POLSKA AKADEMIA NAUK · KOMITET NAUK GEOLOGICZNYCH

PAŃSTWOWE WYDAWNICTWO NAUKOWE · WARSZAWA

acta geologica polonica

Vol. 30, No. 1 Warszawa 1980

JERZY GŁAZEK, RUSSEL S. HARMON & KRYSTIAN NOWAK

Uranium-series dating of the hominid-bearing travertine deposit at Bilzingsleben, G.D.R. and its stratigraphic significance

ABSTRACT: The hominid- and artifact-bearing travertine deposits from Bilzingsleben in G.D.R. have been dated by the $^{230}Th/^{234}U$ method at 228,000 (+17,000—12,000) years B.P. Correlation with the marine foraminiferal oxygen isotope record and North-American/European speleothem records indicates that this travertine was deposited during the penultimate interglacial, that is the Rügen-Warmzeit Interglacial in the local glacial stratigraphic sequence. Related stratigraphic correlations and some archaeological problems are briefly discussed in view of this new age data.

INTRODUCTION

The age and stratigraphic position of most hominid-bearing deposits of Europe are, at present, very questionable outside the ~40,000 year B.P. limit of conventional ^{14}C dating. A new method, uranium-series dating, has been established for absolute age dating of calcium carbonate speleothems (Thompson & al. 1974; Harmon & al. 1975) and more recently tufas and travertines (Schwarcz 1977; Schwarcz & al. 1979). Here we report the results of such dating of a hominid-and artifact-bearing travertine deposit at Bilzingsleben, G.D.R. and discuss the stratigraphic and archaeological significance of this age determination.

The village of Bilzingsleben is located on the Wipper River in the northern part of the Middle German Highlands between the Thuringian Forest and Harz Mountains, about 35 km north of Erfurt (Text-fig. 1).

The Bilzingsleben archaeological site occurs in the Steinrinne travertine quarry which is located about 1 km south of the village and which has been exploited since the 12th Century. Numerous fossils and artifacts have been described from this site, and the first human skull here was noted by v.Schlotheim (1818, 1820) although the exact location of the

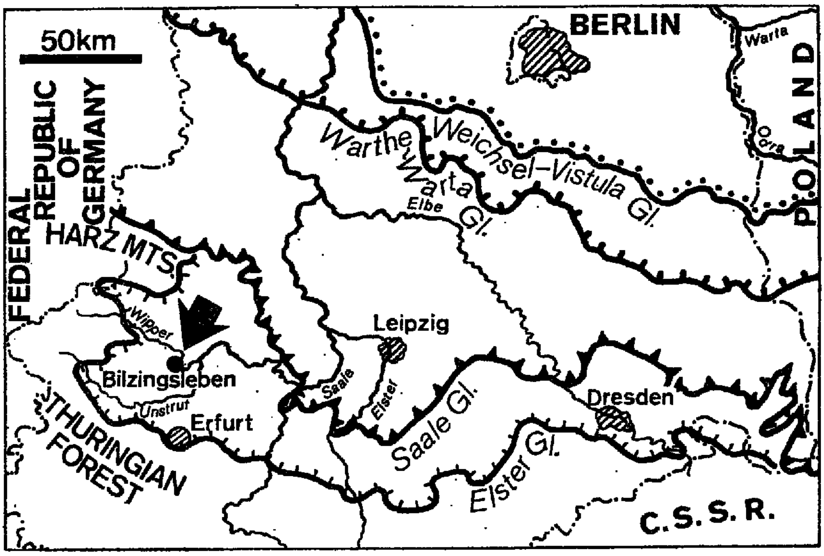

Fig. 1. Southern limits of continental glaciations in the southern part of German Democratic Republic (simplified *after* Cepek 1967) in relation to the Bilzingsleben travertine site

find was not described in detail. Since 1969 detailed excavation conducted by the Landesmuseum für Vorgeschichte, Halle a. Saale (Country Museum of Prehistory in Halle upon Saale) has recovered several human skull fragments, over 60,000 flint artifacts, and numerous tools of rock, bone, and antler (Mania 1977).

GEOLOGIC SETTING

The Bilzingsleben travertine deposits form an isolated plateau at 35 m above the Wipper River capping Lower Keuper marls and dolomites. Gravel terraces are recognized at average elevations 30, 20, 10, and 2—5 m. The gravels of the highest terrace contain flints and abundant boulders derived from crystalline sources in Scandinavia (Text-figs 2 and 3). These terraces are considered (Mania 1977) to be Elsterian (30 m), Saalian (20 m), Wartian (10 m), and Vistulian (2—5 m) in age respectively. The Bilzingsleben travertines in the Steinrinne quarry fill a lake depression over the highest terrace which was formed as the result of subsidence of a karst sinkhole and subsequently infilled with travertine (see Text-fig. 4).

Over the gravels of the 30 m terrace are 3—5 m of silt which have been slightly eroded and furrows in the erosional surface infilled with peat-earth or gley soil. The travertine sequence has been deposited on this soil. Within the travertine the following lithologic sequence occurs: (*I*) 30—50 cm of "sandy", soft, light brown travertine which contains abundant, fossils, artifacts, and hominid remains, as well as hard travertine lenses; (*II*) 50—80 cm of lake limestone; (*III*) 30—40 cm of soft, porous travertine; and (*IV*) 3—6 m of dense, dark brown travertine.

