapuszta. As the females of Kaba display a higher similarity to the females of the geographically closer cemeteries, it is possible that the females represent some settled or autochthonous population. However, the males of Kaba are dissimilar to all the typical earlier settled Avar male series, therefore, it is reasonable to suggest that they have arrived later to this territory.

REFERENCES

ALEXEEVA, T.I. (1966): Die Slawen und ihre Nachbarn (Nach anthropologischen Daten). - Anthropologie (Praha) 4: 3-37.

ALEXEEV, V.P. & DEBETS, G.F. (1964): Kraniometriya. Metodika anthropologitsheskih issledovanii. - Izd. Nauka, Moskva: 128 pp.

BACH, H. (1965): Zur Berechnung der Körperhöhe aus den angen Gliedmassenknochen weiblicher Skelette. - Anthrop. Anz., 29: 12-21.

BREITINGER, E. (1938): Zur Berechnung der Körperhöhe aus den langen Gliedmassenknochen. - Anthrop. Anz., 14: 249-274.

ÉRY, K. (1967): An anthropological study of the late Avar period population of Ártánd. - Annls hist.-nat. Mus. natn. hung., 59: 465-484.

FARKAS, Gy. (1972): Antropológiai praktikum I. [Anthropological practice I.] - Szeged: 28-66 (Manuscript, in Hungarian).

FÓTHI, E. & PAP, I. (1990): Changes of way of life during the 6-12th centuries in the territory of Hungary - Annls hist.-nat. Mus. natn. hung., 82. (in press)
LIPTÁK, P. (1954a): A típusok eloszlása Kiskunfélegyháza környékének XII. századi népességében (Répartition des types anthropologiques de la population des environs de Kiskunfélegyháza du XII[e] siècle). - Biol. közl., 1: 105-120.
LIPTÁK, P. (1954b): Kecel-környéki avarok (Les Avares des environs de Kecel) - Biol. közl., 2: 159-180.
LIPTÁK, P. (1963): Historisch-anthropologische Auswertung der im awarenzeitlichen Gräberfeld von Alattyán erschlossenen Skelettreste. - In: KOVRIG, I., Das awarenzeitliche Gräberfeld von Alattyán. Arch. hung., 40: 245-258.
LIPTÁK, P. (1965): On the taxonomic method in palaeoanthropology (historical anthropology) - Acta biol., 11: 169-183.
LIPTÁK, P. (1969): Embertan és emberszármazástan [Anthropology and geneology]. - Tankönyvkiadó, Budapest, 284 pp.
LIPTÁK, P. & MARCSIK, A. (1966): Szeged-Kundomb avarkori népességének embertani vizsgálata (Die anthropologische Untersuchung des Gräberfeldes Szeged-Kundomb aus der Awarenperiode). - Anthrop. közl. 10: 13-56.
LIPTÁK, P. & MARCSIK, A. (1970): Skelettreste von Szarvas-Kákapuszta-Kettőshalom. Zur Frage der awarischen altungarischen Verbindungen. - Móra F. Múz. Évk., 1: 45-57.
LIPTÁK, P. & VÁMOS, K. (1969): A "Fehértó-A" megnevezésű avarkori temető csontvázanyagának embertani vizsgálata (Anthropologische Untersuchung des Skelettmaterials des awarenzeitlichen Gräberfeldes von "Fehértó-A"). - Anthrop. közl., 13: 3-30.
MARTIN, R. (1928): Lehrbuch der Anthropologie II. - Jena: 579-1182.
MARTIN, R. & SALLER, K. (1957): Lehrbuch der Anthropologie. Bd. 1. - Stuttgart: 440-597.
NEPPER, I. (1982): A Kaba-Bitózugi avar temető (Das awarenzeitlichen Gräberfeldes von Kaba-Bitózug). - Com. Arch. Hung., 93-123.
PENROSE, L.S. (1954): Distance, size and shape. - Annals of Eugenics, 18: 337-343.
VÁMOS, K. (1973): Szeged-Makkoserdő avarkori népességének embertani vizsgálata (Die anthropologische Untersuchung der awarenzeitlichen Bevölkerung von "Szeged-Makkoserdő"). - Anthrop. közl., 17: 29-39.
WENGER, S. (1952): Contributions á l'anthropologie des avars en Hongrie (le cimetière d'Alattyán-Tulát). - Annls hist.-nat. Mus. natn. hung., 2: 205-212.
WENGER, S. (1953): L'anthropologie du cimetière de Jánoshida-Tótkérpuszta. - Annls hist.-nat. Mus. natn. hung., 4: 231-244.
WENGER, S. (1955): Szentes-Kaján népvándorláskori népességének embertani típusai (VII-VIII. sz.) (Types anthropologiques de la population de Szentes-Kaján provenant VII-VIII[e] siècles). - Annls hist.-nat. Mus. natn. hung., 6: 391-410.
WENGER, S. (1972): Anthropological examination of the osteological material deriving from the Avar period cemetery at Tiszavasvár (Hungary). - Anthrop. közl., 11: 199-215.

Author's address: DR. MÁRTA FERENCZ

Anthropological Department
Hungarian Natural History Museum
Budapest, Bajza utca 39.
H-1062
HUNGARY

Table 1 Distribution of crania

Age groups	Measurable		Unmeasurable			Total	
	Male	Female	Male	Female	Undet.	N	%
Infans I	-	-	-	-	8	8	7.1
Infans II	-	-	-	-	10	10	8.8
Juvenis	-	2	4	3	-	9	8.0
Adultus	7	4	15	28	-	54	47.8
Maturus	1	2	23	5	-	31	27.4
Senium	1	-	-	-	-	1	0.9
Total	9 (8.0%)	8 (7.1%)	42 (37.2%)	36 (31.8%)	18 (15.9%)	113	

Table 2 Parameters of male and female series

MARTIN Nº	Males N	V	M	s	Females N	V	M	s
1	8	174-182	179.63	2.46	6	161-173	168.00	5.18
1c	8	174-184	179.13	3.23	6	160-176	169.33	6.44
5	7	97-103	101.71	2.23	3	95-104	98.17	4.95
8	9	117-155	140.00	11.64	8	131-143	138.88	4.20
9	9	88-106	98.33	6.31	8	89-98	93.88	2.72
17	7	131-145	139.43	4.32	3	128-135	131.67	3.54
20	8	112-125	119.38	4.14	5	105-114	109.60	3.52
32-	5	52-57	54.00	2.00	3	46-55	50.00	4.58
40	6	90-104	98.33	5.09	3	87-95	90.33	4.17
45	4	124-138	130.75	6.41	5	119-132	125.40	5.86
46	6	87-108	98.33	7.63	6	83-103	91.17	6.52
47	4	103-126	114.75	9.72	3	115-121	118.00	3.00
48	6	58-71	66.17	5.71	6	59-70	65.50	3.68
51	6	38-42	39.50	1.77	6	36-41	39.17	2.14
52	6	30-34	32.33	1.87	6	32-38	34.17	2.14
54	6	22-39	28.67	5.88	6	20-27	23.50	2.44
55	6	45-55	51.17	3.38	6	44-54	49.17	3.60
62	7	38-48	45.00	3.70	6	36-43	38.83	3.27
63	7	35-46	41.29	3.40	7	37-44	39.14	2.55
65	3	118-123	120.66	2.56	5	115-119	117.20	1.49
66	5	96-111	102.20	6.38	5	87-105	96.00	6.40
69	7	21-34	30.00	4.47	5	24-33	30.40	3.72
70	7	63-77	67.71	4.47	6	56-68	63.00	5.37
71	7	29-35	32.71	2.31	6	29-37	31.17	3.25
72	5	83-91	87.20	3.49	3	87-90	88.67	1.60
8: 1	8	65.4-85.2	78.13	14.90	6	78.4-88.8	82.67	8.78
17: 1	6	73.2-81.0	77.50	5.66	3	74.9-80.8	77.50	6.24
17: 8	7	91.0-112.0	99.07	13.47	3	95.0-103.1	98.17	8.98
9: 8	9	61.9-76.2	70.89	9.27	8	62.2-71.8	67.75	6.11
47:45	3	83.1-91.3	86.00	9.54	3	87.1-100.0	92.67	13.62
48:45	4	45.7-51.5	49.50	5.75	5	50.8-57.9	53.80	5.90
52:51	6	73.8-89.5	82.00	11.37	6	78.1-94.4	87.83	13.68
54:55	6	43.1-70.9	55.67	18.09	6	37.0-56.8	48.33	13.82
63:62	7	79.6-107.9	92.50	19.65	6	88.1-113.9	99.50	22.44
Stature	6	163.7-175.0	169.50	4.14	3	156.4-162.0	158.67	3.09

Table 3 Distribution of morphological characteristics

Characteristics		Male		Female		Total	
		N	%	N	%	N	%
Norma verticalis	Pent.	11	64.7	11	57.9	22	61.1
	Ovoid	4	23.5	4	21.1	8	22.2
	Ellips.	2	11.8	1	5.2	3	8.3
	Rhomb.	-	-	3	15.8	3	8.3
	Total:	17		19		36	
Glabella	Broca 1	2	7.7	14	56.0	16	31.4
	Broca 2	3	11.5	9	36.0	12	23.5
	Broca 3	11	42.3	2	8.0	13	25.5
	Broca 4	6	23.1	-	-	6	11.8
	Broca 5	3	11.5	-	-	3	5.9
	Broca 6	1	3.9	-	-	1	1.9
	Total:	26		25		51	
Protuberantia occipitalis externa	Broca 0	1	6.7	3	33.3	4	16.7
	Broca 1	4	26.7	6	66.7	10	41.7
	Broca 2	6	40.0	-	-	6	25.0
	Broca 3	2	13.3	-	-	2	8.3
	Broca 4	2	13.3	-	-	2	8.3
	Total:	15		9		24	
Sina nasalis anterior	Broca 1	-	-	-	-	-	-
	Broca 2	5	41.7	9	64.3	14	53.9
	Broca 3	6	50.0	5	35.7	11	42.3
	Broca 4	1	8.3	-	-	1	3.8
	Total:	12		14		26	
Fossa canina	(1)	5	27.8	1	7.1	6	18.8
	(2)	5	27.8	5	35.7	10	31.2
	(3)	4	22.2	6	42.9	10	31.2
	(4)	3	16.6	1	7.1	4	12.5
	(5)	1	5.6	1	7.1	2	6.3
	Total:	18		14		32	
Alveolar prognathism	Vertical	2	14.3	1	8.3	3	11.5
	Moderate	8	57.1	6	50.0	14	53.9
	Expressed	4	28.6	5	41.7	9	34.6
	Total:	14		12		26	

