Annual Report of the Research Center for 2019

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

Human evolution is a story of expansions. During the last two million years the genus *Homo* spread from Africa into Asia and Europe in several waves of migration. New species developed and old groups became extinct (*range expansions*). As early as three million years ago, hominins had established new ways of dealing with their specific environment through culture. Stone tools produced with the help of another stone tool opened up access to new resources and activated changes in body, mind and behavior (*expansion of performances*). The ecospace of human species and their conspecifics changed the viability and development of potential resource spaces not only through natural processes, but also through changes in the distribution of a species and its behavior, which itself was increasingly shaped by culture (*expansions of resource space*).

ROCEEH's mission is to develop a systemic understanding of "becoming human", one which integrates these three types of expansion and how they interacted with each other. The project encompasses the time from three million to 20,000 years before present and spans from Africa to Eurasia. The project focuses particular attention on the development of the human capacity for cultural activities, as well as its background and characteristics.

At the core of the project is the multidisciplinary, web-based georelational database known as ROAD (ROCEEH Out-of-Africa Database) with its geographical information system (GIS) functionality. ROAD unifies geographical data about sites with additional information about the stratigraphical structure of layers and the archaeology those layers contain. In addition, ROAD assimilates information on human fossil history, fauna, flora and climate, information which can be 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 GIS.

Started in 2008 and projected to run for 20 years, ROCEEH is a multidisciplinary research project situated at the interface between the cultural and natural sciences. This far-reaching, international effort is carried out by a team of cultural scientists, 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: regular members of the Academy, Barbara Beßlich (Heidelberg), Hermann H. Hahn (chairman, Karlsruhe), Lothar Ledderose (Heidelberg), Irmgard Männlein-Robert (Tübingen), Joseph Maran (Heidelberg), Ekkehard Ramm (Stuttgart); as well as Prof. Dr. Ofer Bar-Yosef (Harvard), Prof. Dr. Zvi Ben-Avraham (Tel Aviv), Prof. Dr. Manfred Ehlers (Osnabrück), Prof. Dr. Jürgen Richter (Köln), Prof. Dr. Wulf Schiefenhövel (Andechs), Prof. Dr. Mark Stoneking (Leipzig).

Heads of the Research Center: Nicholas Conard (speaker, Tübingen), Prof. Dr. Volker Hochschild (Tübingen), Volker Mosbrugger (Frankfurt/M.), Prof. Dr. Friedemann Schrenk (Frankfurt/M.).

Research staff: in Frankfurt, Priv.-Doz. Dr. Angela Bruch, Claudia Groth (parental leave until mid-December 2019, 75%)), Priv.-Doz. Dr. Miriam Haidle (scientific coordinator; 60%), Dr. Christine Hertler, Dipl.-Biol. Julia Hess (administrative coordinator; 50%); in Tübingen, apl. Prof. Dr. Michael Bolus, Dipl.-Inf. Zara Kanaeva, Dr. Andrew Kandel, Maria Malina (75%), Christian Sommer, M.Sc. (75%)

Guests of the Research Center in 2019: Prof. Dr. Jordi Agusti (Tarragona, Spain), Dr. Jan-Ole Berndt (Trier, Germany), Alex Brittingham (Connecticut, USA), Shashi Bhushan (Mohali, India), Natia Chikhelidze (Tbilisi, Georgia), Ravindra Devra (Mohali, India), Dr. Ellery Frahm (New Haven, USA), Elen Hakobyan (Yerevan, Armenia), Narine Hayrapetyan (Yerevan, Armenia), Tamta Kapanadze (Tbilisi, Georgia), David Kaub (Trier, Germany), Prof. Dr. Wout Krijgsman (Utrecht, The Netherlands), Prof. Dr. Eliso Kvavadze (Tbilisi, Georgia), Dr. Emma Loftus (Cambridge, England), Prof. Dr. David Lordkipanidze (Tbilisi, Georgia), Dr. Ani Magelishvili (Tbilisi, Georgia), Yezad Pardiwalla (Mohali, India), Prof. Dr. Alfred Pawlik (Manila, The Philippines), Prof. Dr. Martin Porr (Crawley, Australia), Dr. Mika Rizki Puspaningrum (Bandung, Indonesia), Anna Theresia Maria ter Schure (Oslo, Norway) and Prof. Dr. Takuya Yamaoka (Shizuoka, Japan). Furthermore, Dr. Knut Bretzke was based at ROCEEH/Frankfurt within the framework of his DFG-funded project, and since October 2018 Priv.-Doz Dr. Oliver Schlaudt (Heidelberg, Germany) is based at ROCEEH/Tübingen as a Heisenberg Fellow of the DFG.