The analyzed travertine sample was taken from unit *I*, the "sandy" travertine. It consists of a dense, light brown travertine in which the original void space is less than 10%. Thin section examination reveals that this travertine is composed of micritic calcite that originally precipitated on a substrate of plant tissue. Many of the original voids have been totally or partially infilled with radially oriented sparite formed after decomposition of the plant stems. A small amount (<1%) of fine quartz sand is present in some layers of the travertine. The dark brown travertine of unit *IV* is a dense micritic calcite, but contains a substantial admixture of detrital sand, clay, and iron oxide, and thus is unfavorable for dating by uranium-series techniques.

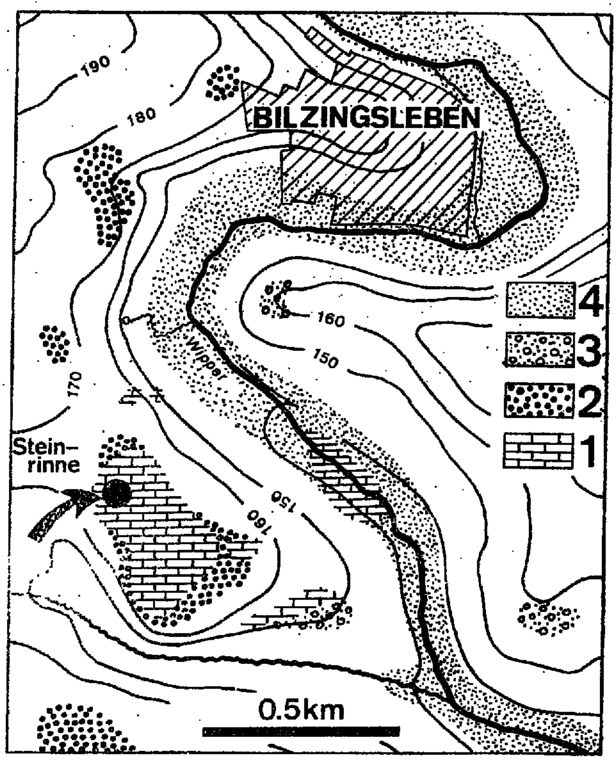

Fig. 2. Quaternary travertines and terraces in the vicinity of Bilzingsleben (*after* Mania 1977; simplified); arrowed is the excavation place in Steinrinne Quarry

1 travertines and other lake deposits, *2* 30 m terrace gravels, *3* 20—10 m terrace gravels, *4* loams and silts of the lowest terrace

The age of the Bilzingsleben travertine is equivocal. Wiegers (1928, 1940) and Mania (1974, 1976a, 1976b, 1977) have inferred a Holstein (i.e. Elster/Saale) age. However, other workers have suggested that the deposit is younger, perhaps of Rügen-Wermzeit age (Cepek 1978) or Eemian age (Woldstedt 1935, 1958; Vent 1955; Toepfer 1960, 1970; Werth 1922, 1925). Thus, radiometric dating of the Bilzingsleben travertine was required to resolve this problem.

URANIUM-SERIES DATING

The travertine chosen for analysis was a 150 g piece of the dense, light brown, micritic calcite from the bottom of a furrow filled with soft "sandy" travertine (Text-fig. 4). This sample was crushed, pulverized, and divided into four fractions of approximately equal size by floatation. The four fractions were analyzed by standard uranium-series techniques (Harmon & *al.* 1975). Each sample was dissolved in dilute nitric acid and a $^{229}Th/^{232}U$ tracer and iron carrier solution added. Radionuclides of uranium and thorium were subsequently coprecipitated with iron hydroxide and then individually isolated by ion exchange and organic solvent techniques. After plating onto stainless steel discs for counting, individual uranium and thorium isotope activities were measured by alpha spectrometry-pulse height analysis. Measured isotope activities were corrected for detector background, chemical yield, and interferring peaks.

The resultant uranium concentrations, isotope activity ratios, and calculated age for the Bilzingsleben travertine are here presented (Table 1). Only a single age of a $228{,}000^{-12{,}000}_{+17{,}000}$ years B.P. was calculated because of the very close agreement in the $^{234}U/^{238}U$ and $^{230}Th/^{234}U$

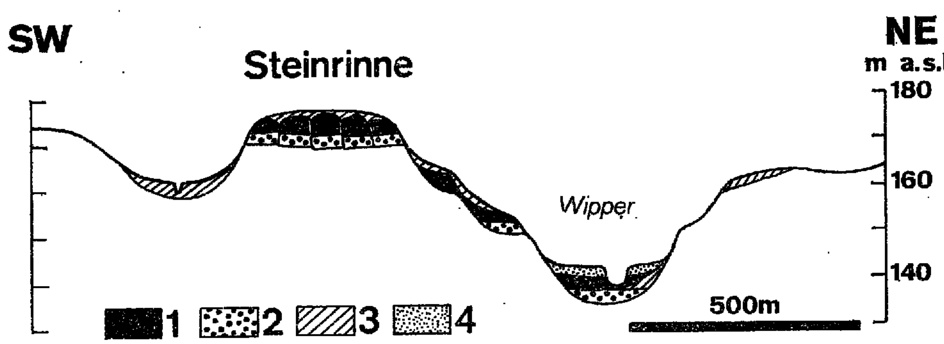

Fig. 3. Schematic section showing relation of travertine deposits to terraces near Bilzingsleben (*after* Vlček & Mania 1977; simplified)

1 travertine and other lake deposits, *2* terrace gravels, *3* slope and loess deposits, *4* loams of the lowest terrace (Holocene)