Table 4 Individual measurements and indices of males

MARTIN No	Grave No / Age	16 Ad	29 Ad	35 Sen	117 Ad	118 Ad	125 Ad	145 Ad	146 Mat	148 Ad
1		-	180	174	181	180	182	180	181	179
1c		-	178	174	183	180	179	177	184	178
5		103	-	103	101	103	103	102	-	97
8		142	122	146	150	147	155	136	145	117
9		98	93	100	103	91	104	102	106	88
17		141	-	141	145	139	141	138	-	131
20		118	-	116	120	122	125	119	123	112
32-		-	-	-	53	52	55	57	-	53
40		99	-	-	104	90	103	96	-	98
45		-	-	-	-	127	138	134	-	124
46		101	-	-	108	87	104	97	-	93
47		118	-	-	-	-	126	112	-	103
48		68	-	-	71	58	71	69	-	60
51		41	-	-	39	38	42	38	-	39
52		34	-	-	34	30	31	34	-	31
54		39	-	-	29	22	29	28	-	24
55		55	-	-	52	51	51	53	-	45
62		43	44	-	48	38	48	48	-	46
63		43	35	-	40	41	46	43	-	41
65		-	-	-	-	-	123	121	-	118
66		-	105	-	-	103	111	96	-	96
69		33	33	30	-	21	34	28	-	31
70		66	66	77	-	66	69	67	-	63
71		34	35	34	-	29	34	33	-	30
72		-	-	-	83	91	89	89	-	84
8: 1		-	67.8	83.9	82.9	81.7	85.2	75.6	80.1	65.4
17: 1		-	-	81.0	80.1	77.2	77.5	76.7	-	73.2
17: 8		99.3	-	96.6	96.7	94.6	91.0	101.5	-	112.0
9: 8		69.0	76.2	68.5	68.7	61.9	67.1	75.0	73.1	75.2
47:45		-	-	-	-	-	91.3	83.6	-	83.1
48:45		-	-	-	-	45.7	51.4	51.5	-	48.4
52:51		82.9	-	-	87.2	79.0	73.8	89.5	-	79.5
54:55		70.9	-	-	55.8	43.1	56.9	52.8	-	53.3
63:62		100.0	79.6	-	83.3	107.9	95.8	89.6	-	89.1

Table 5 Individual measurements and indices of females

MARTIN No	Grave No	14 Ad	23 Juv	45 Ad	63 Ad	108 Ad	122 Mat	126 Juv	141 Mat
1		161	173	163	173	171	-	-	167
1c		160	176	169	176	171	-	-	164
5		-	95	-	-	96	-	-	104
8		143	139	141	140	134	141	142	131
9		89	92	96	98	93	95	94	94
17		-	132	-	-	128	-	-	135
20		-	112	-	105	108	114	-	109
32-		-	55	-	-	46	-	-	49
40		-	89	-	-	87	-	-	95
45		121	-	-	-	124	131	119	132
46		91	83	-	-	89	91	90	103
47		121	-	-	-	-	118	-	115
48		70	59	-	-	65	67	65	67
51		41	41	-	-	36	38	38	41
52		38	32	-	-	34	35	33	33
54		20	25	-	-	22	23	24	27
55		54	44	-	-	50	47	48	52
62		36	43	-	-	36	42	36	40
63		41	38	44	-	38	37	39	37
65		117	-	117	119	-	118	-	115
66		95	-	96	87	-	97	-	105
69		31	-	33	24	-	33	-	31
70		61	56	68	58	-	67	-	68
71		29	29	30	29	-	33	-	37
8:1		88.8	80.4	86.5	80.9	78.4	-	-	78.4
7:1		-	76.3	-	-	74.9	-	-	80.8
17:8		-	95.0	-	-	95.5	-	-	103.1
9:8		62.2	66.2	68.1	70.0	69.4	67.4	66.2	71.8
47:45		100.0	-	-	-	-	90.1	-	87.1
48:45		57.9	-	-	-	52.4	51.2	54.6	50.8
52:51		92.7	78.1	-	-	94.4	92.1	86.8	80.5
54:55		37.0	56.8	-	-	44.0	48.9	50.0	51.9
63:62		113.9	88.4	-	-	105.6	88.1	108.3	92.5

Table 6 Taxonomical analysis

Types		Male	Female	Total
Cromagnoids	CrA	1	-	1
	CrA-n	-	1	1
	CrB	1	-	1
	CrB-x	1	1	2
	Crx	2	-	2
		5 (33.4%)	2 (13.3%)	7 (46.7%)
Brachycranials	d	2	-	2
	p	-	1	1
	p-x	1	-	1
	br-x	1	1	2
		4 (26.7%)	2 (13.3%)	6 (40.0%)
Nordoids		-	2	2 (13.3%)
Total:		9 (60.0%)	6 (40.0%)	15

Table 7 Size, shape and generalized PENROSE distance of different male and female series from Kaba

Series	Males			Females		
	C_Q^2	C_Z^2	D_P^2	C_Q^2	C_Z^2	D_Q^2
1. Alattyán-Tulát	0.11	1.03	16.44	0.04	0.55	8.72
2. Ártánd	0.11	1.34	21.27	0.04	0.44	7.09
3. Fehértó-A	0.009	0.74	11.66	0.02	0.50	7.83
4. Jánoshida	0.01	0.92	12.79	0.23	0.62	10.47
5. Kecel	0.002	0.87	13.68	0.001	0.54	8.53
6. Szarvas-Kákapuszta	0.25	0.99	16.39	0.17	0.46	7.84
7. Szeged-Kundomb	0.0002	0.93	14.57	0.007	0.46	7.21
8. Szeged-Makkoserdő	0.007	0.95	14.81	0.02	0.36	5.62
9. Szentes-Kaján	0.06	0.61	9.74	0.16	0.20	3.60
10. Tiszavasvári	1.02	0.84	16.64	1.007	0.07	4.45

Table 8 Some comparative indices of the neuro- and splanchnocranium
- Males and females -

Series	Males N	1	2	3	4	Females N	1	2	3	4
1. Alattyán-Tulát	110	78.4	53.2	26.1	19.3	101	78.1	52.9	27.0	19.7
2. Ártánd	37	80.8	52.2	24.8	17.5	27	81.5	49.8	25.4	19.0
3. Fehértó-A	79	81.8	53.9	26.2	19.2	78	80.0	54.1	27.5	19.9
4. Jánoshida	23	80.8	51.3	25.9	19.1	14	78.6	53.9	28.2	20.4
5. Kecel	26	79.4	54.5	25.3	18.9	19	78.5	53.2	26.3	19.2
6. Szarvas-Kákapuszta	14	82.6	55.6	25.3	19.9	5	84.4	50.7	24.7	18.4
7. Szeged-Kundomb	64	79.1	53.2	25.4	18.9	68	79.2	52.5	26.1	19.2
8. Szeged-Makkoserdő	33	87.4	51.1	24.0	18.2	32	83.2	51.6	25.6	18.7
9. Szentes-Kaján	50	84.8	51.9	25.6	19.4	22	81.7	53.6	28.2	19.8
10. Tiszavasvári	21	85.9	51.9	25.1	19.0	29	85.2	50.9	26.1	20.6
11. Kaba	9	87.2	47.5	23.2	21.9	8	85.8	49.8	26.0	18.7

$1 = \frac{17 \times 100}{(1+8):2}$ $2 = \frac{48 \times 100}{17}$ $3 = \frac{52 \times 100}{17}$ $4 = \frac{54 \times 100}{45}$

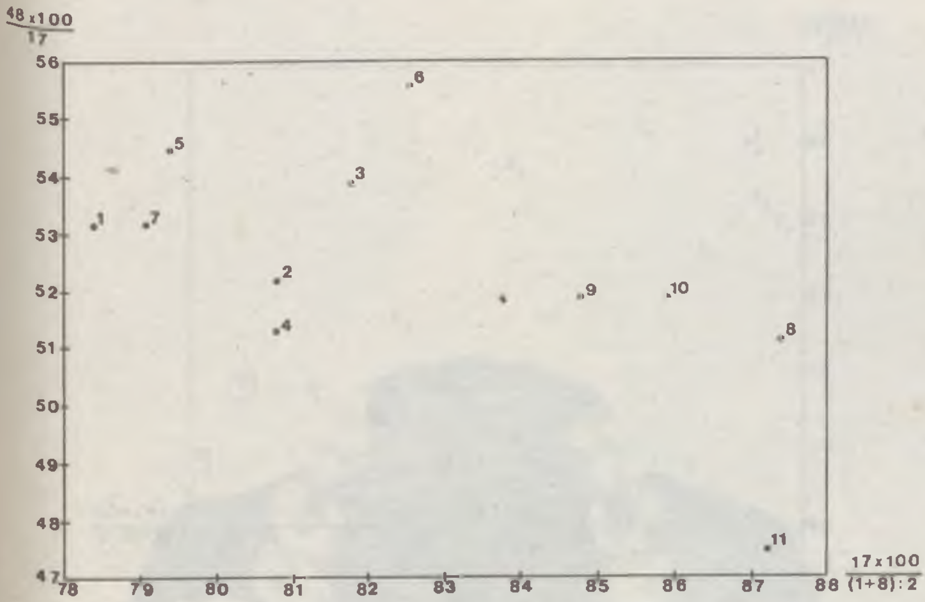
Explanation of plates

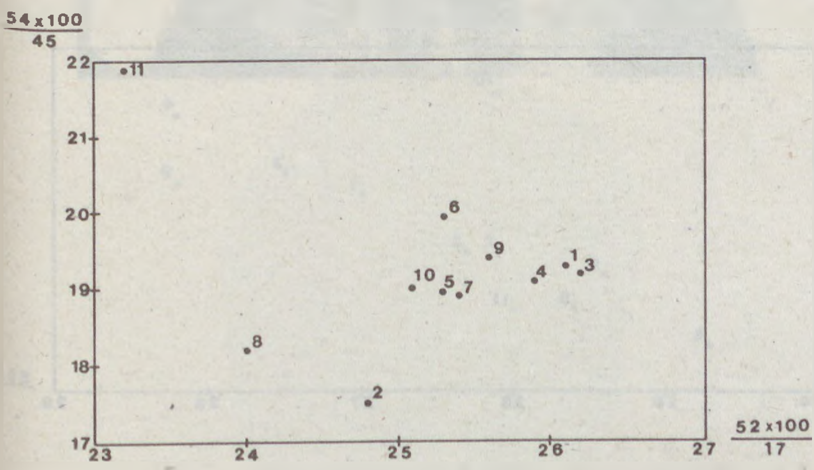
Plate 1 Kaba, Grave No 16, Male, Adultus, cr(x), pin-teeth

Plate 2 Kaba, Grave No 145, Male, Adultus, crB-x

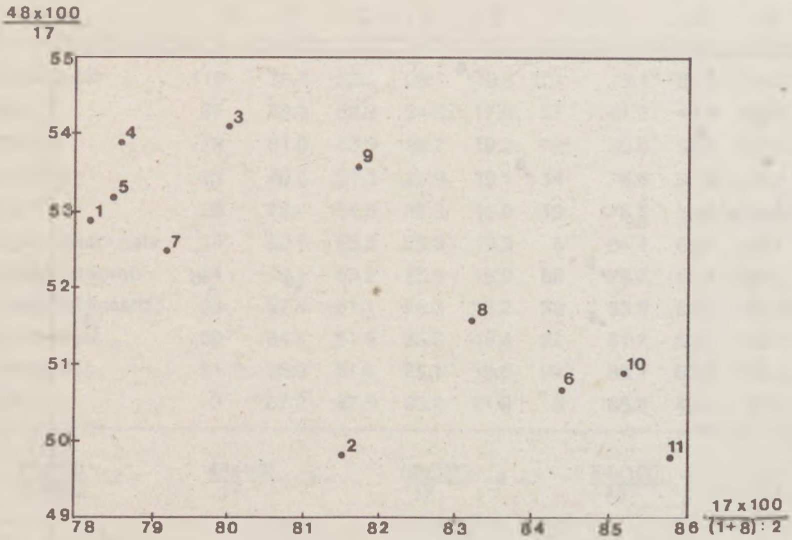
Plate 3 Kaba, Grave No 148, Male, Adultus, cr(x)

