

From Specialty to Specialist: a citation analysis of Evolutionary Anthropology, Palaeolithic Archaeology and the work of John Gowlett 1970-2018

Anthony Sinclair

Introduction

Understanding the relationship between a scholar and their specialty is the task of the intellectual biographer. It usually involves an extensive critical reading of publications and reflecting on the impact or contribution made by these documents and their author to the research of a specialty. Of course, documents are texts that are read and then situated within a *con*-text supplied by the reader or biographer. Two different individuals can both read the same document and yet draw out different understandings depending on the context provided by their own biography of reading and their own understanding of a specialty that they bring to the moment of reading something new in a discipline. The success of any intellectual biography, therefore, is dependent on the expertise, knowledge and breadth of reading that can be brought to the contextualisation of a scholar's work. However, whilst the physical activity of reading and critical reflection may not have changed over the years, the identification of an effective context has become ever more difficult as a result of the growth in number of potentially relevant research outputs for any context within any specialty (see Price 1951, 1963 for an early recognition of this problem). Despite the small size of Archaeology as a discipline, the problem of document abundance is no different; the number of research outputs and, therefore, documents for contextualisation is growing exponentially (Sinclair 2016; figure 1).

There is, however, another way to see the relationship between a scholar and their specialty rather than the reading and contextualisation of a set of documents by a single biographer. The documents themselves can be used to generate a directed network (of influence) flowing 'inwards' from other published documents, researchers and collaborating colleagues, and 'outwards' through writings and contacts to other publications and scholars. Documents are joined together in a network either directly via the collaboration of authors or through the process of citation (Price 1965), or 'indirectly' or in the shared use of terms and their engagement in the same conceptual milieu. Through networks of citation we can analyse the way in which one scholar has been influenced by the work of other scholars by examining the citations made

to other publications, and we can look at the influence of one scholar within their specialty, or beyond, by examining how their own work has been cited by others. Lastly, we can look at the terms used within a set of publications to see how a specialty structures its conceptual understanding of its research interests (see Klavans and Boyack 2014). This is citation analysis.

Citation analysis is qualitatively different from intellectual biography since the process of reading and document contextualisation is distributed from a single scholar to the members of a discipline as a whole. In simplest terms, citations record the influence of one document and its authors upon another. And, even though the exact rationale and nature of citation is still actively debated (for example: Kaplan 1965; Cronin 1984; Hyland 1999; Leydesdorff 1988; Nicolaisen 2007; Davenport and Snyder 2009; Chi 2016; Boyack *et al.* 2018) there are some clear advantages to the use of this approach in the modern era. The analysis of citations, in effect, aggregates the reading of many specialists to generate a context much greater in size than the sample of publications that might be read by a single scholar whilst also reducing the impact of potentially idiosyncratic readings that might be made by any one individual. Citation analysis also facilitates the tracing of influence through a collection of publications that might number many more documents than any individual could possibly read.

Despite the development of citation data and its analysis in the 1960s (see Wouters 1999 for a succinct history), its use for understanding the humanities and social sciences has been minimal (Ardanuy 2013). Its use in archaeology has been if anything even rarer, though the few examples published illustrate its potential. These include studies of the use of citation analysis to review the use of new methods of analysis (network analysis - Brughmans 2013; microwear analysis - Dunmore *et al.* 2018), the nature of citation in the discipline (the citation of women scholars Hutson 2002; and self-citation - Hutson 2006), and for a broad historical overview (the intellectual base of archaeology 2004 to 2013 - Sinclair 2016). Missing in these examples is the use of citation analysis as a technique for examining a discipline at multiple scales, something for which citation analysis is well-suited and that is

now unachievable through standard historiographic approaches due to the number of documents.

In the following study, therefore, citation analysis has been used to analyse a single discipline across three nested scales. At the broadest scale, the analysis begins with the discipline of Evolutionary Anthropology, then focuses down on the specialty of Palaeolithic archaeology and end by examining the research of a single scholar - John Gowlett. Data has been collected from a defined starting date (1970) up to the present day (2018). The 1970s are a good starting date for examining the discipline of palaeoanthropology as a self-aware, and distinguishable discipline in its own right. They begin with the publication of the first monographs on the excavations of the earliest hominins and their artefacts at Olduvai Gorge (Leakey 1971), with the appearance of the *Journal of Human Evolution* in 1972, the first journal specifically designed to circulate research in this field. And, whilst there has been archaeological excavation and research publications of Palaeolithic age materials since the mid 19th century (Lartet and Christy 1865-1875) one can argue that it is the combination of the external chronology of the marine oxygen isotope record along with the statistical analysis of lithic and faunal assemblages, the long-term ethnographic record of surviving hunter-gatherer populations and the first radio-carbon dates all coming together in the 1970s that gives Palaeolithic archaeology its unique character distinct from other forms of prehistoric archaeology. Finally, the first article by John Gowlett was published in 1978.