Key aspects

The following paragraphs detail key aspects of ROCEEH's main achievements in 2019, including an update on the ROCEEH Out of Africa Database (ROAD), details about a new cooperation with the Coalition for Archaeological Synthesis, insight into future perspectives for ROAD and its sustainability, implementation of the database PlantBITES and finally a new publication series entitled "ROCEEH Communications."

ROCEEH Out of Africa Database (ROAD)

One of the focal points of ROCEEH's work in 2019 was the further development of ROAD. The Research Center strived to improve the structure, data entry and user friendliness (see below) of ROAD, above all, with a view to expand its use beyond the project's staff, scope and duration. As in preceding years, links to other databases and project partners who enter their own research data helped to enlarge the "queryable" content of ROAD. Building on an introductory workshop to ROAD held last year in Chandigarh (India), ROCEEH welcomed three doctoral students to Tübingen, who entered sites from the Subcontinent into ROAD as part of a practical month abroad. Even after their departure, the students continue to enter sites into the database. As a result of this very positive experience, we hope to make increasing use of the special knowledge held by our research partners. These colleagues know the sites in their regions best and have access to local publications in many languages. As a result we plan to offer further introductory workshops in Southeast and East Asia and sponsor additional guest visits to Germany.

Cooperation with the Coalition for Archaeological Synthesis

Representing the Research Center, Andrew Kandel was invited to attend a workshop on "Human Migration as Understood from a Long-Term Perspective" sponsored by the Coalition for Archaeological Synthesis, a joint endeavor of the Society for American Archaeology, the European Association of Archaeologists and the Society for Historical Archaeology. One of 15 researchers selected from a field of 52 applicants, he was invited to participate in a design workshop in Dragoon, Arizona. The participants came from America, Europe and Africa, each offering diverse research perspectives centered on themes of migration, and included experts in archaeology, ethnography, paleoclimate, isotopes and ancient DNA. The participants also focused on variable time frames, ranging from Paleolithic hunters and gatherers all the way to migrants of the present who live on the streets. The goal of the workshop was to conceive of new ideas for projects which would make use of existing data,

in order to develop new perspectives about the very current issue of human migration. ROCEEH's expertise was employed to the group, "Long-Term Effects of Past Migration on Human Security." The starting point of this topic was the United Nations Development Program's (1994) list of basic human securities (Food, Environment, Personal, Health, Economic, Community, Political). For each human security the group defined specific archaeological variables and the expected effects on human security which could be tested through synthesis of data from case studies. The transdisciplinary integration of datasets from archaeological sciences, applied and communal archaeology, anthropology, material culture studies, ethnography and digital museology represented a core theme of this topic. The ideas developed in September 2019 will be worked into a proposal for submission to a funding agency in late 2020. (http://www.archsynth.org/fall-2019.html).

Future perspectives for ROAD and its sustainability

As one of two projects selected by the Heidelberg Academy, ROCEEH participated in a poster session in conjunction with the evaluation of the Academy Program of the Mainz Academy of Sciences. The exchange with different Academy projects made it clear that greater sustainability can be achieved by securing digital project data, preserving the functionality of databases beyond the end of the project and publishing the results in digital format. At the same time, however, these issues represent unknown challenges that are only now coming to light. To address these issues, multiple solutions must be developed in the future. In this regard, ROCEEH made significant efforts to establish links with two global archaeological databases, the ARIADNEplus Network[1] and tDAR (*The Digital Archaeological Record*)[2].