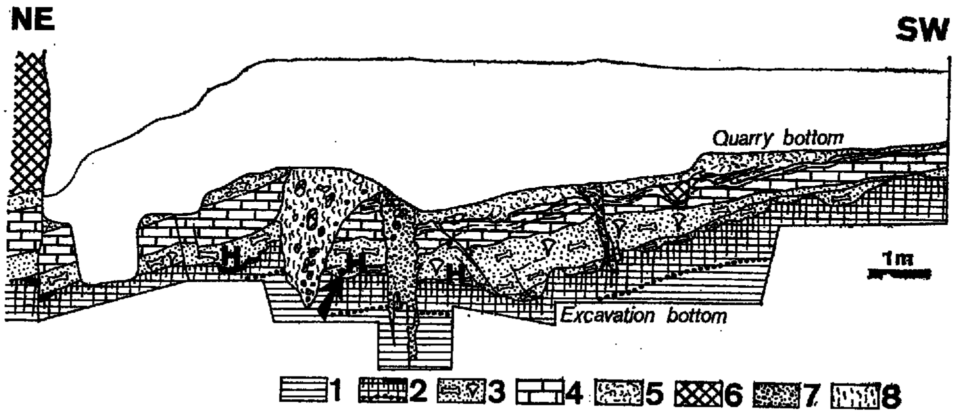

Fig. 4. Section of travertine excavation in Steinrinne Quarry near Bilzingsleben (*after* Mania 1976a; simplified)
1 silts, 2 soil profile on silts (*black on top*: gley horizon; *vertical dashing*: peat-earth; *black spots in bottom*: carbonate concretions), 3 "sandy travertine" (hominid-, artifact- and bone-bearing layer), 4 lake limestone, 5 soft travertine, 6 hard travertine, 7 fissure filling with travertine debris, 8 loess with travertine debris; arrowed is the site of dated sample; H — hominid bone fragments

isotope activity ratios for the four samples. We have confidence in this result because (*i*) $^{230}Th/^{232}Th$ ratios are high indicating that ^{230}Th activity is authigenic and (*ii*) $^{234}U/^{238}U$ ratios and uranium concentrations are uniform indicating that the travertine had been not subject to post--depositional loss or addition of uranium.

HOMINID REMAINS AND ARTIFACTS

The Bilzingsleben site is famous as one of the earliest discoveries of an ancient human skull (Schlotheim 1818, 1820). Subsequently, at the beginning of this century, an amateur, G.A. Spengler had collected hominid molars and a small parietal bone fragment in the Steinrinne quarry (Wiegers 1922; Mania 1977). More recent discoveries of hominid material include: one large and one small

Table 1

Uranium concentrations, isotope activity ratios, and calculated age for the Bilzingsleben "sandy" travertine

Sample number	Description	Uranium concentration /ppm/	$\frac{^{230}Th}{^{234}U}$	$\frac{^{234}U}{^{238}U}$	$\frac{^{230}Th}{^{232}Th}$	Age, years B.P.
373	Bulk sample	4.4	0.92±0.02	1.22±0.02	202	
374	Fine fraction /<270 mesh/	4.3	0.93±0.02	1.24±0.02	34	
375	Intermediate fraction /70 - 270 mesh/	4.5	0.91±0.02	1.19±0.02	75	
376	Coarse fraction />70 mesh/	5.0	0.91±0.02	1.21±0.02	76	
	Average of four analyses		0.918±0.02	1.215±0.02	97	$228,000^{+17,000}_{-12,000}$

fragment of *os occipitale* which fit together well in spite of having been found at different times and in different places within the "sandy" travertine unit, one middle part and one fragment of *os frontale*, and a molar (Grimm 1976; Grimm & Mania 1976; Grimm & *al.* 1974; Mania 1974, 1975, 1976a, b, 1977; Mania & Grimm 1974; Mania & *al.* 1976; Vlček & Mania 1977).

Taxonomic analysis by Grimm & *al.* (1974), Mania & *al.* (1976) and Vlček & Mania (1977) indicates that this hominid material is characteristic of the form *Homo erectus* (Dubois) which is similar to the Vértesszöllös material from Hungary and which bears resemblance to the Sinanthropus *III* individual from Choukoutien (China) and the Olduvai *9* individual from Olduvai George (Tanzania).

The earliest archaeological materials from Bilzingsleben consisted of about 900 flints considered by Wiegers (1928) to be Chéelen and by André (1939) to be representative of a hand axe culture. Later, Toepfer (1960, 1961, 1970) has differentiated Moustérian korns and Tayacian points in this collection and assigned a Pontiano-Moustérian character resembling that of Saccopastore to the Bilzingsleben artifacts. However, finds during recent excavations include small flint artifacts and larger pebble tools of quartzite, quartz, porphyry, crystalline rock, and Muschelkalk limestone as well antler, bone, and ivory for which Mania (1976a, 1977), Müller-Beck (1977) and Vlček & Mania (1977) suggest a Clactonian typology.

FOSSILS

One very important feature of the Bilzingsleben site is that the archaeological significant travertine deposit also contains an abundance of floral and faunal fossil material. This assemblage (Table 2) occurs primarily in the "sandy" travertine unit we have dated and thus also permits us to reconstruct the prevailing surface climate approximately 240,000 to 200,000 years ago.