Bibliometric data and the identification and analysis of disciplines

The bibliometric data necessary for citation analysis currently exists in readily accessible through the academic citation indices first started by Eugene Garfield in the 1960s (Garfield 1955, 1964). These indices include not only the details of a publication - the author, date, title and place of publication, but now also include the reference list of any publication, key words and the abstract amongst other information. Garfield already recognised the potential for this type of information in the process of examining how disciplines and the specialties within then developed over time and called this study algorithmic historiography (Garfield and Sher 1963).

In recent years developments in computing power to process and visualise complex networked data sets has led to the development of 'science mapping' as a research technique in its own right (see Börner *et al.* 2003; Chen 2017 for reviews of this approach), with the potential for science maps can be made for document sets that number into the millions (see Boyack *et al.* 2005 for an early example). The quality of the visualisation

depends on the reliability of the bibliometric data used: specifically, whether it represents a coherent field of research. This can be problematic for a multi-disciplinary research field like Palaeoanthropology. In this study bibliometric data from the Web of Science and Scopus citation indices have been used, as well as Google Scholar. Citation indices are, by necessity, samples of currently available academic literature with none providing complete coverage of the academic literature (see Wouters 1999 for an insightful history of the first citation indices). Studies indicate that the Web of Science has better coverage of publications in the natural sciences but is known to have weaknesses in its coverage of the social sciences and particularly the arts and humanities, further exacerbated by its original focus on journals as the publication form chosen for indexing; Scopus, on the other hand, has better coverage for the social sciences, the arts and humanities as well as for publications in monograph form (Martin-Martin *et al.* 2018a, 2018b; Anderson and Nielsen 2018; Falagas *et al.* 2007).

Extracting a representative sample of bibliometric data for Palaeoanthropology with a research approach that includes everything from the physical and chemical sciences right through to the arts and social sciences, and with publications in both journal and monograph form, the use of both databases is necessary. Both the Web of Science and Scopus apply subject category codes to publication sources - journals - rather than to individual documents, following the assumption that researchers within a discipline preferentially publish in a select set of sources for that discipline (Wang and Waltman 2016). However, since neither Palaeoanthropology or Palaeolithic Archaeology has been classified as a distinct subject by the Web of Science or Scopus, the journals where its research is often published are not identifiable by a defined subject category. Moreover, research outputs in these research areas whilst often published in a common set of journals also appear in a much wider set often categorised to different research fields. Therefore, the search for bibliometric data for these two research areas, needs to identify publications in journals classified at the intersections of recognised subject fields, or via the use of terms that are exclusively used by a coherent group of researchers to identify individual documents by 'topic'. Both approaches are described in more detail below.

The networks in this study have been constructed using *VOSviewer*, a program designed specifically for the visualisation and analysis of networks of academic literature, created by Nees Jan van Eck and Ludo Waltman at the Centre for Science and Technology Studies at the University of Leiden (van Eck and Waltman 2010). It is available free of charge for academic use (see www.vosviewer.com). *VOSviewer* can construct and visualise citation-based network

based on several forms of relationship: these include co-citation, bibliographic coupling or direct citation. In its visualisations, the nodes in the network can be either sources of publications (journal or monograph titles), or authors; the size of the node is indicative of the frequency of citation or use and nodes are placed closest to those with which they are most commonly associated against a measure of association strength (van Eck and Waltman 2010). The visualisations here use a co-citation relationship in which authors and sources are identified and placed together according to the number of times with which they are both included in a publication's reference list. Co-citation relationships are believed to be an effective way of understanding the intellectual base of a discipline – defined as the key publications that form the foundations of a discipline's knowledge. This is discussed in more detail in Sinclair (2016). Aside from the citation-based maps, *VOSviewer* can also generate network maps of the language of a set of publications by extracting significant terms from titles and abstracts, though at present abstracts are usually only available in the databases for publications dated after 1995. When examined online, individual maps can be magnified so that all nodes might be identified, but in the maps printed here the scale used means that many of the nodes are not specifically identified especially in the larger maps. *VOSviewer* is also able to represent the relationships ('edges') between nodes as a series of lines between nodes. This facility has been used in a number of the maps below where their presence helps identify relationships for discussion.