ROCEEH is organizing a conference in July 2020 to foster exchange about integrative methods for the development, use and future perspectives of scientific databases in the context of archaeological and paleoenvironmental research. The primary research question

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[1] ARIADNEplus (https://ariadne-infrastructure.eu) is a research infrastructure funded by the H2020 Program of the European Commission. The ARIADNEplus cloud-based data infrastructure creates a virtual environment for data-based archaeological research. The project has developed a linked data method for data evaluation, which allows its users to employ innovative services such as visualization, commentary, text mining and geo-temporal data management.

[2] tDAR (https://www.tdar.org) is an international repository for digital archaeological records, developed and maintained by *Digital Antiquity* (https://www.digitalantiquity.org), a collaborative, non-profit organization for improving the preservation of and access to irreplaceable archaeological records and data.

centers on how databases that use innovative methods of information technology can generate new knowledge about early human prehistory. In the foreground is the integration within databases of different qualitative and quantitative, primary and derived data from archaeology, paleoanthropology, paleoenvironmental research and geography. This step forward raises the possibility of analyzing data and developing new technical standards for software, hardware and data models as well as networking of databases. During this conference we will address core questions about digitalization, whereby possibilities and problems of large, multidisciplinary databases will be illuminated. Software tools and digital data continue to be widely used in scientific projects; however, questions of linking, targeted expansion, universal analysis and sustainable backups of the data remain unresolved. Some innovative methods that we will explore include data mining and machine learning as well as deep learning and artificial intelligence.

PlantBITES

The BMBF funded a new project, PlantBITES, "Changes in Vegetation and Plant Resources in the Southern Caucasus – Plant Biodiversity in Time and Space." Headed by Angela Bruch in cooperation with colleagues from the Georgian National Museum in Tbilisi and the Botanical Institute of the Armenian Academy of Sciences in Yerevan, the project was successfully completed in 2019. Vegetation and plant diversity were, and still are, of utmost relevance to the habitats in which humans lived. Plants deliver crucial and diverse resources which are influenced by natural and anthropogenic climate change. Therefore, one goal was to reconstruct the vegetation history with regard to climate change in the geographically complex region of the Southern Caucasus since it was first settled by humans. The project developed methods to quantify the offerings of plant resources, which allowed for specific analysis of the resource spectra of fossil vegetation units for different groups of people.

An important product of this work is the PlantBITES Database developed by its cooperation partners. The database contains information about wild plants and their potential to serve as food and raw material with special consideration of their availability in specific vegetation units, and even in fossil remains. The dominant plant types documented in these vegetation units are recorded in the PlantBITES Database along with details of their utility (especially useable plant parts, nutrient content, seasonal availability, essential processing techniques, etc.), as initially researched from published sources. Furthermore, ethnobotanical interviews will be conducted in Armenia at the village level to fill large gaps and identify wild plants of

socioeconomic importance. This work will contribute to the preservation of local knowledge, which is increasingly at risk of disappearing. By connecting with the local population and bringing wild plant use to the forefront, a case for sustainable use will be made.

The project will consider the utility of plants to different groups of early humans, who lived in the Caucasus since about 2 million years ago and had different biological and cultural capacities. Thus, PlantBITES goes far beyond existing ethnobotanical databases (e.g. *Plants for a Future*). The conception and realization of the database structure are complete. A detailed handbook documents the general structure and individual attributes of the tables. To date information on the edibility of over 400 taxa has been compiled with details on 343 edible plant parts and over 400 other possible uses (e.g. fibers, colors, wood). For each vegetation unit we compile information about the number of edible plant parts, their nutritional quality (e.g. carbohydrate, fat), in which season they are available and with which technology they can be made usable (e.g. with or without fire, tools, storage). These methods were used to successfully reconstruct vegetation units for the environment of early humans at Dmanisi. The first results underscore the significance of forests as sources of nutrition from plant resources in the Caucasus in the case without fire.

Now that the database has been successfully established, it can be further developed and sustainably consolidated. Within the scientific context of the Research Center, PlantBITES offers many possible applications for the evaluation of vegetation units beyond the Caucasus. A very important goal to normalize the quantification of the availability of resources. This will allow for supra-regional, standardized comparisons of vegetation types from different climate zones and continents with completely different plant types. The first supra-regional comparison of results from the Caucasus is currently underway using data from the Baza Basin of southern Spain, where the earliest evidence of *Homo* in Western Europa exists (doctoral thesis of Yul Altolaguirre). In southern Spain a clearly different picture emerges, with higher values of resource availability in open landscapes as compared to the Caucasus (Fig. 1).