Table 2

List of floral and faunal fossils associated with hominid remains and artifacts in the Bilzingsleben travertine deposits

PLANTS /after Vent 1955; see also Werth 1925/	SNAILS /after Wöhlstadt 1921; see also Pohlig 1886; Wüst 1901/	VERTEBRATES /after Keyser 1884; Pohlig 1886; Wüst 1901, 1903; Wiegers 1922; Mania 1977/
Characeae gen. et sp. indet.	Vitrina elongata Drap.	Cyprinidae gen. et sp. indet.
Picea cf. excelsa Link.	Zonites verticillus Fér.	Aves gen. et sp. indet.
cf. Rubus sp.	Patula solaria Mke.	Castor cf. fiber L.
Acer cf. pseudoplatanus L.	Fruticicola umbrosa Partsch	Trogontherium sp.
Betula cf. pubescens Eh.	Dibothrion bidens Chemn.	Glis glis /L./
Corylus avellana L.	Cepaea nemoralis L.	Canidae gen. et sp. indet.
Quercus spp.	Eulota? chouquetania Tournouër	Ursus cf. arctos L.
Salix cf. cinerea L.	Clausilia pumila C. Pfeif.	Felidae gen. et sp. indet.
Buxus sempervirens L.	Clausilia tumida Rossm.	Palaeoloxodon antiquus /Falc./
cf. Rhododendron sp.	Clausilia filograna Rossm.	Mammuthus primigenius /Blum./
Fraxinus cf. excelsior L.	Orcula doliolum Brug.	Equus cf. caballus L.
	Isthmia claustralis Gredl.	Dicerorhinus mercki /Jäg./
	Vertigo moulinsiana Dup.	Bovidae gen. et sp. indet.
	Vertigo pusilla Müll.	Cervus cf. elaphus L.
	Vallonia costellata Al. Br.	Capreolus cf. capreolus /L./
	Azeca schulziana Wüst	
	Belgrandia germanica Cless.	
	Neritina cf. grateloupiana Fenn.	

The climate at the time of deposition of the discussed "sandy" travertine was slightly warmer than at present and thus of interglacial character. The plant and vertebrate assemblage further suggests a forest environment and a mean annual temperature about 1.5 to 2.0°C higher than at present without substantial winter frost. This interpretation differs slightly from that of Vlček & Mania (1977) who have postulated a steppe environment both warmer and drier than at present based upon snails which were probably found in upper layers at the sequence.

DISCUSSION

The classical glacial stratigraphy of Northern Europe was established by Keilhack (1926) who mapped the moraines of the Fennoscandinavian ice sheet in north-central Germany. These endmoraine systems which cross the Netherlands, Denmark, Germany, and Poland were originally named "Weichsel", "Warthe", "Saale", and "Elster". Previously the Warthe moraines has been grouped first with the Weichsel (Keilhack 1926) and later with the Saale (Woldstedt 1954; Cepek 1967), but Picard (1964) has argued that it deserves the status of a full glacial cycle. Our dating of the Bilzingsleben travertine supports this view and permits us to directly correlate portions of the Northern Europe glacial stratigraphy with the well studied marine foraminiferal oxygen isotope record which is the most complete record of Pleistocene glacial history presently available.

Geological evidence at Bilzingsleben indicates that the travertine sequence and associated archaeological materials are younger than Elsterian in age, but beyond this there has been no consensus as to the exact stratigraphic age of these deposits. The floral and faunal fossil assemblage requires deposition during a period of interglacial climate, but until now it has not been possible to be more precise. This ambiguous situation at one time or another, has resulted in the assignment of the Bilzingsleben travertines, to the Elster/Saale (Wiegers 1928, 1940; Mania 1974, 1976a,b, 1977), the Saale/Warthe (Cepek 1978) or the Warthe/Weichsel (Werth 1922, 1925; Woldstedt 1935, 1958; Vent 1955; Toepfer 1960, 1970) interglacial periods. From our $^{230}Th/^{234}U$ age of $228{,}000^{+17{,}000}_{-12{,}000}$ years B.P. we can, by direct correlation with Stage 7 of the marine ^{18}O record (Shackleton & Opdyke 1973) and the European and North American speleothem chronologies (Harmon & *al.* 1977; Atkinson & *al.* 1978), conclusively say that the Bilzingsleben travertine was deposited during the penultimate interglacial period. This indicates a Rügen-Warmzeit stratigraphic age thus elevates this warm event to the status of a full interglacial period between the Saale and Warthe glaciations.