Figs. 1-2 Comparison of male series
Sequences of series of Figures 1-4 are the same as in Table 8





Figs. 3-4 Comparison of female series
Sequences of series of Figures 1-4 are the same as in Table 8



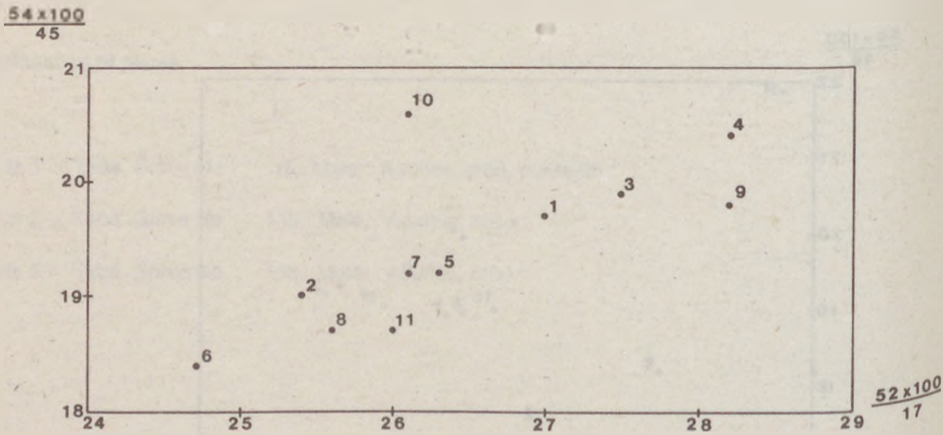


Plate 1

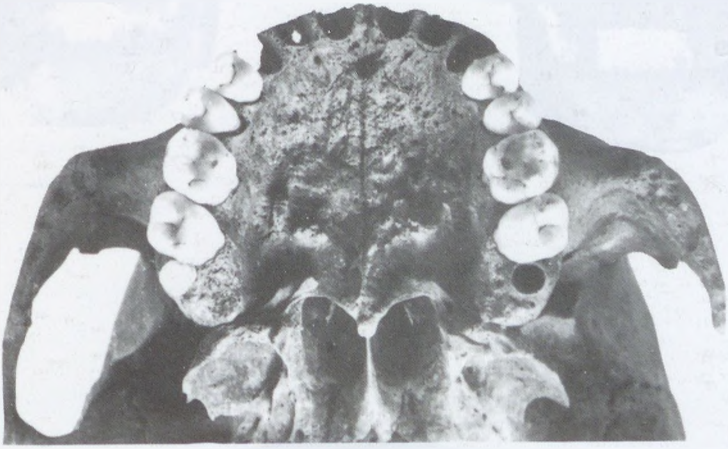


Plate 2

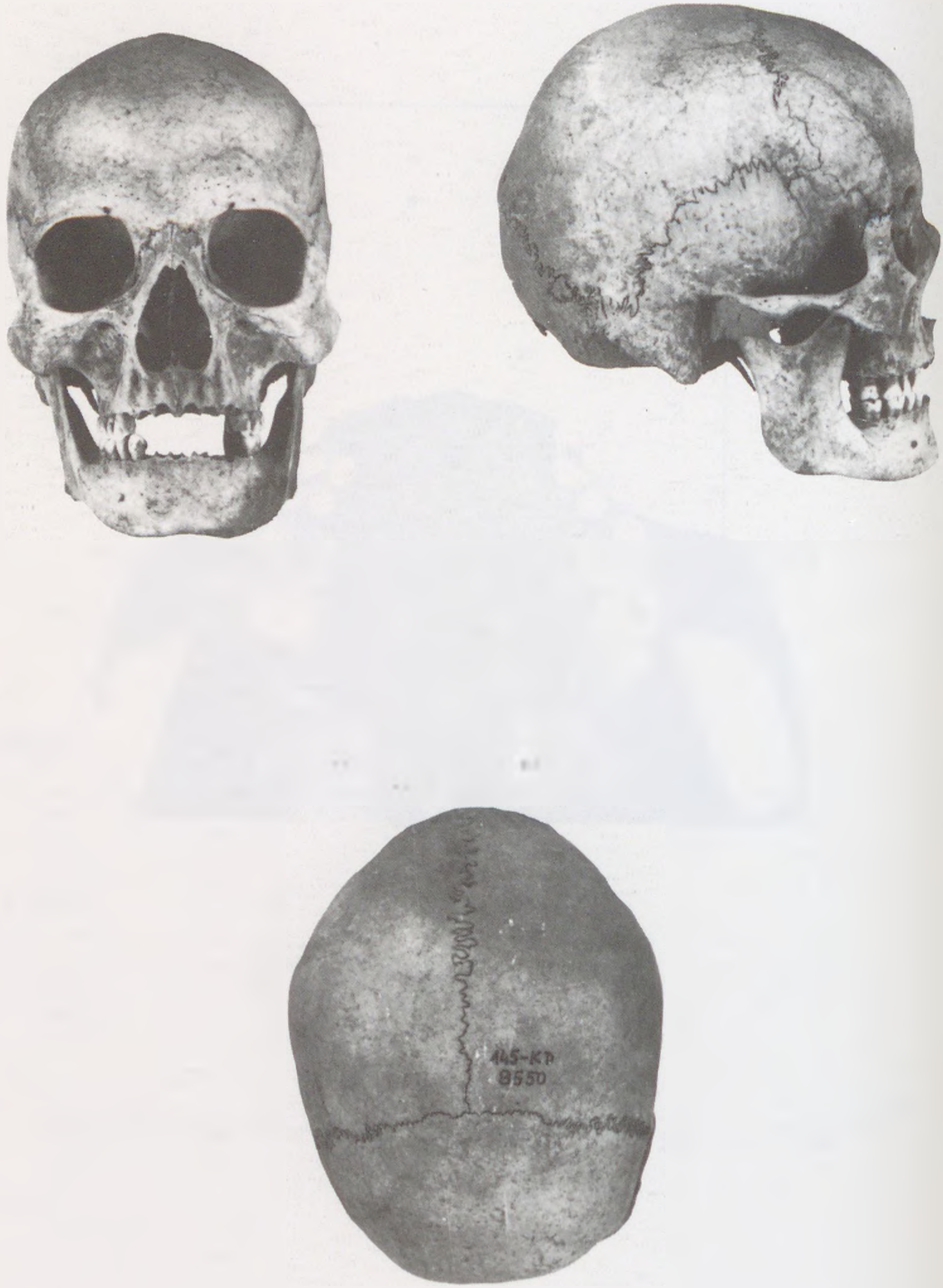
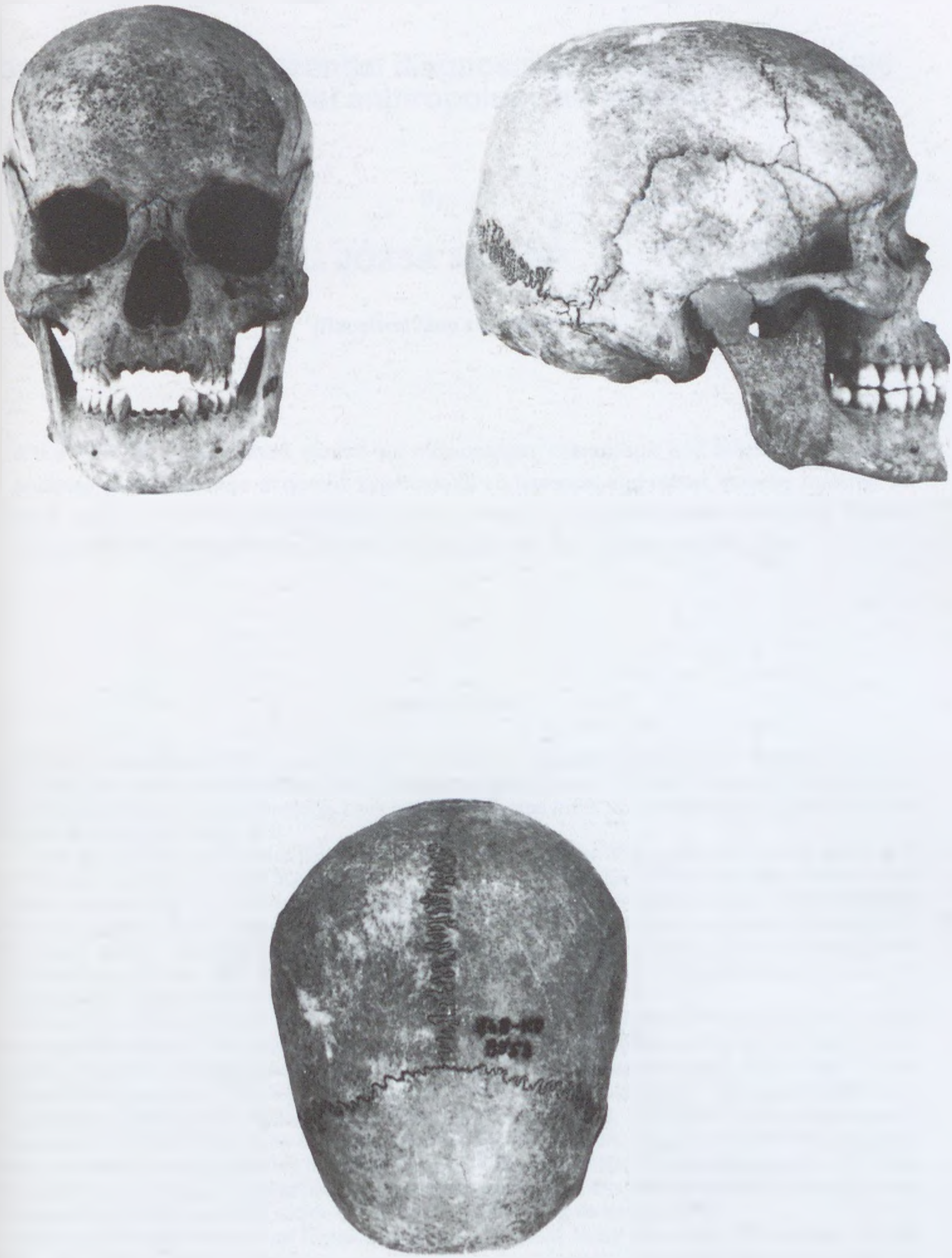


Plate 3



ANTHROPOLOGIA HUNGARICA
XXI. 1990 p. 69-80

Morphology and differential diagnosis of porotic hyperostosis on historical anthropological material

By

L. JÓZSA & I. PAP

(Received May 14, 1990)

Abstract. The authors carried out macroscopic, microscopic and electron microscopic analyses of the structure of porotic hyperostosis on historical and recent autopsy material. All three types of porotic hyperostosis (porotic, cribrotic, trabecular) were examined. Clinical patterns and their differential diagnosis were discussed. With 2 tables and 15 plates.