The adaptation of PlantBITES to resource analysis in Asia is currently underway within the framework of the research project, "Pleistocene Hominin Migration of Java: Multi-Scale Agent-Based Model Simulation." This project is a cooperation with Dr. Mika Puspaningrum (Bandung, Indonesia) to quantify the resource availability of edible wild plants for *Homo*

erectus in Java. Another current analysis looks at the seasonal availability of edible plant parts in the habitats of Neanderthals in Central Europe between glacial and interglacial periods. The resource culture of Neanderthals is imprinted with the more complex cultural behavior of gatherers and the storage and preparation of plant foods, which must first be individually defined for each group based on archaeological finds.
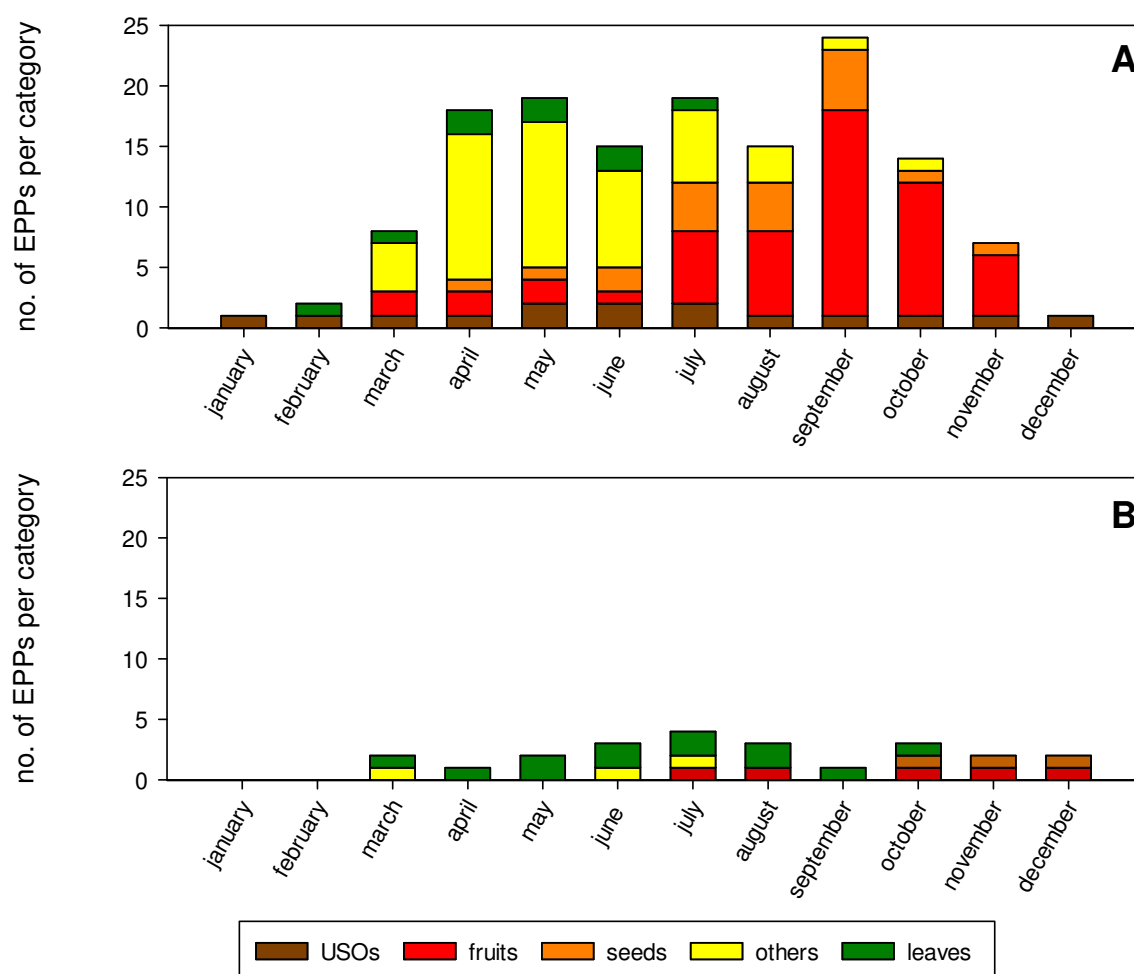