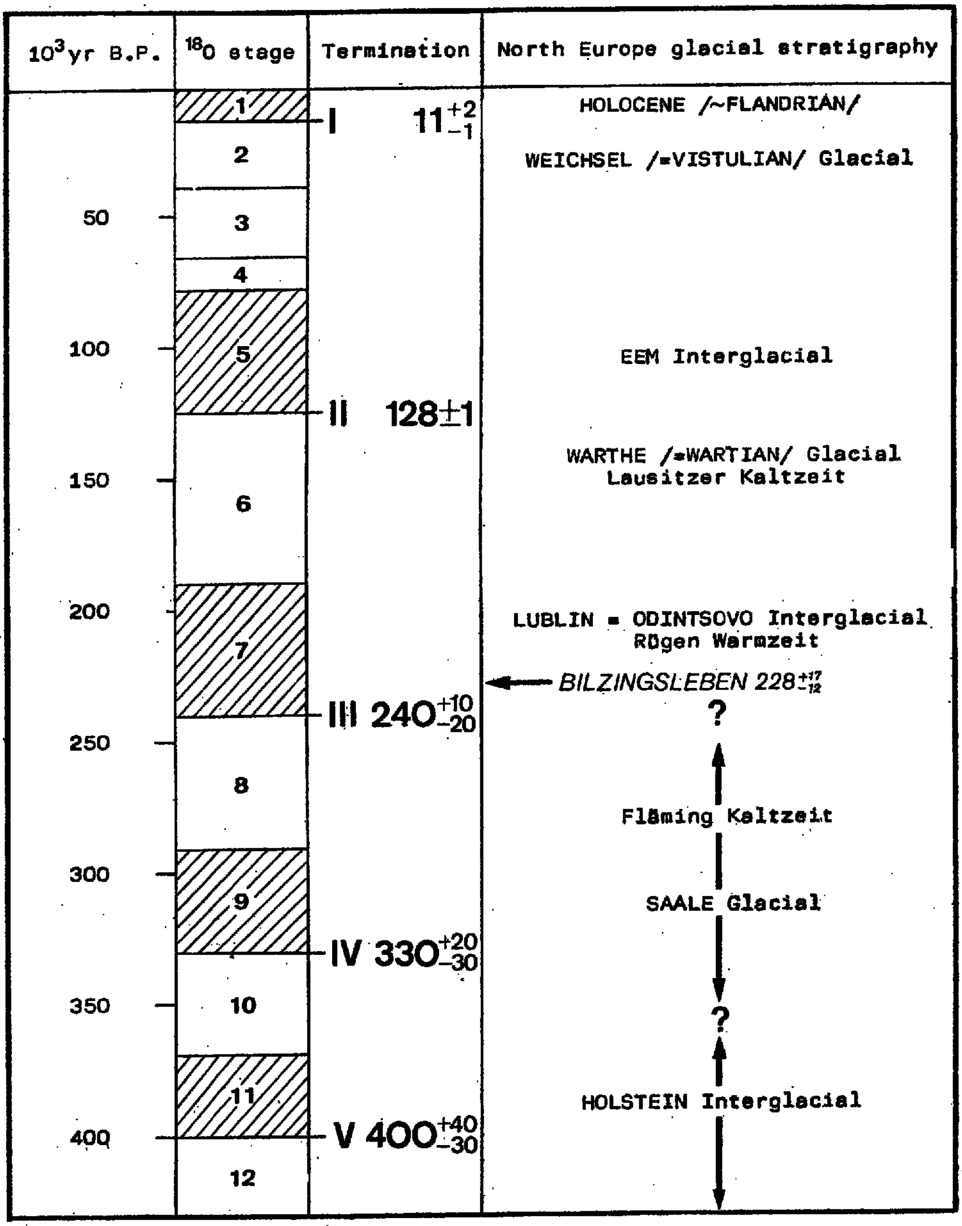

Fig. 5. Suggested correlation between the Middle and Later Pleistocene glacial stratigraphic sequence of Northern Europe and the marine foraminiferal oxygen isotope record

Shown for reference are the ¹⁸O stages (Shackleton & Opdyke 1973) which indicate major periods of maximum (even numbers) and minimum (odd numbers) ice volume, the terminations (Broecker & van Donk 1970) which are considered to represent major glacial/interglacial boundaries, and the stratigraphic position of the Bilzingsleben travertine deposit. The Rügen-Warmzeit, here elevated to full interglacial status, has previously been considered (Cepek 1967) as an interstadial phase within the Saalian glacial sequence

Having established the Rügen-Wermzeit as the penultimate interglacial, it is thus also possible to further correlate the Northern Europe glacial stratigraphic record with the marine ^{18}O record (Text-fig. 5). The Weichsel and Warthe glaciations are now shown to be younger than isotope Stage 7. From ^{14}C dating, it is clear that the Weichsel directly correlates to Stage *2*, the last glaciation in the marine record. These moraines overlie type Eemian Interglacial deposits which, in Denmark, cut through Warthe moraines. The Warthe must therefore correlate with isotope stage *6* and the Eemian of Denmark with Stage *5*. The age of the type Eemian in the Netherlands is more problematic because here these marine beds are sandwiched between Weichsel tills on the top and Saale ground moraines on the bottom. The Saale moraines must be at least of Stage *8* age and more likely of Stage *10* because varves in the Bad Kösen area are overlain by loess and soils of three glacial cycles (Kukla 1977). The age of the Holstein Interglacial and Elster Glacial are not firmly fixed by either absolute dating or geologic relationships. There is evidence to suggest that the type Elster may be composed of multiple glacial events and thus be more complicated than the younger glacial deposits.

Correlation between the various glacial stratigraphic records of Europe is a more difficult matter. Certainly the major glaciations in the Alps, Fennoscandinavia, and the North Sea must have been synchronous. However, there is no reason to believe that advances of individual glacial lobes in different areas had to have been contemporaneous or that the glacial deposits preserved in different areas of Europe must be of the same age. For example, the third moraine or till in a stratigraphic sequence in two different regions may not necessarily be of the same absolute age or, because of possible gaps in the record, may not even represent the same major glacial event. Thus, the only safe technique for correlation between regions is one based on absolute age dating.

We have shown that the Bilzingsleben travertine can be assigned to the Rügen-Warmzeit Interglacial period based upon its age of $228{,}000^{+7{,}000}_{-12{,}000}$ years B.P. Direct correlation can be made to Poland where the Lublin Interglacial (Środoń 1969; Różycki 1979) has been recently dated by thermoluminescence techniques at $245{,}000 \pm 45{,}000$ years B.P. (Lindner & Prószyński 1979) and to the Western U.S.S.R. where the Odintsovo Interglacial has likewise been dated at $227{,}000 \pm 28{,}000$ and $236{,}000 \pm 25{,}000$ years B.P. (Zubakov & Kochegura 1973; Zubakov 1978). Therefore, one can conclude that these interglacials all represent the penultimate interglacial event in their respective glacial stratigraphic records. Overlying deposits must be younger and underlying deposits older, but it is dangerous to attempt further intra- or interregional correlations without additional absolute age determinations.