INTRODUCTION

Porotic hyperostosis (PH) is an alteration of thin bones with the thinning or resorption of the cortical layer and with the proliferation of the cancellaneous bone. It is most frequent on the frontal and parietal bones of the neurocranium. Less frequently it also turns up on other parts of the skull and on the sternum and on ribs as well.

It was WELCKER (1888) who first described it. He found it on the upper part of the orbita and named it cribra orbitalia. HRDLICKA (1914) discovered the same phenomenon on the skulls of pre-Columbian Indians dug up in Peru and designated it osteoporosis symmetrica. Later it was detected on historical as well as on recent material and was described under various names osteoporosis cranii, cribra cranii, hyperostosis spongiosa, hyperostosis porotica (MOLLER-CHRISTENSEN & SANDISON 1963, ANGEL 1967, MARCSIK 1974, 1975, MARCSIK & KÓSA 1976). It is known as "hair on end" or periostitis villosa in the literature of radiology.

HRDLICKA (1914) found it only with the inhabitants of coastal regions and never with people living in mountain areas. This led him to the conclusion that this disease must be the result of some toxic harm. WILLIAMS (1929) added that some local irritation and pressure atrophy could also bring it about besides toxic agents. COOLEY & LEE (1925) confirmed by clinical and X-ray examinations that PH is a constant alteration in thalassaemia major (Cooley-anaemia). HOOTON (1930) established a 66% frequency of PH on the skulls of North-American Indian children. He pointed out that there was no Cooley-anaemia at all in America in the period examined. Therefore, this lesion had to be the result of some other factor. VOGT & DIAMOND (1930) found marked bone lesions with all severe congenital anaemia cases (Cooley-anaemia, sickle-cell anaemia, spherocytosis hereditaria).

Later it became evident that hyperostosis porotica could occur as a result of malaria, of milk anaemia, and of iron deficiency anaemia - quite independently whether iron deficiency was caused by diet, by chronic haemorrhage or by helminthiasis (JELIFFE & al. 1962, LIE-INJO 1958, MOSELEY 1961, 1965, HENGEN 1971, MARTIN et al. 1985). It scarcely develops with congenital a heart disease cases with calcipenic conditions and with chronic infections.

PH occurred all around the world. WELCKER discovered it on archaeological material from Germany. HRDLICKA found PH in Peru, HOOTON in Mexico, WAKEFIELD & al. (1937) in Arizona. WILLIAMS (1929) established its presence on pre-Columbian material from Arkansas, JELIFFE et al. (1962) found it with children of the Bahima people in Uganda and ADACHI (1904) detected it on ancient Egyptian and Daiak skulls. It was discovered on 182 skulls in Czechoslovakia up to 1981 (HANAKOVA & VYHNAŇEK1981). NATHAN & HAAS (1966) observed it on monkeys and apes.

The data are quite varied on the frequency of PH. HRDLICKA traced it down on 11 skulls from a total of 278. WILLIAMS found four cases from 176 ancient Peruvian crania while he found no PH at all in the Ontario skeletal material. "Hair on end" was perceived by HOOTON on two-thirds of all the ancient Mexican children's skulls analyzed. VOGT & DIAMOND (1930) found it with all his hereditary anaemia patients as well as JELIFFE & al. who also noticed it with all his anaemic patients. There are authors (HENSHEN 1961, MOSELEY 1965) who consider racial differences as one of the reasons for the different frequency of PH.

MATERIAL AND METHOD

We performed macroscopic, microscopic and electron microscopic analysis of the structure of PH as it occurred on historical and recent autopsy material.

Recent, autopsy material: 8002 autopsies were examined in the National Institute of Traumatology between the 1st of January 1968 and 31st of December 1987. In the first decade the patient material came from the surgery and internal medical wards while the deceased came exclusively from the surgery ward in the second decade.

Historical material: We analyzed the bones of 805 individuals originating from the territory of Hungary (Vörs-Papkert B: 8-11th c., Nagykőrös: 11-13th c., Esztergom-Vasútállomás: 11-12th c., Szabolcs-Petőfi utca: 11-13th c.) in the 8-13th centuries.

X-ray examination: The bones bearing the traces of PH were analyzed by Medicor GT-2 X-ray equipment with tv image-amplifier. X-ray pictures of the selected material were taken.

Microscopic analysis: The bones were embedded in paraffin after decalcification with EDTA or in Durcupan ACM without decalcification. The 5-8 µm sections were stained with HE (haematoxylin-eosin), picrosirius and PAS and toluidine blue staining, and were scrutinized by light and polarization microscopes. The skeletal material was investigated by stereomicroscopeas well, to establish the bone structure.

Scanning electron microscopic analysis: The skeletalized material was coated in gold without dehydration and fixation (PAWLICZKI 1976). Photographs were taken through a Tesla 300 BS scanning electron microscope.

RADIOGRAPHIC MORPHOLOGY

This lesion could be identified on the frontal bone, on the parietal bones, on the squamous part of temporal bones and on the palate. The first signs of PH is a clearly periostitis-like alteration on the tubera parietalia et frontalia and on the processus orbitalis ossis frontalis. It is closely followed by superficial osteoporosis. The continuous surface of lamina externa is ruptured, the diploe gets wider and a strongly defined trabecular system is visible. The lamina interna always remains compact. The lamina externa is thinned and turns porotic. Spicula take shape in a radial system, perpendicularly to the outer surface. These spicula can be 2-3 mm long. In profile a brush-like configuration is formed (Plate 1). Lamina externa is bulky and compact around porotic areas. The diploe is narrow and it contains only few trabeculae. The PH affected regions of cranial bones became markedly thicker. Wide, condensed lamina externa is visible in X-ray pictures after the remodelling brought about by healing.

GROSS MORPHOLOGY

NATHAN & HAAS (1966) classified three main types of PH. With the porotic type lamina externa is thinned, and small, 0.2-2 mm diameter round or oval openings (Plate 2) are present on the skull. There are no spongiotic areas and no surface level alterations in these cases. With the cribrotic type the openings are bigger and they tend to conglomerate. The superabundant bone trabecular system of diploe is clearly visible. With the trabecular type lamina externa is extensively destroyed (in several cm^2 regions). Trabeculae are spongious or they present a proliferating coral-like structure. They protrude above the level of the surrounding lamina. The affected area is 1-3 mm higher than the neighbouring regions. The lesion is round, oval or butterfly-shaped as a result of several conglomerating centres. It is extending in outward growing circles. Cribrotic and/or porotic details can be observed on the edge of the trabecular type lesion. The sutures set a limit to the spreading of this lesion. It never extends beyond this borderline. Any given skull may bear several and different types of lesions (Plate 3). The porotic, cribrotic and trabecular types are different stages of the same process. They may be located beside each other or in various parts of the same eruption.

The bone eruptions may become quite extended and they may appear on splanchnocranial bones (palate, maxilla, os zygomaticum) as well, depending on the severity and course time of the anaemia. Parallel with these processes the development and pneumatization of facial cavities may fail to occur and the multiplication of trabeculae may take place in the maxilla, too. The medullary cavities of tubular bones expand and the cortical layer becomes thin.

MICROSCOPIC FEATURES

The cortical layer is thinned out and it is absorbed in some smaller regions in the porotic type. The multiplied trabeculae of spongiosa form a complicated medullary cavity system (Plate 4). The lamina externa is resorbed within the whole region of the lesion, while it is remarkably thinned in the cribrotic type. The spongious substance is made up of a great number of thin bone trabeculae (Plates 5-7). In the trabecular type bulky, hyperplastic trabeculae take shape in the substantia spongiosa - quite differently from the cribrotic form. The lamellar and collagen structure of these trabeculae is far from being normal (Plates 8-10). The superabundant trabecular system surrounds large "cystae".

Modifications of the bone architecture: Bone trabeculae form a grid-like structure between lamina externa and interna in normal cranial (frontal, parietal) bones. This structure has a similar pattern to that of the girders of bridges. This structure itself is not altered in the porotic type, only the density and thickness of trabeculae is different. The normal architecture and the structure of the trabecular type is mixed up in the cribrotic type. The spatial system of trabeculae is altered in the trabecular type. The bunches of girders are arranged in a cranio-caudal pattern, the trabeculae form a coral-like structure.

SCANNING ELECTRON MICROSCOPIC FEATURES

The outer surface bears a large number of 20 μm – 1-2 mm diameter cavities which are in anastomosis with diploe (Plate 11). Uncovered collagenous fibrils can be seen on the edge of the cavities. The superabundant trabeculae of diploe become uncovered and therefore visible in the cribrotic type. These trabeculae are varied in their thickness. They surround a complicated system of cavities (Plate 12). Secondary cavities occur within the diploe's trabeculae. The surfaces of trabeculae bear bark-like patterns formed of collagen fibrils (Plate 13). Fracture surfaces of spicula present an irregular internal structure instead of the normal lamellar one (Plate 14). In the trabecular type trabeculae are formed perpendicularly to the bone surface, with deep, shaft-like cavities (Plate 15).

Clinical patterns

PH may accompany a wide variety of inherited or acquired diseases and pathological conditions (Table 1). It is frequently associated with severe, congenital clinical patterns. Its frequency is almost 100% with Cooley-anaemia cases, while it is 50-80% with spherocytic and sickle-cell anaemias. Acquired haemolithic anaemias, the continuous consumption of haemolithic toxins (some mycotoxins, filix maris), chronic toxic conditions usually have 5-10% of associated PH. Some hallucinogenic fungi contain fallizin, a haemolithic toxin (LÁSZLÓ 1981). These formed a regular item in the diet of shamanistic peoples. PH is rare in megaloblastic anaemias (B_{12} vitamin deficiency, folic acid deficiency) (LALLO & al. 1977, HENGEN 1971).

Most iron deficiency anaemias are caused by biased diets. Iron deficiency anaemia develops with an almost 100% certainty if a mixed diet with greens and meat is not introduced at the age of 6-18 months. Anaemia starts in the first year of the children's life and it ends only with a basic change of diet. In the Middle Ages children were breast-fed up to the age of 2-3 years according to historical sources. Breast-feeding was occasionally supplemented by cereals (bread and pulps). Infections produce rapidly developing severe anaemia with infants and young children - as a consequence of accelerated. Then it can result in even more severe nutritional anaemia with all its skeletal manifestations.

Biased diet, chronic infections and achlorhydria can lead to iron deficiency anaemia with children above 5 years of age. Iron deficiency anaemia is regularly associated with malignant tumours and chronic renal diseases. The majority of anaemias is not accompanied by PH, though the living organism attempts to compensate iron deficiency anaemia by increased red blood cell production. This lesion occurs mainly on the cranial bones of children. It is quite rare on the skulls of adults but it is more frequent on their sternum and ribs. Uncured and therefore lasting iron deficiency and nutritional anaemias lead to the formation of cribra in 50-80% of the recent material. A similar ratio is probable for historical material, too. Though we found no references on the relationship of PH and red blood cell count (the authors mention its presence with severe anaemia at best), we attempt to provide data from our own limited recent material. A long lasting red blood cell count of about 2 million/mm^3 or the lasting 50% decrease of haemoglobin content results in porotic alterations on the sternum and very seldom on cranial bones (primarily on the parietal bone) in 1-2% of adults. From a total of several thousand autopsies only two children who died of malignant tumours were affected with PH. Their red blood cell counts were between 1.5-2 million/mm^3 with 30-45% haemoglobin contents - despite chemical and transfusion therapies. Though leukaemia also has associated anaemia and bone marrow hyperplasia, no PH was found at all in 100 autopsy cases of leukaemia.