Fig. 1: Quantitative representation of seasonal availability of edible plants in forests of A: Caucasus (beech forest) and B: Southern Spain (Mediterranean oak forest), for groups of early humans without fire use or storage. The most important energy sources are fruits, seeds and underground storage organs (USOs). The group 'others' includes edible plant parts (EPPs) such as blossoms, stalks, buds, bark, plant sap, etc. The high proportion of edible wild plants in the forest of the Caucasus underscores its role as a refugium.

ROCEEH Communications

In its twelfth year, the Research Center inaugurated its own publication series "ROCEEH Communications" with the Heidelberg University Press (heiUP). The first volume is scheduled to appear in 2020. The Research Center plans to publish its conference proceedings and research results in this new series. Newsletters providing additional information on these and other topics can be accessed through ROCEEH's website (www.roceeh.net).

Field Work

In 2019 the staff of the Research Center conducted or participated in eight? field projects:

Africa

- South Africa: Sibudu Cave and Umbeli Belli Rock Shelter. Excavation and analysis of finds (Conard, N., Bader, G., 12 weeks)
- South Africa: KwaZulu-Natal. Survey and analysis of finds (Conard, N., Hochschild V., Sommer, C., 5 weeks)
- Tanzania: Mumba Cave. Excavation and analysis of finds (Conard, N.J., Bader G., Blessing, M., Becher, J., 3 weeks)

Arabia

- United Arab Emirates: Buhais 84. Excavation (Bretzke, K., 3 weeks)

Caucasus

- Armenia: Aghitu-3 Cave. Analysis of finds (Kandel, A.W., Jabbour, F., 3 weeks)

Levante:

- Israel: Sefunim Cave. Analysis of finds (Kandel, A.W., 3 weeks)

Europe

- Germany: Hohle Fels in Schelkingen and Lonetal. Excavation and analysis of finds (Malina, M., Conard, N.J., 14 weeks)
- Germany: Schöningen. Excavation and analysis of finds (Conard, N.J., Serangeli, J., 40 weeks)

ROCEEH Out-of-Africa Database (ROAD) and ROADWeb

The generation of ROAD Site Summary Datasheets as PDFs, which began last year, was completed in 2019 and implemented online. Site Summary Datasheets provide a convenient overview of all data for each locality stored in ROAD. A catalog of datasheets in PDF format provides access to fundamental but often difficult to obtain information about sites important to the development of early humans dating between three million and 20,000 years ago.

Every year we improve the user-friendliness of ROADWeb. We streamlined the workflows for data entry so that all essential forms could be accessed by selecting a single site. Various efforts corrected and extended the capabilities of ROAD and its application, ROADWeb. In 2019 we

expanded ROAD by adding three new tables containing metadata about the institutions which actually house the finds stored in the ROAD database. In order to make future data analysis easier we implemented a new management system of the ROADWeb SQL query. We reprogrammed the CSV import on account of an update from PHP 5 to PHP 7. Finally, the Beta Version of the import is now incorporated into ROADWeb.

Research assistants continued to enter data into ROAD in 2019. In addition, three doctoral students from India who attended a workshop last year joined us for a month as guests of the Research Center and entered Indian sites into ROAD. To increase the number of ROAD users, we held an introductory workshop in ROAD, ROADWeb and SQL querying at the University of Cologne. As of December 30, 2019 ROAD contained 1,800 localities and 10,738 assemblages.

Project relevant conference contributions and lectures by research staff

The staff of the Research Center participated in 14 conferences. They were the main organizers of three conferences: the NECLIME Annual Meeting in St. Petersburg, Russia; the German-Israeli Symposium "Frontiers of Humanities" in Jerusalem, Israel; and supported the organization of the 7th Biennial Conference of the East African Association of Paleontology and Paleoanthropology in Nairobi, Kenya. In addition, the ROCEEH staff led two workshops and three conference sessions. They were lead or contributing authors in 15 lectures and presented eight posters. They also presented the project or their work five times at work meetings, lecture series, and in the *Studium Generale*.