It is obvious that archaeological and geological correlations predominantly based upon the antiquated concept of only four Pleistocene glaciations must be permanently discarded. It is becoming quite clear that many archaeological localities assigned to one or another interglacial on meagre field evidence are miscorrelated. For example, the Ehringsdorf travertine sequence long considered to be of Eemian age and the Westbury-sub-Mendip deposits thought to be of Cromerian age both have turned out to be of penultimate interglacial age (*i.e.* 200,000—230,000 years B.P.) when dated by uranium-series techniques (Kukla, 1977; Schwarcz, *pers. comm.*). It would thus appear that a correlation of these two sites with the Bilzingsleben deposits we have studied is reasonable.

In summary, it is demonstrated that the Bilzingsleben archaeological materials were deposited about $228{,}000^{+17{,}000}_{-12{,}000}$ years B.P. during the penultimate interglacial. This age permits direct correlation of the local glacial stratigraphic sequence with the marine ^{18}O record and elevates the Rügen-Warmzeit event to full interglacial status. This result also suggests that two hominid types, *Homo erectus* (Dubois) from Bilzingsleben and *Homo sapiens* L. from Swanscombe/Steinheim, as well as two cultural industries, the Clactonian and Acheulian, coexisted in Europe during the penultimate interglacial. Further archaeometric studies should serve to simplify the pattern of hominid evolution and correlation of ancient industries and resolve such problems as the three different ages cited by Collins (1977) for the British Acheulian.

Acknowledgements. The authors are grateful to Dr. D. Mania (Landesmuseum für Vorgeschichte, Halle, G.D.R.) for assistance with sample collection. This research was made possible by a joint exchange program between Warsaw University and Glasgow University. The Scottish Universities Research and Reactor Centre is supported by a grant from the Natural Environment Research Council. Helpful discussions with Dr. T. Wysoczański-Minkowicz (Institute of Geology, Polish Academy of Science), Dr. H. P. Schwarcz (McMaster University), Mr. P. Smart (Bristol University), and Dr. C. B. Stringer and Mr. A. Currant (British Museum) are also acknowledged.

Institute of Geology
of the Warsaw University,
Al. Żwirki i Wigury 93,
02-089 Warszawa, Poland
(J. Głazek)

Scottish Universities
Research and Reactor Centre,
East Kilbride, Glasgow G75 OQU,
Scotland, United Kingdom
(R. S. Harmon)

Institute of Archeology,
of the Warsaw University,
ul. Widok 10,
00-023 Warszawa, Poland
(K. Nowak)

REFERENCES

ANDREE J. 1939. Der eiszeitliche Mensch in Deutschland und seine Kulturen; pp. 758. *Enke;* Stuttgart.

ATKINSON T. C., HARMON R. S., SMART P. L. & WALTHAM A. C. 1978.

Palaeoclimatic and geomorphic implications of $^{230}Th/^{234}U$ dates on speleothems from Britain. *Nature*, **272**, 24—28. London.

BROECKER W. S. & VAN DONK J. 1970. Insolation changes, ice volumes, and the O^{18} record in deep-sea cores. *Rev. Geophys. Space Phys.*, **8**, 169—198.

CEPEK A. G. 1967. Stand und Probleme der Quartärstratigraphie im Nordteil der DDR. *Ber. d. Deutsch. Ges. Geol. Wiss., A — Geol. Paläont.*, **12** (3/4), 375—404. Berlin.

— 1978. Discussion on the 2nd Bilzingsleben Colloquium (*in preparation*).

COLLINS D. M. 1977. Das Altpaläolithicum in England. *Ethnogr.-Archäol. Zt.*, **18**, 63—71. Berlin.

GRIMM H. 1976. Demonstration der Hominidenreste von Bilzingsleben, Kreis Artern, DDR. *Anthropologie*, **14**, (1/2), 109—111. Berlin.

— & MANIA D. 1976. Bilzingsleben B — einer weiterer mittelpleistozäner Hominiden-Fund aus dem Elbe-Saale-Gebiet. *Biol. Rundschau*, **14** (3), 155—156. Jena.

— , — & TOEPFER V. 1974. Ein neuer Hominidenfund in Europa — Nachtrag zum Vorbericht über Bilzingsleben, Kr. Artern. *Zt. f. Archäol.*, **8** (2), 175—176. Berlin.

HARMON R. S., FORD D. C. & SCHWARCZ H. P. 1977. Interglacial chronology of the Rocky and Mackenzie Mountains based upon ^{230}Th—^{234}U dating of calcite speleothems. *Can. J. Earth Sci.*, **14** (11), 2543—2552. Ottawa.

— , THOMPSON P., SCHWARCZ H. P. & FORD D. C. 1975. Uranium-series dating of speleothems. *Bull. Natn. Speleo. Soc. Amer.*, **37** (2), 21—33. Huntsville, Alabama.

KAYSER E. 1884. Erläuterungen zur Geologischen Specialkarte von Preussen und den Thüringischen Staaten. *Lieferung* **9**, *Gradebl.* **56**, *No.* **47**, *Blatt Kindelbrück (Weissensee)*. Berlin.

KEILHACK K. 1926. Das Quartär in Grundzuge der Geologie, Vol. **2**. *Salomon*, Stuttgart.

KUKLA G. J. 1977. Pleistocene Land-sea correlations I. Europa. *Earth Sci. Rev.*, **13** (2), 307—374. Amsterdam.