Red blood count may be as high as 6 million/mm^3 with 130-160% haemoglobin contents in congenital, heart malformation (Fallot tetralogy, truncus arteriosus, Eisenmenger disease, transposition of great blood-vessels, etc.). Only 1-5% of the cases showed PH in spite of the increased red blood cell production.

Differential diagnosis

It is not difficult to establish differential diagnosis for recent cases with laboratory data available. However, the situation is quite different with PH of fossil bone material. When we try to draw conclusions on etiology on the primary disease, we must consider a number of factors, as the geographical and race frequency of diseases, all kinds of morphological and radiographic alterations of bones, and family relations.

1. Geographic distribution

Thalassaemia major (Cooley-anaemia) and thalassaemia minor developed in the Northern Mediterranean region and they are endemic there (ANGEL 1966, 1967). They are quite common in Italy, in Greece, in Turkey and in Bulgaria. Their frequencies decrease in parallel with the growth of the distance from this area. No Cooley-anaemia was reported with Hungarian citizens during the last 60 years (HOLLÁN 1973). (COOLEY described this disease in 1925.) Sickle-cell anaemia (drepanocytaemia, haemoglobin C disease) is characteristic for black African peoples. 5-10% of the black populations of Middle-, East- and West-Africa have sickle-shaped red blood cells and 10% of them is affected with severe anaemia. None of these diseases occurred in pre-Columbian America and in the northern parts of Eurasia. We may practically disregard these clinical patterns in the differential diagnosis of Hungarian skeletal material as only sporadic isolated cases or disease affected families were found in Hungary. Up to the present only a single Cooley-anaemia case came to light from a Roman cemetery in Pécs (SZALAI 1986).

2. Family relations

Congenital haemolithic anaemias may have dominant (Cooley-anaemia, sickle-cell anaemia, elliptocytosis familiaris) or recessive inheritance. The hereditary character of the basic disease must be considered when family relations can be established within a cemetery, and PH occurs cumulatively in the members of a given family.

Pyruvat-kinase enzyme deficiency symptom is also a hereditary disease. It is very rare in the recent Hungarian population but we must not disregard it when analyzing skeletalized material. When this enzyme deficiency is cumulatively present in a family, at least half of the children becomes afflicted. Due to enzyme deficiency anaemia PH develops in them. PH occurs almost as a rule with each individual whose anaemia was caused by pyruvat-kinase enzyme deficiency but postcranial alterations are usually absent in these cases.

3. Immunological examinations

Haemoglobin's protein component (apohaemoglobin) has two different chains (alpha and beta). The two chains have different immunological character and both are antigenic. Therefore, not only the quality but the quantity of fossil bone's haemoglobin content can be detected by immunochemical methods (ASCENZI & al. 1985). Even the haeomoglobin content of 15-20,000 years old bone material can be determined. The haemoglobin content of bones is proportional to the grade of erythropoesis. Therefore, an increased haemoglobin content may indicate hyperactive erythropoesis even before their morphological manifestation on bones.

4. Trace element analysis of bones

Iron deficiency anaemia is probably the most frequent etiology of PH. The iron content of bones could be an excellent marker of iron deficiency. Though soil can affect the iron content of fossil bones trace element analysis is convenient to determine the etiology of PH on bones from the same microenvironment. Atomic absorption spectrophotometric analysis of normal bones always detected iron contents larger than 800 ppm while iron deficiency samples always had smaller than 700 ppm values (usually 200-400 ppm) (FORNICARI & al. 1981).

Iron deficiency anaemia can be excluded as an etiological factor when gross morphology indicates the presence of PH but the bone has normal iron contents. Larger than normal iron contents could indicate even a hyperglobulia based on congenital vitium and polycytaemia vera.

5. The spatial location of cranial lesions

Congenital haemolytic anaemias (Cooley-anaemia, sickle-cell anaemia etc.) stay remain the diseased persons for all their lives. Therefore, increased red blood cell production and hyperplastic marrow remain constant characteristics during the life span. PH may appear not exclusively on the parietal and frontal bones but on the maxilla, on the zygomatic bone and on the bony palate, etc. The face may take Mongoloid features with protruding teeth and protuberant os zygomaticum. The development and pneumatization of paranasal cavities fail to occur or are retarded. These cavities are often mere apertures even on the skulls of 12-15 years old individuals.

Iron deficiency or nutritional anaemias usually bring about PH formation restricted to the bones of the neurocranium. The pneumatization of paranasal cavities is undisturbed (MOSELEY 1965). PH develops most often on the upper part of the orbital cavities, on parietal, on frontal and on temporal bones in a decreasing order of frequency. The area of lesion affected skull surfaces can reach 6-8 cm^2 per centre in congenital haemolithic anaemias but it remains smaller in iron deficiency and nutritional anaemias (LIE-INJO 1958).

Macrocephaly develops at the age of 6-12 months with congenital hyperphosphatasy. An extremely large trabecular type spherostosis is formed on the skull from the forehead to the nape (EYRING & EISENBERG (1968). Bi-concave vertebrae, severe osteoporosis of tubular bones and thinned outer cortical layer are also characteristic.

The duration and severity of the primary disease seem to be correlated not only with the size of the lesion but with the type of it as well. The trabecular type is dominant or almost exclusive in congenital haemolytic anaemias. Iron deficiency anaemias are accompanied with less severe and smaller size lesions. If the presence of Wilson-bands and/or enamel hypoplasia of incisors or canines can be verified by microscopic examinations it points towards nutritional or iron deficiency anaemia (ROSE & al. 1985). Frontoparietal cranial deformation is usually incidental to congenital haemolytic anaemias as well as to PH caused by cyanotic vitium. Whereas the deformity of the occipital region is more characteristic for iron deficiency anaemias (SZALAI 1986).

6. Alterations of tubular bones

There are no specific lesions on tubular bones in congenital haemolytic anaemias. The expansion of the medullary cavity of diaphysis, the thinning of the cortical layer and the resorption or absence of medullary cavity trabeculae is clearly visible in X-ray pictures and/or on the sawn up bones.

Vertebral corpus compression may occur in sickle-cell anaemia. In hypovitaminosis conditions (scurvy, rickets) macroscopically and radiographically characteristic alterations can be found in the growth zone of bones.

Dietary disorders (and less frequently other reasons such as febrile diseases or endocrine disturbances) may temporarily arrest the growth of long bones and Harris lines are formed. The Harris lines are well defined, 0.5-2 mm wide, transverse lines of increased opacity. These radiographic patterns may occur in single or multiple form on both ends of the femur, tibia, humerus and of the radius. The position of Harris lines relative to the midshaft makes it possible to determine the etiological age when a child was affected by dietary disorder. Harris lines can be detected in recent populations, too. Their frequency is 1-5%. The absence of Harris lines may indicate the absence of any dietary disorder (milk anaemia, iron deficiency anemia). Their presence - especially in the multiplied form - renders dietary and/or deficiency anaemias probable.

We observed the combined presence of PH and the radiographically detectable alterations of tubular bones. Half of the PH affected individuals also had Harris lines in their tibiae, femora and less frequently in other tubular bones as well (JÓZSA & PAP 1988). However, no significant association was found between PH and Harris lines by other authors in other materials (MARCSIK 1987).

Renal diseases leading to chronic uraemia produce PH in a small percentage. When the lesion is formed as a result of such a disorder the traces of PH are detectable on tubular bones. Renal diseases leading to chronic uraemia always result in secondary hyperparathyreosis that brings about severe osteoporosis in the entire skeleton and may occasionally lead to osteodystrophia fibrosa generalisata of the Recklinghausen type. In cyanotic congenital heart malformations PH frequently develops as the organism attempts to compensate the insufficient oxygenation by increased red blood cell production. These cases can be separated from PH of different etiology if the tubular bones bear radiographic and/or macroscopic/microscopic features of hypertrophic osteopathy. In these cases large bark-like periostal bone formation can be seen on the tubular bones of the distal phalanges. When phalangeal bones are available, hippocratic deformities of the distal phalanges always indicate cyanotic conditions.

The metastatic process is characteristic for malignant tumours (except tumours of the central neural system). Bone metastasis was found in 36.7% of almost 3,000 recent tumour cases by autopsy and/or histological analysis. Though malignant tumours were less frequent is historical material than nowadays we have no reason to presume that the biological characteristics and metastatic features of tumours changed at all. Nowadays, tumorous metastasis is very rare below elbows and knees. Only 0.6% of all bone metastasis occurs on the distal bones of limbs (LISZKA & al. 1989). Their vast majority can be located on the skull, on the spine, the pelvis, the thigh-bones and on the ribs. These bones are the most frequent remains of skeletalized material. Gross macroscopical analysis without sawing up is able to identify only a minority of metastases. Therefore, when PH caused by tumours, or tumorous anaemias is suspected it is well worth carrying out X-ray examinations. This way we have a fair chance to detect approximately one-third of all malignant tumours by bone metastasis.

PATHOGENESIS OF PH

No matter what the primary disease is erythroid hyperplasia of the bone marrow is a common factor of PH. Cell-rich marrow is formed in the cranial bones, and a certain degree of spatial disproportion develops. Lamina externa is thinned out from the direction of diploe and then it is perforated. Finally it is completely destroyed over large areas. A subperiosteal proliferation of cell-rich bone marrow begins. Periosteal irritation brings about the formation of new bone material by the blood vessels of the medullary cavity. As the blood vessels of the medullary cavity are running perpendicularly to the outer cortical bone, the trabeculae formed parallel to these blood vessels follow a similar pattern. The bone marrow proliferates above the level of the lamina externa by these newly formed trabeculae. Parallel to this process lamina interna is gradually becoming thicker and thicker (MOSELEY 1965, HAMPERL & WEISS 1955).

REFERENCES

ADACHI, B. (1904): Die Porositat des Schadeldaches. - Ztsch. Morph. Anthropol., 7: 373-395.

ANGEL, J.L. (1966): Porotic hyperostosis, anaemia, malarias and marshes in prehistoric Eastern Mediterranean. - Science, 153: 760-763.

ANGEL, J.L. (1967): Porotic hyperostosis or osteoporosis symmetrica. In: Brothwell, D. A., Sandison, A.T. (eds), Disease in antiquity. Springfield, Illinois: C. Thomas, 378-389.

ASCENZI, A., BRUNORI, M., CITRO, G. & ZITO, R. (1985): Immunological detection of haemoglobin in bones of ancient Roman times and of Iron and Eneolithic ages. Proc. Nat. Acad. Sci., 82: 7170-7172.