Third Party Funding

To complement the financing provided by the Academy, additional funds were sought for case studies, regional investigations and visits from guest researchers and young academics. ROCEEH received additional support from the German Ministry of Education and Research (BMBF), the International Union for Quaternary Research, the Alexander von Humboldt Foundation and the Coalition for Archaeological Synthesis. Three doctoral candidates received fellowships from the Gerda Henkel 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, Ericson Hölzchen
- Lectures and seminars at the University of Tübingen: Michael Bolus, Angela Bruch, Miriam Haidle, Christian Sommer
- Lectures and seminars at the Karlsruhe Institute of Technology: Christine Hertler
- Supervision of Master's, Diploma and Doctoral theses: Michael Bolus, Angela Bruch, Miriam Haidle, Christine Hertler
- Supervision of archaeo-technical trainees: Maria Malina

Project relevant publications by research staff and principal investigators

A total of 36 project relevant publications appeared in 2019 in which the principal investigators and staff of the Research Center played a leading or contributing role:

ISI-listed publications: 13

1. Altolaguirre, Y., Postigo-Mijarra, J.M., Barrón, E., Leroy, S.A.G., Bruch, A.A. (2019): An environmental scenario for the earliest hominins in the Iberian Peninsula: Early Pleistocene palaeovegetation and palaeoclimate. Review of Paleobotany and Palynology 260: 51-64. https://doi.org/10.1016/j.revpalbo.2018.10.008

2. Fuentes, R., Ono, R., Nakajima, N., Nishizawa, H., Siswanto, J., Aziz, N., Sriwigati, Sofian, H. O., Miranda, T., Pawlik, A. (2019). Technological and behavioural complexity in expedient industries: The importance of use-wear analysis for understanding flake assemblages. Journal of Archaeological Science 112 (2019): 105031.

3. Gretzinger, J., Molak, M., Reiter, E., Pfrengle, S., Urban, C., Neukamm, J., Blant, M., Conard, N.J., Cupillard, C., Dimitrijević, V., Drucker, D.G., Hofman-Kamińska, E., Kowalczyk, R., Krajcarz, M.T., Krajcarz, M., Münzel, S.C., Peresani, M., Romandini, M., Rufí, I., Soler, J., Terlato, G., Krause, J., Bocherens, H., Schuenemann, V.J. (2019): Large-scale mitogenomic analysis of the phylogeography of the Late Pleistocene cave bear. Scientific Reports 9: 10700. https://doi.org10.1038/s41598-019-47073-z.

4. Krijgsman, W., Tesakov, A., Yanina, T., Lazarev, S., Danukalova, G., van Baak, C.G.C, Agustì, J., Alçiçek, M.C., Aliyeva, E., Bista, D., Bruch, A., Büyükmeriç, Y., Bukhsianidze, M., Flecker, R., Frolov, P., Hoyle, T.M., Jorissen, E.L., Kirscher, U., Koriche, S.A., Kroonenberg, S.B., Lordkipanidze, D., Oms, O., Rausch, L. Singarayer, J., Stoica, M., van de Velde, S., Titov, V.V., Wesselingh, F.P. (2019): Quaternary time scale

for the Pontocaspian domain: Interbasinal connectivity and faunal evolution. Earth-Science Reviews 188: 1-40. https://doi.org/10.1016/j.earscirev.2018.10.013

5. Lombard, M., Haidle, M. N., Högberg, A. (2019). Cognition: From capuchin rock pounding to Lomekwian flake production. Cambridge Archaeological Journal 29(2): 201-231. https://doi.org/10.1017/S0959774318000550

6. Märker, M., Schillaci, C., Melis, R.T., Kropáček, Bosino, A., Vilímek, V., Hochschild, V., Sommer, C., Altamura, F., Mussi, M. (2019): Geomorphological processes, forms and features in the surroundings of the Melka Kunture Palaeolithic site, Ethiopia. Journal of Maps 15(2): 797-806. https://doi.org/10.1080/17445647.2019.1669497