LINDNER L. & PRÓSZYŃSKI M. 1979. Geochronology of the Pleistocene deposits exposed at Wąchock, northern part of the Holy Cross Mts. *Acta Geol. Polon.*, **29** (1), 121—132. Warszawa.

MANIA D. 1974. Bilzingsleben, Kr. Artern — eine Altpaläolitische Fundstelle im nördlichen Mitteleuropa. *Zt. f. Archäol.*, **8** (2), 157—173. Berlin.

— 1975. Bilzingsleben (Thüringien): Eine neue altpaläolitische Fundstelle mit Knochen reste des *Homo erectus*. *Archäol. Korrespondenzblatt*, **5** (4), 263—272. Berlin.

— 1976a. Altpaläolitischer Rastplatz mit Hominidenresten aus dem mittelpleistozänen Travertin-Komplex von Bilzingsleben (DDR). IX Congr. d. U.I. d. Sc. Préhistoriques et Protohistoriques, Colloque IX — Le peuplement anténéandertalien de l'Europe, Nice, p. 35.45. Nice.

— 1976b. Altpaläolitische Travertinfundstelle bei Bilzingsleben, Kr. Artern. *Ausgrabungen u. Funde*, **21** (1—4), 24—26. Berlin.

— 1977. Die altpaläolitische Travertinfundstelle von Bilzingsleben, Kr. Artern. *Ethnogr.-Archäol. Zt.*, **18**, 5—24. Berlin.

— & GRIMM H. 1974. Bilzingsleben, Kreis Artern — eine paläoökologisch aufschlussreiche Fundstelle des Altpaläolithikums mit Hominidenfund. *Biol. Rundschau*, **12** (6), 361—364. Jena.

— , — & VLCEK E. 1976. Ein weiter Hominidenfund aus dem mittelpleistozänen Travertinkomplex bei Bilzingsleben, Kr. Artern. *Zt. f. Archäol.*, **10** (2), 241—249. Berlin.

MÜLLER-BECK H. J. 1977. Zum Problem der "faustkeilfreien altpaläolithischen Industrien" im Mitteleuropa. *Ethnogr.-Archäol. Zt.*, **18**, 39—56. Berlin.

PICARD K. 1964. Die stratigraphische Stellung der Warthe-Eiszeit in Schleswig--Holstein (Deutschland). *Rep. 6 Int. Congr. Quat., Warsaw 1961*, **2**, 191—197. Łódź.

POHLIG H. 1886. Travertin mit Elephas antiquus bei Frankenhausen. *Verhandlungen d. Naturhist. Vereins d. Preussischen Rheinlande, Westfalens u.d. Reg. — Bezirke Osnabrück*, **43**, 17—19. Bonn.

RÓŻYCKI S. Z. 1979. From Mochty to a synthesis of the Polish Pleistocene. *Roczn. PTG (Ann. Soc. Géol. Pologne)*, **48** (3/4), 445—478. Kraków.

SCHLOTHEIM E. F. v. 1818. Der Kalktuff als Glied der aufgeschwemten Gebirgsformation. *In: Leonhards Mineralogisches Taschenbuch*, **12**, 315—345.

— 1820. Petrefaktenkunde. Gotha.

SCHWARCZ H. P. 1977. Uranium series dating of travertines from palaeolithic sites. *INQUA Congr. X, Birmingham, Abstr.* 409. Birmingham.

— , BLACKWELL B., GOLDBERG P. & MARKS A. E. 1979. Uranium series dating of travertine from archaeological sites, Nahal Zin, Israel. *Nature*, **277**, 558—560. London.

SHACKLETON N. J. & OPDYKE N. D. 1973. Oxygen isotope and palaeomagnetic stratigraphy of equatorial Pacific core V28-238: Oxygen isotope temperatures and ice volumes on a 10^5 year and 10^6 year scale. *Quaternary Res.*, **3** (1), 39—55. Washington.

ŚRODOŃ A. 1969. Stratigraphic position of fossil floras in the Lublin Region referable to the Mazovian Interglacial. *Biul. Inst. Geol.*, **220**, 5—10. Warszawa.

THOMPSON P., SCHWARCZ H. P. & FORD D. C. 1974. Continental Pleistocene climatic variations from speleothem age and isotopic data. *Science*, **184**, 893—895. Washington.

TOEPFER V. 1960. Das letztinterglaziale mikrolithische Paläolithikum von Bilzingsleben, Kr. Artern. *Ausgrabungen u. Funde*, **5**, 7—11. Berlin.

— 1961. Das Altpaläolithikum im Flussgebiet der unteren Saale und der Mittelelbe. *Geologie*, **10** (4/5), 571—585. Berlin.

— 1970. Stratigraphie und Ökologie des Paläolithikums. *In:* Periglazial—Löss—Paläolithikum im Jungpleistozän der Deutschen Demokratischen Republik. *Erganzungsheft zu Petermanns Geogr. Mitteil.*, **27**, 329—422. Gotha.

VENT W. 1955. Über die Flora des Riss—Würm—Interglazials in Mitteldeutschland unter besonderer Berücksichtigung der Ilmtaltravertine von Weimar-Ehringsdorf. *Wiss. Z. F. Schiller Univ. Jena*, **4** (4/5), 467—485. Jena.

VLČEK E. & MANIA D. 1977. Ein neuer Fund von Homo erectus in Europa: Bilzingsleben (DDR). *Anthropologie*, **15** (2/3), 159—169. Brno.

