The Role of Culture in Early Expansions of Humans (Frankfurt and Tübingen)

Annual Report for 2012

In the last 2 million years, the genus *Homo* spread from Africa to Asia and Europe in several waves of migration. While the habitat for australopithecines, early humans and other animals was limited by natural conditions, cultural achievements over the course of humanization permitted new ways of adapting to the environment. The Research Center "The Role of Culture in Early **E**xpansions of Humans" (ROCEEH) asks the pivotal question: When, where, and in what form did the interplay of changing environmental conditions, biological evolution and cultural development allow the genus *Homo* to move beyond the behavioral niche of a large African ape? How did *Homo* succeed in expanding not only culturally, but also into ecologically defined niches beyond Africa? The project aims to reconstruct the spatio-temporal and phylogenetic expansion of the various hominin species, the expansion of ecological environment as well as the expansion of cultural capacities between 3 million and 20,000 years before present, while shedding light on their causal relationship. Particular attention is paid to the development of human capacities for cultural activities, their backgrounds and actual occurrences. Archaeological excavations in **A**frica, Asia and Europe deliver this important information. At the core of the project is the **i**nterdisciplinary, web-based database known as ROAD (**R**OCEEH **O**ut of **A**frica **D**atabase) with complete GIS functionality. ROAD unifies geographical data about localities with information on the stratigraphical structure of layers and the archaeology contained therein. In addition, information on human fossil history, climate, as well as flora and fauna, is assimilated and then used to model early human habitats. The results are integrated into a digital atlas detailing the development of humans and environment on the basis of geographical information systems (GIS).

Started in 2008 and projected to run for 20 years, ROCEEH is an interdisciplinary research project at the interface between natural and cultural sciences. This extensive, international, scientific research is carried out by a team of archaeologists, paleoanthropologists, paleobiologists, geographers and database specialists situated at the Senckenberg Research Institute in Frankfurt and the University of Tübingen.

Members of the Scientific Commission: members of the Academy, Karl Fuchs, Lothar Ledderose, Joseph Maran, Ekkehard Ramm, Volker Sellin (chairman); external members, Prof. Dr. Ofer Bar-Yosef (Cambridge, USA), Prof. Dr. Manfred Ehlers (Osnabrück), Prof. Dr. Bernhard Eitel (Heidelberg), Prof. Dr. Wulf Schiefenhövel (Andechs), Prof. Dr. Mark Stoneking (Leipzig), Prof. Dr. Elisabeth Vrba (New Haven), Prof. Dr. Zvi Ben-Avraham (Tel Aviv).

Heads of the Research Center: in Frankfurt, Volker Mosbrugger, Prof. Dr. Friedemann Schrenk; in Tübingen, Nicholas Conard, Prof. Dr. Volker Hochschild.

Staff: in Frankfurt, Dr. Knut Bretzke (administrative coordinator starting Aug. 2012), Priv.-Doc. Dr. Angela Bruch, Claudia Groth, Priv.-Doc. Dr. Miriam Haidle (project coordinator), Dr. Christine Hertler, Dipl.-Biol. Chidi Nwokeji (through Dec. 2012), Dipl.-Biol. Rebekka Volmer; in Tübingen, Prof. Dr. Michael Bolus, Dipl.-Inf. Zara Kanaeva, Dr. Andrew Kandel, Maria Malina, Dr. Michael Märker, Dipl.-Geol. Geraldine Quénéhervé.

Guests of the Research Center in 2012: Prof. Paul Goldberg Ph.D. (Boston, summer semester); from Yerevan, Dr. Ivan Gabrielyan, Dr. Alla Hayrapetyan; from Tbilisi, Prof. Dr. Eliso Kvavadze, Inga Martkoplishvili; from Palermo, Prof. Dr. Edoardo Rotigliano, Dr. Silvia Angileri, Luigi Lombardo; Dr. Olesya Bondarenko (Vladivostok); Reza Zakerinejad (Tehran); Enqu Wondimu Negash (Addis Ababa); Dr. Jésus Rodríguez Mendéz (Burgos); Dr. Claudio Tennie (Leipzig); Prof. Dr. Volker Gerhardt (Berlin).