Further details of the process of data extraction and preparation and for mapping can be found in an earlier study examining the intellectual base of archaeology as a whole (Sinclair 2016). This study also describes the process of 'cleaning up' publication data to avoid multiple representations of the same author or source due to variations in how authors' names are recorded, and variations in publication source names caused by differing editorial policies.

Evolutionary Anthropology as a research specialty

Three maps provide a network representation for the specialty of Evolutionary Anthropology. Each map is based on bibliometric data for research outputs published in sources classified in the Web of Science as being both in the subject categories of 'Anthropology AND Evolutionary Biology'. This is, almost certainly, a sample of the total population of research outputs within Evolutionary Anthropology since the Web of Science does not index all journals and, for Evolutionary Anthropology, there will certainly be research outputs published in other journals than those classified according to these two subject categories. There may also be documents concerning research in

evolutionary biology beyond non-hominin species. This search generates a sample data set of bibliometric information on more than 37,000 individual documents each with links to other documents via their own cited references. Some of these other documents will already be included in the original sample set; but others will be items in journals not identified in these two subject categories and, more importantly, published in journals or books or book chapters not indexed by the Web of Science at all. As such, the maps based on the sample of bibliometric data used here probably provide a good overview of the primary networks for this research specialty. For each map, it is the relative association strength between items (nodes) that is used by *VOSviewer* to place either sources, authors or terms physically closer to each other and for determining clusters of nodes whilst ensuring that the map retains a sufficient legibility of the whole.

Figure 1 presents a co-citation network map of the 350 most frequently cited sources from more than 590 sources that have been cited at least 100 times; six discrete clusters of sources have been identified (Table 1). These sources are the primary places where Palaeoanthropologists either publish their research or go to read new research. Figure 2 presents a co-citation map of the 350 most commonly cited authors having an influence in Palaeoanthropology from more than 850 individuals cited at least 100 times with 6 discrete clusters identified (Table 2). Figure 3 presents 288 terms extracted from the titles and abstracts of the initial bibliometric document data, and once again with 6 clusters identified (Table 3).

A series of major journals provide occupy a central place for the publication of research in Palaeoanthropology: *Journal of Human Evolution*, *American Journal of Physical Anthropology*, *Yearbook of Physical Anthropology*, *Nature*, *Science*, and *Proceedings of the National Academy of Sciences of the USA*. Surrounding these journals are clusters of sources related to genetics, anatomy, primatology and animal behaviour and a cluster that is palaeontological. Finally, there are two closely overlapped clusters related to archaeology and quaternary science and another which appears to be related to the same theme but comprising journals based out of the USA or the UK, and sometimes publishing papers in languages other than English. The clustering of authors does not follow the same theme. There is a clear cluster of authors publishing research on the hominin record from east and southern Africa (Wood, Leakey, Johanson, Tobias) alongside a group of authors publishing research on the nature of modern human behaviour and the archaeological record (McBrearty, Klein, Marean, Mellars) and another cluster of researchers examining pre-modern hominins including Neanderthals (Hublin, Wolpoff, Smith, Stringer). The three remaining clusters contain authors publishing research on aspects of

Table 1. Clusters of sources identified in the co-citation network map of sources publishing documents in the discipline of Evolutionary Anthropology 1970-2018.

Cluster No.	No. of Nodes	Example Nodes
1	86	Journal of Human Evolution, Current Anthropology, Journal of Archaeological Science, Quaternary International, Palaeogeography, Palaeoecology & Palaeoenvironment, Evolutionary Anthropology, Nature
2	73	American Journal of Physical Anthropology, Journal of Zoology, American Journal of Anatomy, Anthropological Sciences, Journal of Dental Research, Science
3	49	International Journal of Osteoarchaeology, Journal of Biomechanics, American Journal of Clinical Nutrition, Journal of Experimental Biology, Anatomical Record
4	45	International Journal of Primatology, American Journal of Primatology, Primates, Philosophical Transactions of the Royal Society B: Biological Sciences, Animal Behaviour, PLOS One
5	45	American Journal of Human Genetics, Annual Review of Human Genetics, Forensic Science International, Molecular Evolution, Trends in Genetics, Proceedings of the National Academy of Sciences of the United States of America