COOLEY, T. B. & LEE, P. (1925): Series of cases of splenomegaly in children with anaemia and peculiar bone changes. - J. Am. Pediat. Soc., 37: 29-45.

EYRING, E. J. & EISENBERG, E. (1968): Congenital hyperphosphatasy. - J. Bone Joint Surg., 50A: 1099-1117.

FORNICARI, G., MALLEGNI, F., BERTINI, D. & NUTTI, V. (1981): Cribra orbitalia and elemental bone iron in the Punics of Carthage. - Ossa 8: 63-77.

HAMPERL, H. & WEISS, P. (1955): Über die spongiöse Hyperostose an Schädeln aus Alt-Peru.- Virchows Arch.A.Path. Anat. 327: 629-642.

HANÁKOVA, H. VYHNÁNEK, L. (1981): Paläopathologische Befunde aus dem Gebiet der Tschechoslowakei. - Acta Muz. Nat. Pragae, 37B: 1-76.

HENGEN, O. (1971): Cribra orbitalia: Pathogenesis and probable etiology. - Homo 22: 57-75.

HENSCHEN, F. (1961): Cribra cranii, a skull condition said to be of racial or geographical nature. - Path. et Microbiol. (Basel), 24: 724-749.

HOOTON, E. A. (1930): The indians of Pecos Pueblo. A study of their skeletal remains. - Yale Univ. Press, New Haven. pp.

HRDLICKA, A. (1914): Anthropological work in Peru in 1913, with notes on pathology of ancient Peruvians. - Smithsonian Misc. Collections, 61: 1-69.

JELIFFE, D.B. & BLACKMAN, V. (1962): Bahima disease: possible "milk-anaemia" in late childhood. - J. Pediat., 61: 774-779.

JÓZSA, L. & PAP, I. (1988): Nutritional variations within a 9-10th century cemetery. In: Abstracts of the 6th Congr. Europ. Anthrop. Ass., Budapest, p. 31.

LIE-INJO, L.E. (1958): Chronic iron-deficiency anaemia with bone changes, resembling Cooley-s anaemia. - Acta Haemat., 19: 263-268.

LISZKA, Gy.. RIEDL, E. & RINGWALD, G. (1989): Polikemoterápiában részesült betegek patológiás törései. - M. Radiol., 63: 110-114.

LALLO, J., ARMELAGOS, G.J. & MENSFORTH, R.P. (1977): The role of diet, disease and physiology in the origin of porotic hyperostosis. - Human Biol., 49: 471-483.

LÁSZLÓ, N. (1981): Mérges gombák, gombamérgezések [Poisoning fungi, mycetism]. - Medicina, Budapest

MARCSIK, A. (1974): "Symmetrical osteoporosis" in a palaeopathological material. - Acta biol. (Szeged), 20: 191-197.

MARCSIK, A. (1975): Egy csontelváltozás feltételezett aetiológiája (Supposed ethiology of a bone alteration). - Anthrop. Közl., 19: 47-53.

MARCSIK, A. (1978): Comparative evaluation of pathological Avar findings from excavation between the Danube and Tisza rivers. - Acta biol. (Szeged), 24: 145-150.

MARCSIK, A. & KÓSA, F. (1976): Újabb adatok egy vitatott palaeopathologiai lelet aetiológiájához szövettani vizsgálatok alapján (Further data to the debated etiology of a palaeopathological find (in Hungarian) - Anthrop. Közl.. 20: 127-131.

MARTIN, D. L., GOODMAN, A.H. & ARMELAGOS, G.J. (1985): Skeletal pathologies as indicators of quality and quantity of diet. - In: Gilbert, R.I., J.H. MIELKE (eds), The analysis of prehistoric diets. Academic Press, Orlando - San Diego - New York, pp. 227-279.

MOLLER-CHRISTENSEN, V. & SANDISON, A.T. (1963): Usura orbitae (Cibra orbitalia) in the collection in the Anatomy Department of the University Glasgow. Path. Microbiol.26: 175-183.

MOSELEY, J.E. (1961): Skull changes in iron-deficiency anaemia. - Am. J. Roentgenol., 85: 649-652.

MOSELEY J.E. (1965): The paleopathologic riddle of "Symmetrical osteoporosis". Am. J. Roentgenol. 95: 135-142.

NATHAN, H. & HAAS, N. (1966): On the presence of cribra orbitalia in apes and monkeys. - Am. J. Phys. Anthrop., 24: 351-360.

PAWLICKI, R. (1976): Preparation of fossil bone specimens for scanning electron microscopy. Stain. Technol. 51: 147-152.

ROSE, J.C., CONDON, K. W. & GOODMAN, A.H. (1985): Diet and dentition: Developmental disturbances. - In: Gilbert, R.I., J.H. MIELKE (eds), The analysis of prehistoric diets. Academic Press, Orlando - San Diego - New York, pp. 281-305.

SZALAI, F. (1986): Occurrence of Thalassemia major on a paleoanthropological findings. Acta Biol. (Szeged) 32: 175-182.

VOGT, E. C. & DIAMOND, L. K. (1930): Congenital anaemias, roentgenologically considered. - Am. J. Roentgenol., 23: 625-627.
WAKEFIELD, E. G., DELLINGER,S. C. & CAMPO, J. D. (1937): Study of osseous remains of "mound builders" of Eastern Arkansas. - Am. J. Med. Sci., 193: 488-495.
WELCKER, A. (1888): Cribra orbitalia. - Arch. Anthrop. 17: 1-18.
WILLIAMS, H.U. (1929): Human palaeopathology, with some original observations on symmetrical osteoporosis of skull. - Arch. Path., 7: 839-902.

Authors' addresses:

DR. LÁSZLÓ JÓZSA

Department of Morphology
National Institute of Traumatology
Budapest, P.O.B. 21.
H-1430
HUNGARY

DR. ILDIKÓ PAP

Department of Anthropology
Hungarian Natural History Museum
Budapest, Bajza u. 39.
H-1062
HUNGARY

Table 1 Diseases and conditions inducing PH

ANAEMIAS
I. Congenital haemolytic anaemias
Thalassaemia major (Cooley-anaemia) Thalassaemia minor Sickle cell anaemia (Haemoglobin C disease) Spherocytosis hereditaria Pyruvat-kinase deficiency anaemia Elliptocytosis hereditaria Congenital hyperphosphatasy
II. Acquired anaemias
Iron deficiency anaemia Copper deficiency anaemia Milk anemia Postinfectious anaemia
OTHER DISEASES
Congenital heart malformations Polycytaemia vera Malaria Calcium deficiency Vitamin C deficiency Chronic renal diseases, chronic uraemia Anaemia attached to malignant tumours

Table 2 Differential diagnosis of PH on historical material

CONGENITAL ANAEMIAS	
Cooley-anaemia Sickle-cell anaemia Elliptocytosis hereditaria Pyruvat-kinase deficiency anaemia	Geographical distribution Race characteristics Family relations PH on splanchnocranium Pattern of PH Depneumatization of paranasal cavities Large area PH Medullary cavity expansion on tubular bones
ACQUIRED ANAEMIAS	
Iron deficiency anaemia Milk anaemia	PH restricted to neurocranium PH of different patterns Less extensive PH Wilson bands on teeth Harris lines on tubular bones Reduced iron content of bones in iron deficiency anaemias
HEART MALFORMATION	
Osteopathia hypertrophica on tubular bones Deformities of the distal phalanges	
RENAL DISEASES WITH CHRONIC URAEMIA	
Diffuse osteoporosis Osteodystrophia cystica	

Plate 1 X-ray picture of a "hair on end" case

Plate 2 Symmetrical porotic hyperostosis on the forehead and the orbita (arrow)

Plate 3 Several types of lesions on the same skull

Plate 4 Irregular cavities formed by the spongiosa. Spongiosa opens outwards (10x)

Plate 5 Hyperplastic and irregular cancellous structure in the depth of diploe. Stereomicroscopic picture.

Plate 6 Cribrotic type with thin irregular trabeculae. HE staining.

Plate 7 Polarization image of the bone of Plate 6

Plate 8 Trabecular type with thick, hyperplastic bone tissue. Stereomicroscopic image.

Plate 9 Light microscopic structure of the cancellous bone. Toluidin blue staining.

Plate 10 Irregular collagen structure within the trabeculae. Polarization microscopic image.

Plate 11 Cavities on the external surface with destroyed cortical osseous lamellae around them. SEM

Plate 12 Trabeculae of various thickness surround a complicated system of cavities

Plate 13 Secondary cavities within trabeculae (arrow). The fibrils running from the bark-like surface of spongiosa. SEM

Plate 14 No normal lamellar structure is visible within this broken bone trabecula (arrow) but coral-like structures are. SEM

Plate 15 Newly formed trabeculae (T) protruding above the level of lamina externa (LE). SEM