Focus topic

During ROCEEH's fifth year its research focused on the further development of the theoretical background and methods required to ascertain three types of expansion that are central to the project: 1) spatial and temporal taxonomic extent, or range; 2) habitat, or ecospace; and 3) cultural capacities. With regard to the first two types of expansion, ROCEEH members developed a reference model for Pleistocene hominid habitats in Sub-Saharan Africa based on specialized herbivore communities (Hertler), quantified open landscape and ecospace parameters (Bruch), and reconstructed ancient landscapes (Märker). The model of cultural capacities that ROCEEH unveiled last year was expanded and applied to case studies on thematic issues such as causality of cognition, development of language, advances in creative and artistic expression, and use of fire (Haidle).

Furthermore, the ROCEEH team employed cross-disciplinary methods to answer questions related to the three types of expansion. Using the ROAD database, ROCEEH investigated tool diversity, raw material transport, cultural capacity, as well as climatic and environmental reconstruction. This large-scale analysis of data examined trends and developments during the Middle Stone Age of southern Africa and tested one of the core hypotheses of the project, namely the assessment of whether the expansion of cultural capacities and cultural performances allowed *Homo sapiens* increased flexibility with regard to its landuse strategies. The results provide the first regional and chronological overview.

Environmental and landscape reconstruction in the Lake Manyara region of northern Tanzania (Hertler, Märker, Quénéhervé) and a study of geomorphological processes in the Ethiopian Highlands (Märker) help clarify the degree to which changes in the cultural capacities of early humans allowed expansions into subtropical habitats starting about two million years ago. Research in Spain and the Caucasus aimed to characterize prevailing environmental conditions during the Early Pleistocene expansions out of Africa (Bruch, Hertler). Moreover, field and laboratory studies conducted in Italy, Southern Germany, the Levant and Armenia focused attention on the expansion of cultural capacities observed during the transition from Middle to Upper Paleolithic (Bolus, Kandel, Malina, Märker). Studies of changes in the habitat preferences of Pre, Early and Classic Neanderthals addressed potential cultural limitations that may have hindered the northern and eastern movement of Neanderthals around the Mediterranean region, while predictive models to locate Neanderthal sites were developed and tested (Märker, Bolus). The possibility of a southern Arabian route for Late Pleistocene expansions out of Africa was investigated in the region of Jebel Faya in the United Arab Emirates (Bretzke, Kandel, Märker). To answer these questions, the ROCEEH team acquired data from museum collections, conducted its own field campaigns, developed new analytical methods, evaluated existing data, and continued to expand and query the ROAD database. A biannual newsletter providing current information on these themes can be accessed through ROCEEH's website (www.roceeh.net).

Fieldwork

In 2012 the staff of the Research Center conducted or participated in 11 projects in the field:

Afrika:

- South Africa: Sibudu Cave (Nicholas Conard in cooperation with Dr. Lyn Wadley; excavation and analysis of finds, 6 weeks)

- Tanzania: Makuyuni, Lake Manyara (Christine Hertler, Michael Märker, Geraldine Quénéhervé; survey, data collection and project preparation, 2 weeks)

Arabia:

- United Arab Emirates: Jebel Faya (Michael Märker in cooperation with Prof. Hans-Peter Uerpmann; survey and stratigraphical analysis, 2 weeks / Knut Bretzke; excavation, 4 weeks)

Levant:

- Israel: Sefunim (Andrew Kandel; find analysis and excavation planning, 3 weeks)

Europe:

- Italy: Mugello (Andrew Kandel, Michael Märker, Maria Malina; survey, field school, data collection, 4 weeks)

- Germany: Hohle Fels (Maria Malina; excavation in Middle Paleolithic and Gravettian layers, 8 weeks)

- Spain: Baza Basin (Angela Bruch; sampling Early Pleistocene sediment core, preparation of project proposal, 1 week)

Caucasus:

- Armenia: Aghitu-3 Cave (Andrew Kandel; excavation and find analysis, 4 weeks)

- Georgia: western and southern regions (Angela Bruch; geological profile analysis and sampling as part of VW project, 3 weeks)

Asien:

- China: Peking, Urumqi, Henan (Angela Bruch; contact trip for project conception “The environment of early humans in China” in cooperation with Cheng-Sen Li, 1 week)

- Indonesia: Bandung (Angela Bruch, Christine Hertler; contact trip for project planning, evaluation of potential of geological profiles, 3 weeks)

ROCEEH OUT OF AFRICA DATABASE (ROAD)

The ROAD system combines a PostgreSQL database with Web-GIS libraries to enable full Web-GIS functionality and includes map servers, Javascript and php scripts. ROAD is currently available to the public with limited user rights through the project website (www.roceeh.net). Through the end of the year a total of 807 localities had been entered into ROAD, mainly in South, East and North Africa.