Table 2. Clusters of authors cited more than 100 times identified in the co-citation network map of authors of documents in the discipline of Evolutionary Anthropology 1970-2018. (For authors cited more than 100 times)

Cluster No.	No. of Nodes	Example Nodes
1	74	Wood, White, Blumenschine, Klein, Hublin, Binford, Marean, Leakey LSB, Leakey MD, Mellars, McBrearty
2	68	Fleagle, Hylander, Walker, Wrangham, McGrew, Pickford, Darwin, Jolly, Goodall, Pilbeam
3	60	Ruff, McHenry, Day, Leakey REF, Lovejoy, Washburn, Zihlman
4	55	Wolpoff, Brace, Arsuaga, Dean, Aiello, Corrucini, Relethford
5	45	Stringer, Trinkaus, Morwood, Rightmire, Hrdlicka, Boule, Lahr

Table 3. Clusters of terms used more than 100 times identified in the association network map of terms from titles and abstracts of documents in the discipline of Evolutionary Anthropology 1970-2018. (For terms used more than 100 times)

Cluster No.	No. of Nodes	Example Nodes
1	68	Hominoid, locomotion, bipedalism, gorilla sp, fossil, anatomy, a. africanus, a. afarensis
2	65	Child, weight, infant, health, mortality, death, race, demography, nutritional status
3	55	Assemblage, cave, Palaeolithic, sediment, carnivore, burial, occupation
4	48	Person, migration, haplogroup, marker, mitochondrial DNA, ethnic group, gene, cluster, marker
5	44	Disease, lesion, pathology, trauma, warfare, violence, geometric morphometrics

anatomy (*Dean, Conroy, Macho, Mays and Relethford*) and two largely overlapping groups considering broader evolutionary approaches to human evolution (*Andrews, Crompton, McHenry, Zihlman*) and another more focussed on primates (*Boesch, Fleagle, Goodall, McGrew and Whiten*). The language of Palaeoanthropology comprises clusters of terms centred on population, morphology, species, primate, growth and evolution. The terms or concepts of these themes largely overlap with smaller clusters of specialised conceptual vocabulary such as the species names of primates and hominins, terms related to disease, death and burial and a quite distinct set of vocabulary related to genetics. Underlying these

clusters of terms is a more dispersed set of terms related to the physical recovery of the fossil remains and their position in ancient landscapes.

Palaeolithic research as a specialty

Documents published in the subfield of Palaeolithic archaeology were located by performing a topic search in the Web of Science. Specifically, a search was made for documents containing either 'Palaeolith*' AND/OR 'Paleolith*' in their titles or abstracts. The combination of two different spellings was used to help collect bibliometric data for documents written either in