Plate 1

Plate 2

Plate 3

Plate 4

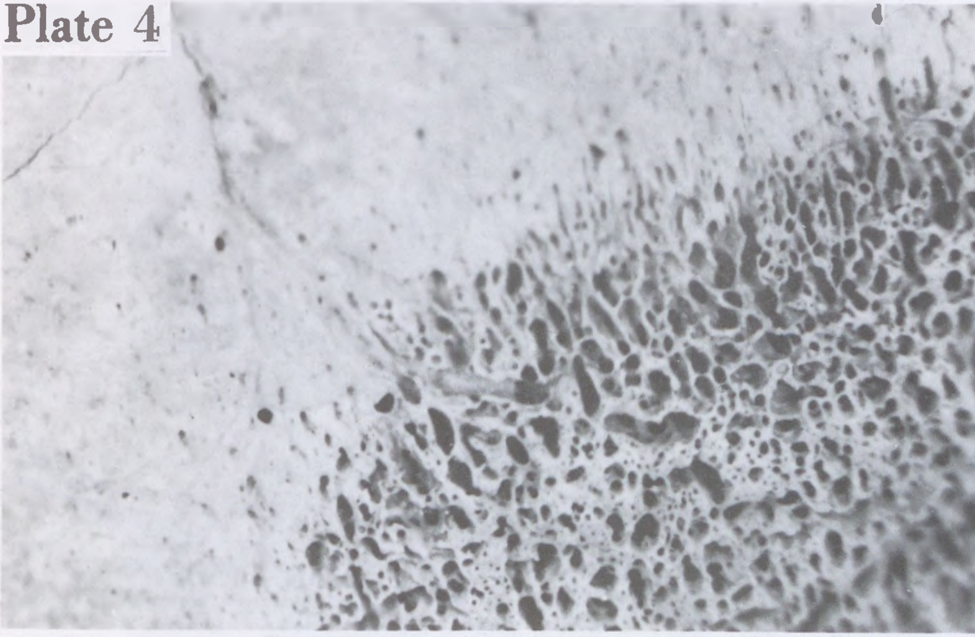


Plate 5

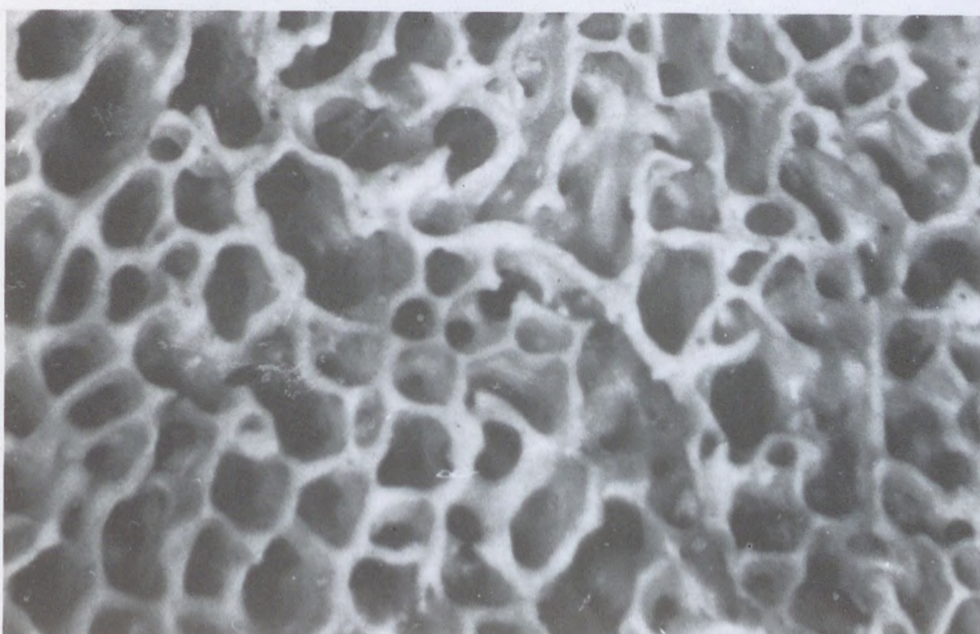


Plate 6

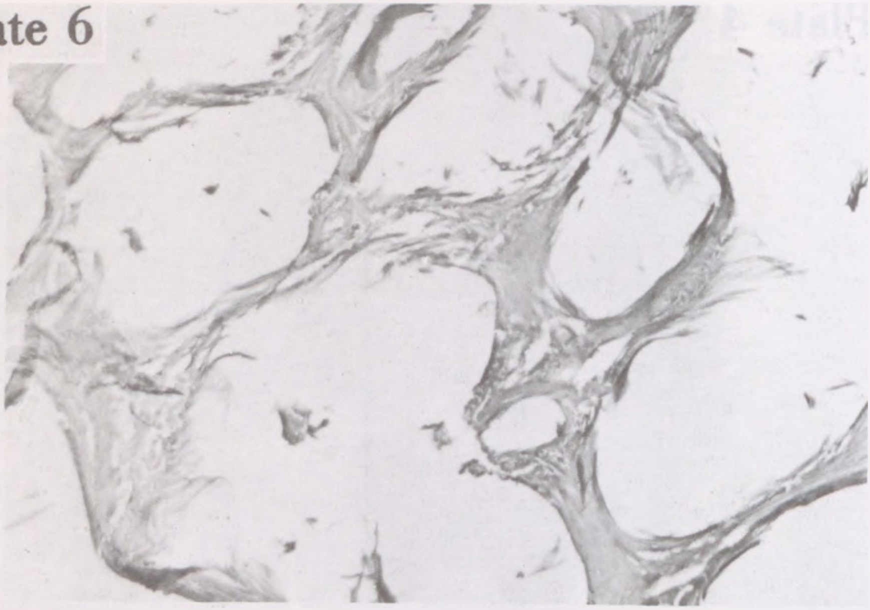


Plate 7

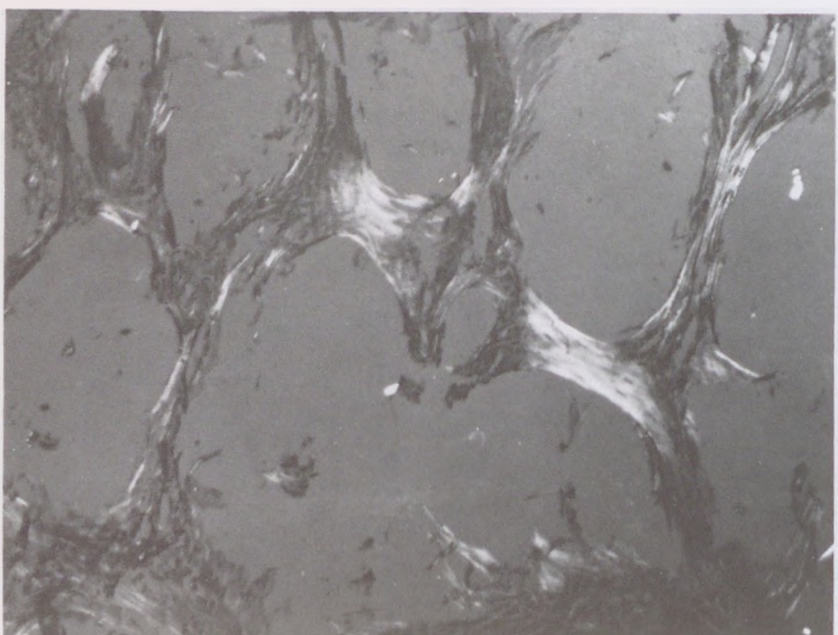


Plate 8

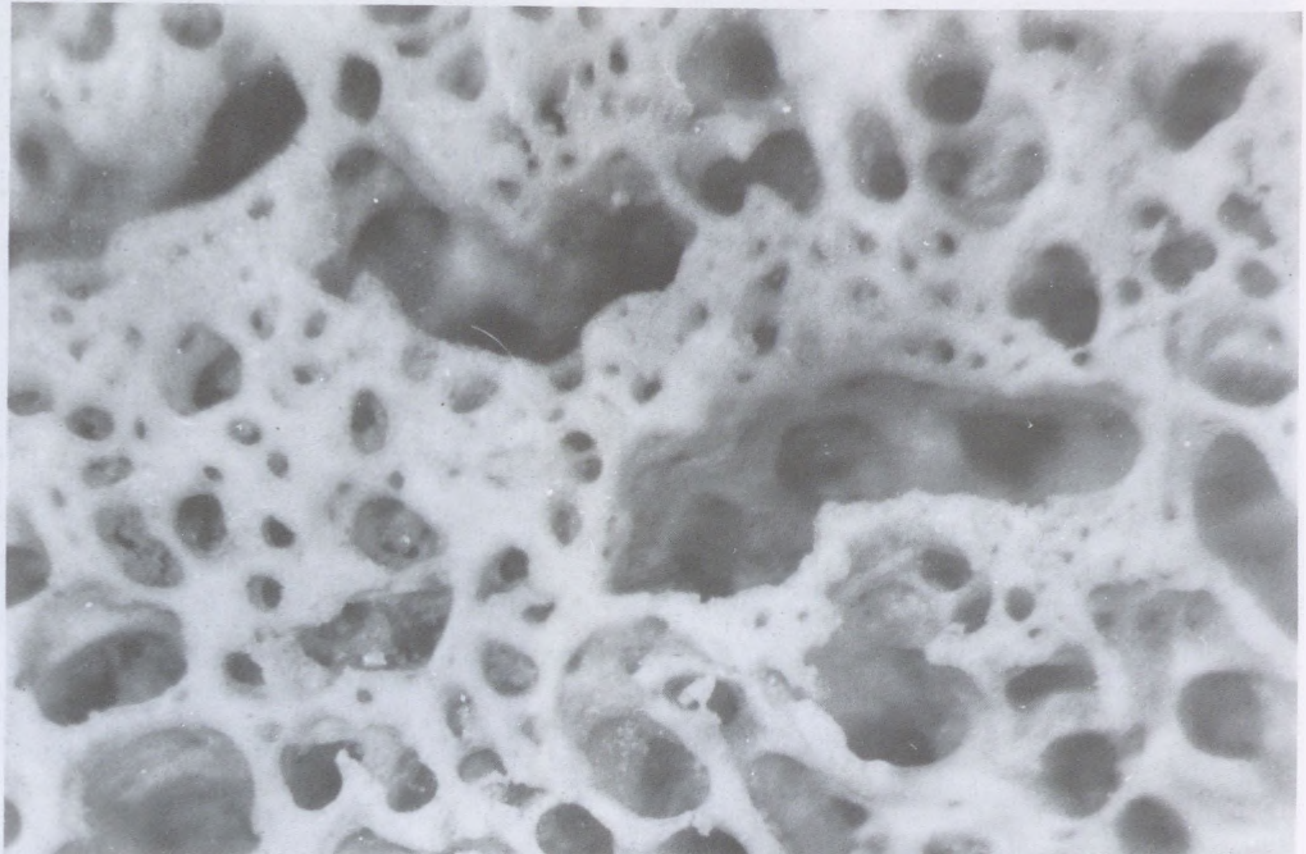


Plate 9

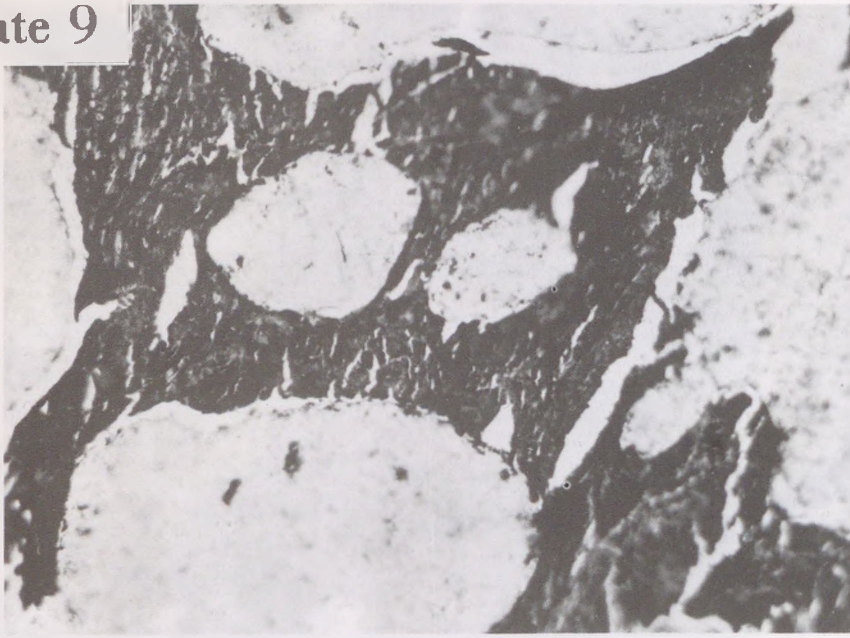


Plate 10

Plate 11

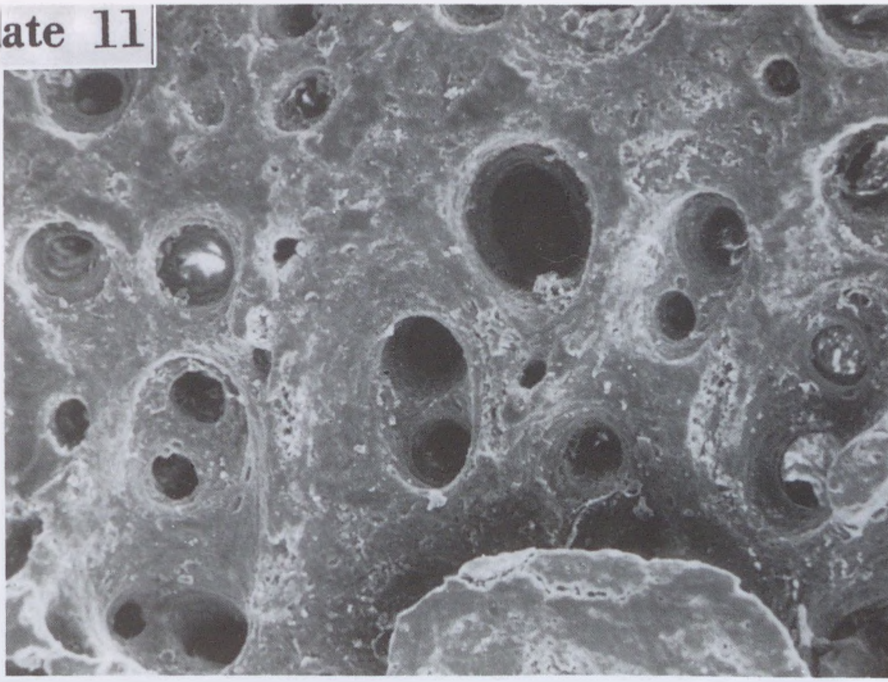


Plate 12

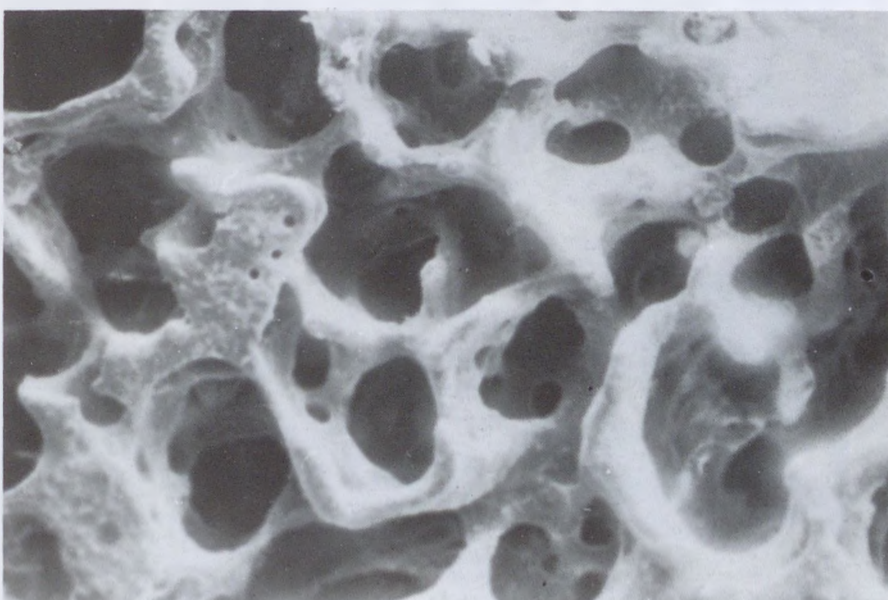


Plate 13

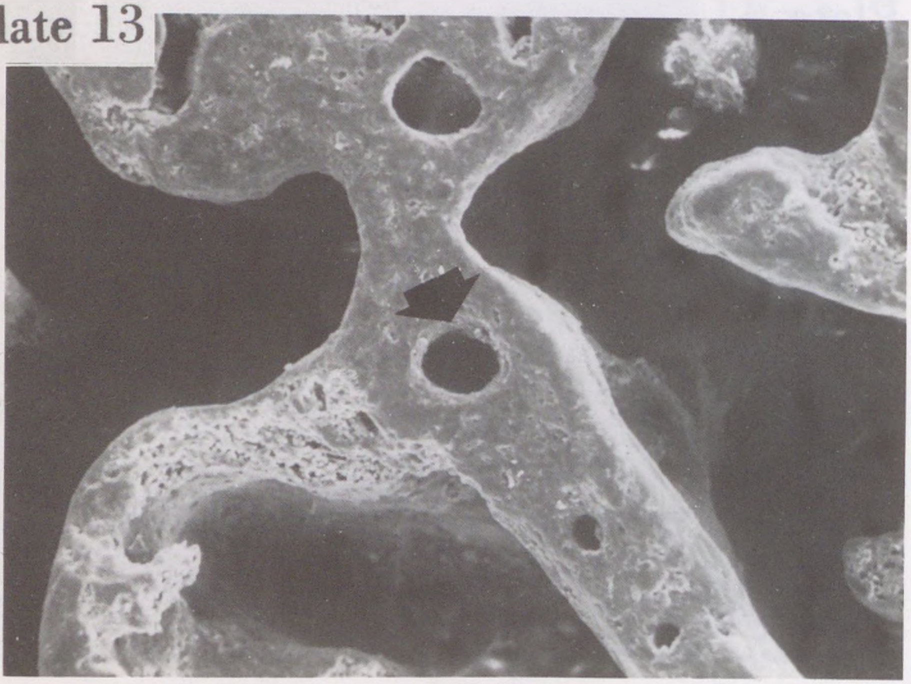


Plate 14

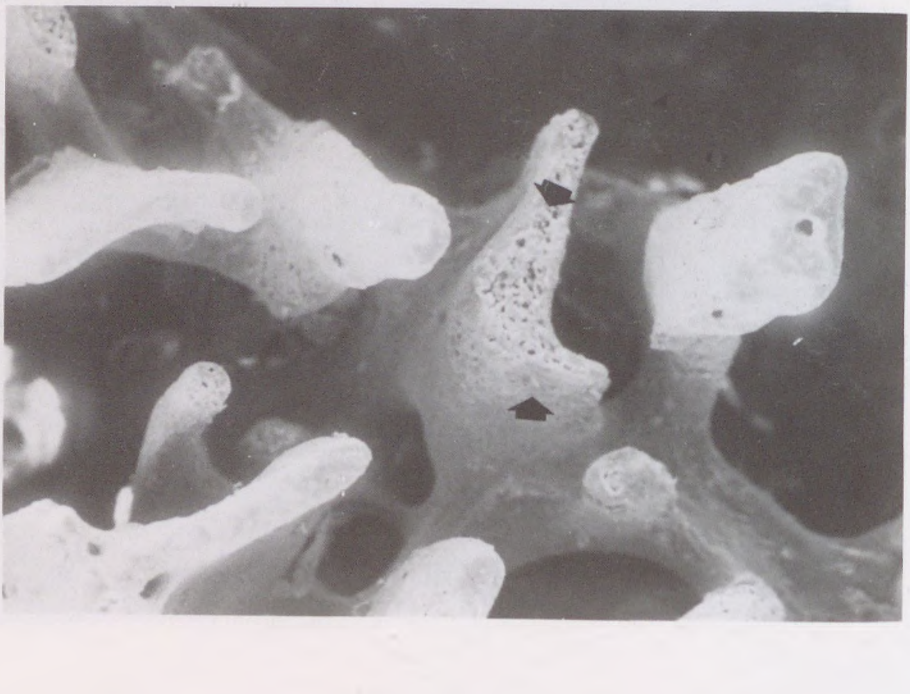
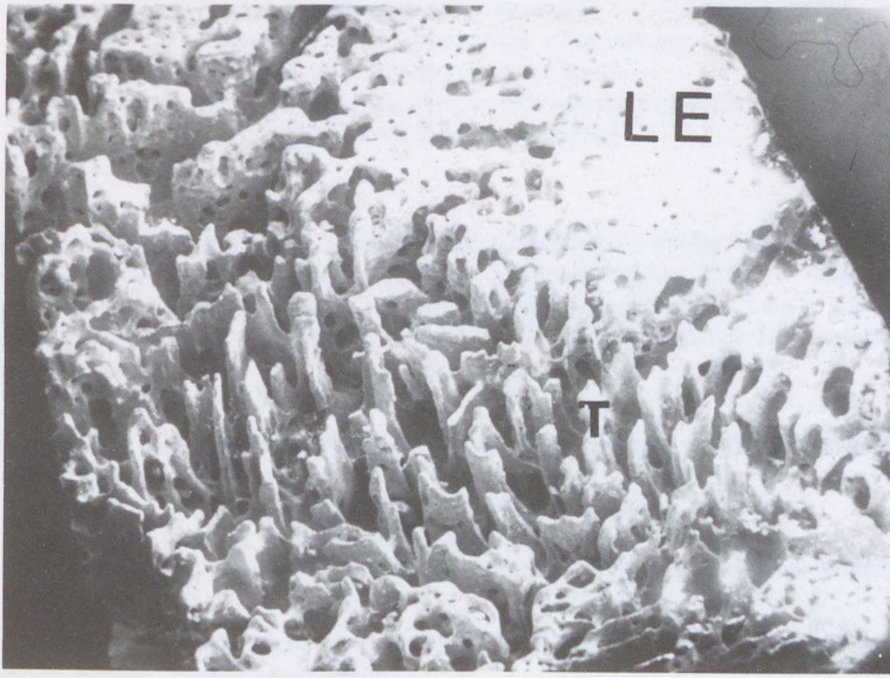


Plate 15



A Természettudományi Múzeum kiadványai
Publications of the Hungarian Natural History Museum
Publikationen des Ungarischen Naturwissenschaftlichen Museums
Publications du Musée Hongrois des Sciences Naturelles

ANNALES HISTORICO-NATURALES MUSEI NATIONALIS HUNGARICI
FOLIA ENTOMOLOGICA HUNGARICA
VERTEBRATA HUNGARICA
MISCELLANEA ZOOLOGICA HUNGARICA
STUDIA BOTANICA HUNGARICA
FRAGMENTA MINERALOGICA et PALAEONTOLOGICA
ANTHROPOLOGIA HUNGARICA