WERTH E. 1922. Sitzungsbericht vom 29 Dezember 1922. *Ber. d. Deutsch. Botan. Ges.*, **40** (10), 354—355. Berlin.

— 1925. Die pflanzenführenden Diluvial-Ablagerungen der Thüringisch-sächsischen Bucht und ihre pflanzengesichtliche und klimatologische Bedeutung. *Ber. d. Deutsch. Botan. Ges.*, **43** (8), 391—399. Berlin.

WIEGERS F. 1922. Neue und vermeintliche Funde paläolithischer Artefakte aus dem Diluvium Sachsens. *Zt. f. Ethnol.*, **54** (1—5), 29—39. Berlin.

— 1928. Diluviale Vorgeschichte des Menschen; pp. 299. *Enke*, Stuttgart.

— 1940. Das geologische Alter der altsteinzeitlichen Kulturen von Wangen a.d.Unstrut und Bilzingsleben a.d. Wipper. *Praehist. Zt.*, **30/31** (3/4), 331—336. Leipzig.

WOHLSTADT R. 1921. Die Molluskenfauna der diluvialen Travertine von Bilzingsleben bei Kindelbrück und Osterode bei Hornburg. *Archiv. f. Molluskenkunde*, **52** (5), 178—183. Frankfurt a.M.

WOLDSTEDT P. 1935. Die Beziehungen zwischen den nordischen Vereisungen und den paläolitischen Stationen von Nord- und Mitteldeutschland. *Mannus*, **27**, 275—187. Leipzig.

— 1954. Saaleeiszeit, Warthestadium und Weichseleiszeit im Norddeutschland. *Eiszeitalter u. Gegenwart*, **4**, 34—38. Öhringen.

— 1958. Das Eiszeitalter. Grundlinien einer Geologie des Quartärs, Bd. 2: Europa, Vorderasien und Nordafrika im Eiszeitalter; *2 ed.*, pp. 438. *Enke*, Stuttgart.

— 1967. The Quaternary of Germany. *In:* K. RANKAMA (*Ed.*), The Quaternary, Vol. **2**, 239—300. *Interscience*, New York.

WÜST E. 1901. *Helix banatica* (=*Canthensis* Beyr.) aus dem Kalktuffe von Bilzingsleben. *Zt. f. Naturwissenschaften*, **74** (1/2), 72—76. Stuttgart.

— 1903. Säugetierreste aus dem Kalktuff von Bilzingsleben bei Kindelsbrück. *Zt. f. Naturwissenschaften*, **75** (3), 237—239. Stuttgart.

ZUBAKOV V. A. 1978. Pozdnokajnozojskaja lednikovaja epokha: khronologija i periodizatsija. *In*: Chtenija pamjati L. S. Berga, **20**, 7—38. *Nauka*, Leningrad.

— & KOCHEGURA V. V. 1973. Khronologija novejshego etapa geologicheskoj istorii SSSR (ot 3 000 000 do 60 000 let). *In*: Khronologija plejstotsena i klimaticheskaja stratigrafija, 39—73. *Geogr. Obshch. SSSR*, Leningrad

J. GŁAZEK, R. S. HARMON i K. NOWAK

DATOWANIE METODĄ URANOWO-TOROWĄ TRAWERTYNÓW ZAWIERAJĄCYCH SZCZĄTKI LUDZKIE Z BILZINGSLEBEN

(Streszczenie)

Trawertyny wydobywane w kamieniołomie Steinrinne w Bilzingsleben koło Erfurtu w Niemieckiej Republice Demokratycznej (fig. 1 i 2) znane są jako bogate stanowisko archeologiczne, które obok zabytków kultury klaktońskiej, zawiera także szczątki *Homo erectus* (patrz Grimm & *al.* 1974, Mania & *al.* 1976, Vlček & Mania 1977) oraz roślin, ślimaków i kręgowców o charakterze interglacjalnym (tab. 2). Trawertyny te, osadzone na wysokim tarasie rzeki Wipper (fig. 2 i 3), zaliczane były do interglacjału holsztyńskiego (Wiegers 1928, 1940; Mania 1974, 1976a,b, 1977) lub eemskiego (Woldstedt 1935, 1958; Vent 1955; Toepfer 1960, 1970); ostatnio Cepek (1978) wyraził przypuszczenie, iż mogą one odpowiadać ociepleniu Rugii.

Próbkę zbitego trawertynu pochodzącą z dolnej warstwy zawierającej szczątki ludzkie, zabytki i kości zwierząt (fig. 4) datowano metodą $^{230}Th/^{234}U$ (*por.* Harmon & *al.* 1975). Dla większej pewności datowania próbkę pokruszono i rozdzielono na frakcje, które analizowano osobno (tab. 1). Ponieważ wyniki oznaczeń są bardzo bliskie, można było wyliczyć jeden wiek $228.000^{+17.000}_{-12.000}$ lat temu.

Otrzymana data pozwala skorelować stanowisko Bilzingsleben z 7 poziomem ^{18}O w osadach głębokomorskich (*por.* Shackleton & Opdyke 1973), z ociepleniem Rugii i interglacjałami lubelskim i odincowskim w lokalnych podziałach plejstocenu europejskiego (fig. 5), a także z datowanymi tą samą metodą stanowiskami archeologicznymi Ehringsdorf (NRD) i Westbury-sub-Mendip (Anglia). Jednocześnie data ta dowodzi, że w przedostatnim interglacjale egzystowały obok siebie w Europie *Homo erectus* i *Homo sapiens* oraz odpowiadające im kultury (klaktońska i aszelska).