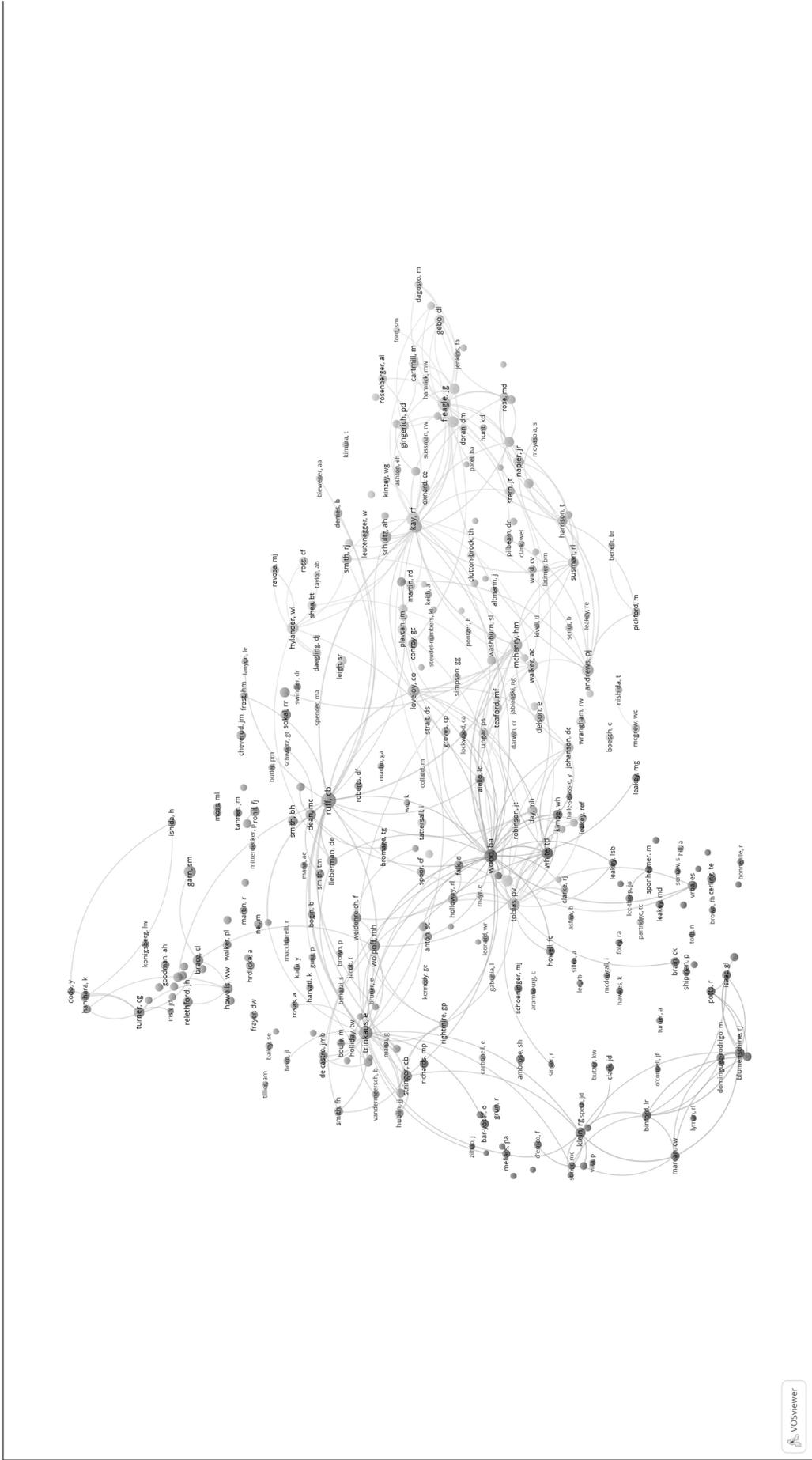


Figure 2. A co-citation network map of authors of documents in the discipline of Evolutionary Anthropology 1970-2018.

English and/or a range of European languages. This search gathered bibliometric data for approximately 6500 research outputs published between 1970 and 2018. The known coverage of the Web of Science means that this data set is likely to be missing information on monographs as well as articles published in smaller journals or not in English, but a good number of these will be picked up through the further citations made in these documents. Using this dataset, network maps of sources, authors and terms were constructed and are presented here with each map restricted to the most commonly used terms or cited authors for the sake of legibility.

The network map of sources (Figure 4) for Palaeolithic research necessarily overlaps with that of Evolutionary Anthropology. Six clusters of sources are identified (Table 4) with two distinctive clusters for quaternary science and dating, and for physical anthropology, genetics and animal behaviour. The remaining four clusters overlap considerably making it difficult to determine how the specific combinations of sources have been clustered at first. Closer inspection, however, suggests that clustering reflects the region of study (Northwestern Europe versus France and Spain) and possibly topic (emergence of modern

humans and modern human behaviour). In the map of terms (Figure 5), six distinct clusters are identified (Table 5). One clear cluster of concepts relates to the interpretation of lithic technology and lithic assemblages (*assemblage, artefact, industry, tool, technology, industry*), with two further clusters related to the chronological interpretation of sites (*sediment, section, layer, occupation, age, sample*) and how we interpret their contents (*cave, bone, remain, resource, fauna, taphonomy*). A further cluster relates to theme of species evolution and movement (*population, transition, modern human, Neanderthal, dispersal, origin, Aurignacian*) and another to hominin social formations (*individual, hunter gather, role, difference, size, diet*). The final and smallest cluster relates to the discovery and interpretation of symbolic materials (*rock art, Palaeolithic art, pigment, imagery, technique*). In contrast to the maps for Palaeoanthropology, the overlapping nature of the maps of terms and sources clearly identifies Palaeolithic archaeology as a conceptually coherent and largely unified area of research generating papers that might be offered to a broad range of sources unless focusses on genetics of the hard science aspects of quaternary research. By contrast the network co-citation map of authors seems more clearly defined (Figure 6, Table 6) with

focused
or

Table 4. Clusters of sources identified in the co-citation network map of sources publishing documents in the specialty of Palaeolithic Archaeology 1970-2018. (For sources cited more than 50 times)