A kiadványok magyar, angol, német, francia és orosz nyelven közölnek értekezéseket. Belföldi személyek és intézmények számára megrendelhetők a Természettudományi Múzeum Könyvtáránál (1088 Budapest, Baross u. 13), külföldi személyek és intézmények számára a "Kultura" Külkereskedelmi Vállalatnál (1389 Budapest 62, Postafiók 149) vagy annak külföldi képviseleteinél és bizományosainál.

The publications contain papers in Hungarian, English, German, French and Russian. Distribution is effected by

"Kultura" Hungarian Foreign Trading Company
H-1389 Budapest 62, P.O.B. 149. Hungary

Orders should be sent to the above address directly or placed through international booksellers.

Die Publikationen enthalten Abhandlungen in ungarischer, englischer, deutscher, französischer und russischer Sprache. Vertrieb erfolgt durch

"Kultura" Ungarisches Aussenhandelsunternehmen
H-1389 Budapest 62, Postfach 149. Ungarn

Bestellungen sind an obige Anschrift direkt zu richten oder durch internationale Buchhändler zu erteilen.

Les publications contiennent des traités en langues hongroise, anglaise, allemande, française et russe. Diffusées par

"Kultura" Société Hongroise pour le Commerce Extérieur
H-1389 Budapest 62, P.O.B. 149. Hongrie

Les commandes peuvent être envoyées directement, ou bien par l'entremise des librairies internationales à la susdite adresse.