Several areas of ROAD were improved and updated in 2012 including the table views, the layout, the online help function, and the data entry masks, while database documentation was updated. Quality control of data was simplified through the implementation of a data dependency tree, which allowed for easier correction and overview of data relationships. One emphasis in ROAD and its applications was the development of modules for the planned Virtual Atlas which allow interactive, thematic use of the database to unregistered, external users. With the help of software based on php and Javascript libraries such as Sencha ExtJS, Openlayers and GeoExt, ROAD can now generate interactive maps.

Project relevant conference contributions and lectures by research staff

In 2012 the Research Center organized. a symposium on “Environment and Culture of Early Humans in China and Beyond” from 27 Feb.–2 March at the Senckenberg Research Institute in Frankfurt/Main funded by the Sino-German Center for the Promotion of Science;. a German-Israeli meeting on the “Levantine Corridor” from 10–11 April at the Senckenberg Research Institute in Frankfurt/Main; a workshop on the “Environmental Background of Early Hominin Dispersal in Western Eurasia” from 19–20 April at the Senckenberg Research Station in Weimar; a workshop on the “Early Pleistocene Environmental Changes in Southern Caucasus–Reconstruction of Climate and Vegetation Development in Armenia and Georgia at the Time of Early Human Expansion into Eurasia” from 25–31 July at the Botanical Institute of the Armenian national Academy of Sciences in Yerevan.

Furthermore, the project staff participated in 21 conferences, hosted three sessions, were lead or contributing authors in 38 lectures and presented six posters. They also introduced the project or their work nine times at colloquia, lecture series and in the *Studium Generale*.

Third Party Funding

To complement the financing provided by the Academy, additional funds were sought for methodological development, regional investigation and visits from guest researchers and young academics. ROCEEH received additional support from the Sino-German Center for the Promotion of Science, the Chilean National Commission for Scientific and Technological Investigation through the German Academic Exchange Service (DAAD), the German Research Council (DFG), the International Research Staff Exchange Scheme (IRSES) program of the European Union, and the Volkswagen Foundation.

Teaching

In addition to their research activities, the staff strive to impart students with the benefits and results of their work and support graduate and postgraduate students in their qualifications:

- Lectures and seminars at the University of Frankfurt/Main: Christine Hertler, Angela Bruch, Rebekka Volmer
- Lectures and seminars at the University of Tübingen: Michael Bolus, Knut Bretzke, Angela Bruch, Miriam Haidle
- Lectures and seminars in the framework of the International Erasmus Mundus Master’s Program “Quaternary and Prehistory” at the Institute of Human Paleontology, Paris: Christine Hertler

- Supervision of students in field schools (Aghitu, Mugello): Andrew Kandel, Maria Malina, Michael Märker
- Supervision of Master's, Diploma and Doctoral theses: Michael Bolus, Angela Bruch, Miriam Haidle, Christine Hertler, Michael Märker
- Supervision of archaeotechnical trainees: Maria Malina

Project relevant publications by research staff

A total of 37 project relevant publications appeared in 2012 in which the staff of the Research Center played a leading or contributing role:

1. Akgün, F., Bruch, A.A., 2012. Preface - Neogene Terrestrial Environments and Climate Change in Eurasia. Turkish Journal of Earth Sciences 21(2), i–iii.
2. Akkiraz, M.S., Akgün, F., Utescher, T., Wilde, V., Bruch, A.A., Mosbrugger, V., 2012. Palaeoflora and climate of lignite-bearing Middle Miocene sediments in Seyitömer and Tunçbilek basins, Kütahya Province, NW Turkey. Turkish Journal of Earth Sciences 21(2), 213-235.
3. Berna, F., Goldberg, P., Horwitz, L.K., Brink, J., Holt, S., Bamford, M., Chazan, M., 2012. Microstratigraphic Evidence of in situ fire in the Acheulean strata of Wonderwerk Cave, Northern Cape Province, South Africa. PNAS 109 (20), E1215-E1220.
4. Bolus, M., 2012. Flake production in the Aurignacian of Southwestern Germany: some examples from the Swabian Jura. In: A. Pastoors und M. Peresani (Hrsg.), Flakes Not Blades: The Role of Flake Production at the Onset of the Upper Palaeolithic in Europe. Wissenschaftliche Schriften des Neanderthal Museums 5. Mettmann, Neanderthal Museum, 153-164.
5. Bolus, M., 2012. Mittelpaläolithische Spitzen. In: H. Floss (Hrsg.), Steinartefakte. Vom Altpaläolithikum bis in die Neuzeit. Tübingen, Kerns Verlag, 273-280.
6. Bolus, M., 2012. Messer mit Rücken. In: H. Floss (Hrsg.), Steinartefakte. Vom Altpaläolithikum bis in die Neuzeit. Tübingen, Kerns Verlag, 287-292.
7. Bolus, M., 2012. Blattförmige Schaber, Limaces, Blattspitzen. In: H. Floss (Hrsg.), Steinartefakte. Vom Altpaläolithikum bis in die Neuzeit. Tübingen, Kerns Verlag, 309-326.
8. Bolus, M., Conard, N.J., 2012. Les débuts de la culture en Europe. Dossier pour la Science 76, 56-60.
9. Bolus, M., Hertler C., 2012. Jenseits von Afrika. Archäologie in Deutschland 4/2012, 22-23.
10. Bolus, M., Bruch, A.A., Haidle, M.N., Hertler, C., Kandel, A.W., Märker, M., 2012. Increasing behavioral flexibility? An integrative approach to understanding the Middle Stone Age of Southern Africa. Tagungsband zur 36. Hauptversammlung der Deutschen Quartärvereinigung DEUQUA. Bayreuther Forum Ökologie 117. Bayreuth: Universität Bayreuth, BayCEER, 94.

11. Bolus, M., Märker, M., Serangeli, J., 2012. Spatial characterization and prediction of Neanderthal sites based on stochastic environmental modeling. Abstracts of the 54th Annual Meeting of the Hugo Obermaier-Gesellschaft, Toulouse (France). Büchenbach: Verlag Dr. Faustus, 17.
12. Bretzke, K., Conard, N.J., 2012. The evaluation of morphological variability in lithic assemblages using 3D models of stone artifacts. Journal of Archaeological Science 39, 3741-3749.
13. Bretzke, K., Drechsler, P., Conard, N.J., 2012. Water availability and landuse during the Upper and Epipaleolithic in southwestern Syria. Journal of Archaeological Science 39, 2272-2279.
14. Bruch, A.A., Sievers, C., Wadley, L., 2012. Quantification of climate and vegetation from Southern African Middle Stone Age sites – an application using Late Pleistocene plant material from Sibudu, South Africa. Quaternary Science Reviews 47, 7-17.
15. Chazan, M., Avery, D.M., Bamford, M.K., Berna, F., Brink, J., Holt, S., Fernandez-Jalvo, Y., Goldberg, P., Matmon, A., Porat, N., Ron, H., Rossouw, L., Scottm, L., Horwitz, L.K., 2012. The Oldowan horizon in Wonderwerk Cave (South Africa): Archaeological, geological, paleontological and paleoclimatic evidence. Journal of Human Evolution 63, 859-866.
16. Conard, N.J., Malina, M., 2012. Neue Forschung in den Magdalénien-Schichten des Hohle Fels bei Schelklingen. Archäologische Ausgrabungen Baden-Württemberg 2011, 56-60.
17. Frost, S.R., Schwartz, H.L., Giemsch, L., Morgan, L.E., Renne, P.R., Wildgoose, M., Saanane, C., Schrenk, F., Harvati, K., 2012. Refined age estimates and paleoanthropological investigation of the Manyara Beds, Tanzania. Journal of Anthropological Sciences 90, 1-12.
18. Haidle, M.N., 2012. Freiheiten im Kopf – Die Expansion der Kulturfähigkeit. Archäologie in Deutschland 4/2012, 30-33.
19. Haidle, M.N., 2012. Genética de la cognición. Investigación y Ciencia 2/2012, 66-67.
20. Haidle, M.N., 2012. How to think tools? A comparison of cognitive aspects in tool behavior of animals and during human evolution. Cognitive perspectives in tool behaviour Vol. 1. http://tobias-lib.uni-tuebingen.de/frontdoor.php?source_opus=6014
21. Haidle, M.N., 2012. Oldowan und andere frühe Geröllgeräte- bzw. Abschlagindustrien. In: H. Floss (Hrsg.), Steinartefakte. Vom Altpaläolithikum bis in die Neuzeit. Tübingen, Kerns Verlag, 159-166.
22. Haidle, M.N., 2012. Polifacético, flexible e ingenioso. Investigación y Ciencia 2-2012, 78-86.
23. Haidle, M.N., Richter, J., 2012. Frühe menschliche Expansionen – mehr als räumliche Ausbreitungen. Archäologie in Deutschland 4/2012, 20-21.
24. Haidle, M. N., 2012. Geschickte Verwandte – Werkzeugverhalten bei Menschenaffen. In: Stiftung Neanderthal Museum (Hrsg.), Wie Menschen Affen sehen . Mettmann, Neanderthal Museum, 52-59.