Cluster No.	No. of Nodes	Example Nodes
1	65	Journal of Human Evolution, Current Anthropology, South African Archaeological Bulletin, Palaeorient, Palaeoanthropology
2	60	American Journal of Physical Anthropology, American Journal of Human Genetics, Human Biology, American Journal of Clinical Nutrition, Nature, Science, PLOS One
3	45	Quaternary International, Quaternary Science Reviews, Quaternary Research, Palaeogeography, Palaeoecology & Palaeoenvironment, Journal of Archaeological Science, Archaeometry, Geoarchaeology
4	42	Radiocarbon, American Antiquity, Cambridge Archaeological Journal, American Anthropologist, World Archaeology
5	42	Journal of Quaternary Science, Proceedings of the Prehistoric Society, ERAUL, Lithics
6	41	Anthropologie, Bulletin de la Societe Préhistorique Française, Journal of Archaeological Method and Theory, Gallia Préhistoire

Table 5. Clusters of authors identified in the co-citation network map of authors of documents in the specialty of Palaeolithic Archaeology 1970-2018. (For authors cited more than 50 times)

Cluster No.	No. of nodes	Example Nodes
1	94	Binford, Stiner, Kuhn, Zilhao, Straus, Gamble, Villa, Dibble, Breuil, Leroi-Gourhan, Clottes
2	64	Mellars, Bordes, Svoboda, Hahn, Klima, Hublin, Hedges
3	50	Bridgeland, Ashton, White, Roebroeks, Moncel, Boeda, Wymer, Roe, de Lumley, McNabb
4	46	D’Errico, Trinkaus, Ruff, Holliday, McBrearty, Henshilwood, Klein
5	46	Bar-Yosef, Stringer, Shea, Petraglia, Goren-Inbar, Dennell, Petraglia, Gowlett