7. Peyrégne, S., Slon, V., Mafessoni, F., de Filippo, C., Hajdinjak, M., Nagel, S., Nickel, B., Essel, E., Le Cabec, A., Wehrberger, K., Conard, N.J., Kind, C.J., Posth, C., Krause, J., Abrams, G., Bonjean, D., Di Modica, K., Toussaint, M., Kelso, J., Meyer, M., Pääbo, S., Prüfer, K. (2019): Nuclear DNA from two early Neandertals reveals 80,000 years of genetic continuity in Europe. Science Advances 5: eaaw5873. https://doi.org/10.1126/sciadv.aaw5873

8. Rhodes, S.E., Starkovich, B.M., Conard, N.J. (2019): Did climate determine Late Pleistocene settlement dynamics in the Ach Valley, SW Germany? PLoS ONE 14(5): e0215172. https://doi.org/10.1371/journal.pone.0215172

9. Richard; M., Falguères, C., Valladas, H., Ghaleb, B., Pons-Branchu, E., Mercier, N., Richter, D., Conard, N.J. (2019): New electron spin resonance (ESR) ages from Geißenklösterle Cave: A chronological study of the Middle and early Upper Paleolithic layers. Journal of Human Evolution 133: 133-145. https://doi.org/10.1016/j.jhevol.2019.05.014

10. Velliky, E.C., Barbieri, A., Porr, M., Conard, N.J., MacDonald, B. L. (2019): A preliminary study on ochre sources in Southwestern Germany and its potential for ochre provenance during the Upper Paleolithic. Journal of Archaeological Science: Reports 27: 101977. https://doi.org/10.1016/j.jasrep.2019.101977

11. Will, M., Kandel, A.W., Conard, N.J. (2019). Midden or molehill: the role of coastal adaptations in human evolution and dispersal. Journal of World Prehistory 32: 33-72. https://doi.org/10.1007/s10963-018-09127-4

12. Wirkner, M., Hertler, C. (2019): Feeding ecology of late Pleistocene *Muntiacus muntjak* in the Padang Highlands (Sumatra). Comptes Rendus Palevol 18 (5): 541-554.

13. Zanolli, C., Kullmer, O., Kelley, J., Bacon, A. M., Demeter, F., Dumoncel, J., Fiorenza, L., Hublin, J.-J., Nguyen, A.T., Nguyen, T.M.H., Pan, L., Schillinger, B., Schrenk, F.,

Skinner, M. M., Ji, X., Macchiarelli, R. (2019). Evidence for increased hominid diversity in the Early to Middle Pleistocene of Indonesia. Nature Ecology & Evolution 3(5): 755-764. https://doi.org/10.1038/s41559-019-0860-z

Other peer reviewed publications: 10

1. Bolus, M., Conard, N.J. (2019): Paläolithforschung in den Höhlen der Schwäbischen Alb. Forschungsgeschichte - Kenntnisstand - Ausblick. In M. Baales, C. Pasda (eds.): "All der holden Hügel ist mir keiner fremd..." Festschrift zum 65. Geburtstag von Claus-Joachim Kind. Universitätsforschungen zur Prähistorischen Archäologie 327. Bonn: Verlag Dr. Rudolf Habelt, 43-66.

2. Frahm, E., Gasparyan, B., Kandel, A.W. (2019). Upper Palaeolithic Settlement and Mobility in the Armenian Highlands: Agent-Based Modeling, Obsidian Sourcing, and Lithic Analysis at Aghitu-3 Cave. Journal of Paleolithic Archaeology 2(4): 418-465. https://doi.org/10.1007/s41982-019-00025-5

3. Garofoli, D., & Iliopoulos, A. (2019). Replacing epiphenomenalism: A pluralistic enactive take on the metaplasticity of early body ornamentation. Philosophy & Technology 32(2): 215-242. https://doi.org/10.1007/s13347-017-0296-9

4. Haidle, M.N. (2019): The origin of cumulative culture – not a single-trait event, but multifactorial processes. In F.L. Coolidge, K. Overmann (eds.): Squeezing minds from stones. Oxford: Oxford University Press, 128-148.

5. Schmid, V.C., Bosch, M.D., Brandl, M., Götzinger, M., Nigst, P.R. (2019): Neue Einblicke in das Gravettien von Willendorf II. Die Steinartefakte der Grabung 1993. Archaeologia Austriaca 303: 11-73.