25. Kandel, A.W., Bauer, C.C., Noback, M.L., Singh, N., 2012. First Annual Meeting of the European Society for the Study of Human Evolution. Evolutionary Anthropology 27, 167-168.

26. Kandel, A.W., Conard, N.J., 2012. Settlement patterns during the Earlier and Middle Stone Age around Langebaan Lagoon, Western Cape (South Africa). Quaternary International 270, 15-29.

27. Kandel, A.W., Gasparyan, B., Bruch, A.A., Weissbrod, L., Zardaryan, D., 2012. Introducing Aghitu-3, the First Upper Paleolithic Cave Site in Armenia. Armenian Journal of Near Eastern Studies 6 (2), 7-23.

28. Kandel, A.W., Hertler, C., 2012. Homo sapiens…"wo noch nie zuvor ein Mensch gewesen ist". Archäologie in Deutschland 2012 (4), 26-27.

29. Lombard, M., Haidle, M.N. 2012. Thinking a bow-and-arrow: cognitive implications of Middle Stone Age bow and stone-tipped arrow technology. Cambridge Archaeological Journal 22 (2), 237-264.

30. McPherron, S.P., Talamo, S., Goldberg, P., Niven, L., Sandgathe, D., Richards, M.P., Richter, D., Turq, A., Dibble, H.L., 2012. Radiocarbon dates for the Late Middle Palaeolithic at Pech de l'Azé IV, France. Journal of Archaeological Science 39, 3436-3442.

31. Meng, Q., Liu, Z., Bruch, A.A., Liu, R., Hu, F., 2012. Palaeoclimatic evolution during Eocene and its influence on oil shale mineralization, Fushun Basin, China. Journal of Asian Earth Sciences 45(2), 95-105.

32. Popova, S., Utescher, T., Gromyko, D.V., Bruch, A.A., Mosbrugger, V., 2012. Palaeoclimate evolution in the Cenozoic of Siberia – evidence from fruit and seed floras. Turkish Journal of Earth Sciences 21(2), 315-334.

33. Soto Bäuerle, M.V., Paz Castro, C., Märker, M., Rodolfi, G., 2012. Dinámica actual de micro cuencas del desierto costero de Atacama (Caldera, Chile) y su influencia en la generación de amenaza. Geografia Fisica e Dinamica Quaternaria 5 (1), 79-89.

34. Thomas, D.B., Chinsamy, A., Conard, N.J., Kandel, A.W., 2012. Chemical investigation of mineralisation categories used to assess taphonomy. Palaeogeography, Palaeoclimatology, Palaeoecology 361-362: 104-110.

35. Vorpahl, P., Elsenbeer, H., Märker, M., Schröder, B., 2012. How can statistical models help to determine driving factors of landslides? Ecological Modelling 239, 27-39.

36. Wu, X., Zhang, C., Goldberg, P., Cohen, D., Pan, Y., Arpin, T., Bar-Yosef, O., 2012. Early pottery at 20,000 years ago in Xianrendong Cave, China. Science, 336, 1696-1700.

37. Yao, Y.-F., Bruch, A.A., Cheng, Y.-M., Mosbrugger, V., Wang, Y.-F., Li, C.-S., 2012. Monsoon versus uplift in Southwestern China–Late Pliocene Climate in Yuanmou Basin, Yunnan. PLoS ONE 7(5): e37760.