6. Schmid, V.C., Porraz, G., Zeidi, M., Conard, N.J. (2019): Blade Technology Characterizing the MIS 5 D-A Layers of Sibudu Cave, South Africa. Lithic Technology 44: 199-236. https://doi.org/10.1080/01977261.2019.1637627

7. Taller, A., Conard, N.J. (2019): Radiocarbon Dates from Hohle Fels Cave from Aurignacian to Gravettian. Archäologisches Korrespondenzblatt 49: 165-181.

8. Taller, A., Kieselbach, P., Conard, N.J. (2019): Reconstructing technology, mobility and land use via intra and inter-site refits from the Gravettian of the Swabian Jura. Archaeological and Anthropological Sciences 11: 4423–4435. https://doi.org/10.1007/s12520-019-00778-8

9. Will, M., Conard, N.J., Tryon, C.A. (2019): Timing and trajectory of cultural evolution on the African continent 200,000-30,000 years ago. In Y. Sahle, H. Reyes-Centeno, C. Bentz (eds.), Modern Human Origins and Dispersal. Tübingen: Kerns Verlag, 25-72

10. Will, M., El-Zaatari, S., Harvati, K., Conard, N.J. (2019): Human teeth from securely stratified Middle Stone Age contexts at Sibudu, South Africa. Archaeological and Anthropological Sciences 11: 3491–3501. https://doi.org/10.1007/s12520-018-00774-4

Publications without peer review: 11

1. Conard, N.J. (2019), Excavations at Geißenklösterle Cave. In N.J. Conrad, M. Bolus, S.C. Münzel (eds.): Geißenklösterle. Chronostratigraphie, Paläoumwelt und Subsistenz im Mittel- und Jungpaläolithikum. Tübingen: Kerns Verlag, 9-21.

2. Conard, N.J., Bolus, M., Münzel, S.C. (eds.) (2019): Geißenklösterle. Chronostratigraphie, Paläoumwelt und Subsistenz im Mittel- und Jungpaläolithikum der Schwäbischen Alb. Tübingen: Kerns Verlag.

3. Conard, N.J., Bolus, M., Münzel, S.C. (2019): Ausblick/Future research. In N.J. Conrad, M. Bolus, S.C. Münzel (eds.): Geißenklösterle. Chronostratigraphie, Paläoumwelt und Subsistenz im Mittel- und Jungpaläolithikum der Schwäbischen Alb. Tübingen: Kerns Verlag, 329-330.

4. Haidle, M.N. (2019). *Homo migrans*: Spuren menschlicher Expansionen von 7 Millionen bis 5000 v. Chr. In R. Rollinger, H. Stadler (eds.): 7 Millionen Jahre Migrationsgeschichte. Annäherungen zwischen Archäologie, Geschichte und Philologie. Innsbruck: Innsbruck University Press, 41-90.

5. Haidle, M. N., B. V. Eriksen 2019. Obituary: Hansjürgen Müller-Beck (13 August 1927 – 2 August 2018). Journal of Anthropological Research 75/1: 1-5.

6. Ioannidou, M., Falcucci, A., Röding, C., Kandel, A.W. (2019). Eighth Annual Meeting of the European Society for the Study of Human Evolution. Evolutionary Anthropology 28: 52-54. DOI: 10.1002/evan.21770

7. Lehmann, J., Serangeli, J., Conard, N.J. (2919): Schöningen FStNr. 13 II, Gde. Stadt Schöningen, Ldkr. Helmstedt. Nachrichten aus Niedersachsens Urgeschichte, Beiheft 22. Darmstadt: Konrad Theiss Verlag, 135-139.

8. Maaß, C.-L., A.-L. Jerg, S. Lippe, F. Pfrommer, L.-A. Lazar, M.N. Haidle (2019). Images, gestures, voices, lives. What can we learn from Palaeolithic art? A conference at the University of Tübingen, organized by the Research Center "The Role of Culture in Early Expansions of Humans" (ROCEEH) and the Senckenberg Centre for Human Evolution and Palaeoenvironment (HEP). Mitteilungen der GfU 27 (2018): 91-104.

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