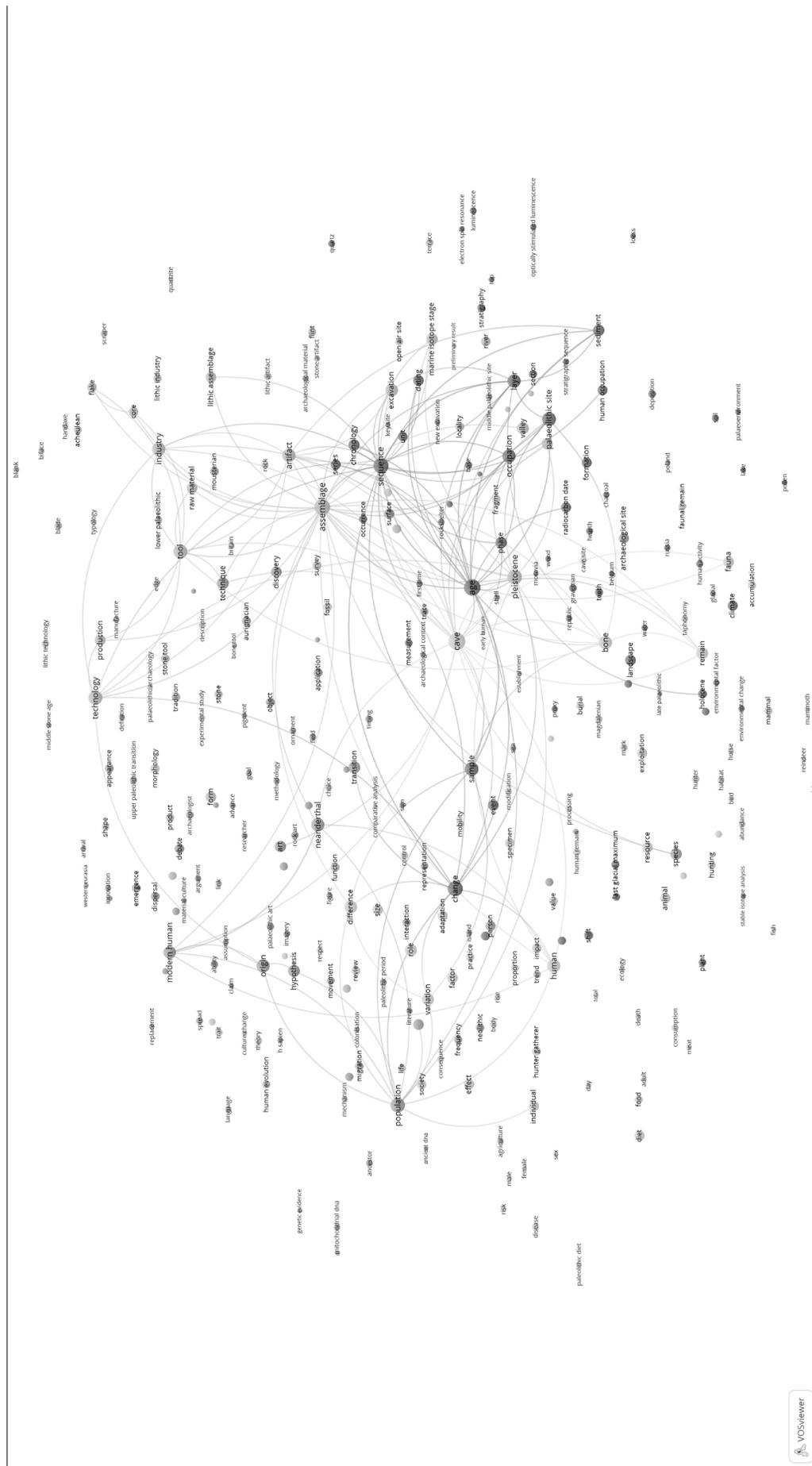


Figure 5. A co-citation network map of authors of documents in the specialty of Palaeolithic Archaeology 1970-2018.

Table 6. Clusters of terms identified in the association network map of terms from titles and abstracts of documents in the speciality of Palaeolithic Archaeology 1970-2018. (For terms used more than 50 times)

Cluster No.	No. of nodes	Example Nodes
1	69	Sequence, age, layer, dating, sediment, Pleistocene, occupation, chronology, sample, stratigraphy
2	65	Bone, burial, carnivore, resource, fauna, remain, trend, diet, food, role
3	41	Acheulean, technology, tool, artefact, industry, core, flake, stone tool, raw material, function
4	39	Modern human, origin, evolution, human, change, Neanderthal, Aurignacian, Gravettian, dispersal
5	32	Cave, art, form, Palaeolithic art, hypothesis, prehistory, painting, rock art

seven clusters of coherent author groupings where the placement of individual authors is determined by the preponderance of citations to an author’s publications by their peers. One cluster includes authors writing about hominin morphology and the transition between species (*Stringer, Ruff, Trinkaus, Wolpoff, Lieberman, Hublin*). Another cluster relates to authors on rock art research specifically (*Bednarik, Breuil, Leroi-Gourhan, Clottes, Conkey and White*) and the interaction between material culture and human social relations more generally (*Shennan, Gamble, Hodder, Mithen, Wobst*). A third cluster is about the earlier Palaeolithic of northern Europe (*Roebroeks, Ashton, Bridgeland, McNabb*), with a fourth relating to the interpretation of faunal assemblages (*Binford, Stiner, Speth, Grayson*). The remaining three clusters gather authors publishing work on early hominin technologies and the Acheulean in particular (*Goren-Inbar, Wynn, Potts, and Shea*) another concerned with the interpretation of lithic technology more generally (*Dibble, Kuhn, Bordes, Odell and Bleed*) and, finally, two clusters of authors working on the dating and impact of modern humans in Western Europe (*Higham, Zilhao, Teyssander*) and in Central and Eastern Europe (*Conard, Derevianko, Klima, Mania, Valoch*).

The work and influence of John Gowlett

Bibliometric data can also be used to drill down into the work of a single researcher, developing what White has termed an ‘ego-centred citation analysis’ (White 2000). In this approach White identifies 4 distinct ‘ego-alter’ relationships split into two broad types; the *citation identity* of an author comprising (1) the author’s collaborators in the form of co-authors, and (2) the other scholars and their publications that an author cites and the *citation image* of an author comprising (3) the network of other scholars who directly cite the author, and (4) the network of scholars who are co-cited along with the author in other publications. The distinction between the *citation identity* that is created by an author’s own agency and the *citation image* that is cumulatively created by the agency of the readers of the author’s work makes it possible to see whether the documents of an author are read and contextualised by readers in the same way that they have been by their author. Since research develops over time, change in an author’s networks of co-authors, and their citation identity may also change across time. Despite the potential for using bibliometric data for this form of

Table 7. Forms of Ego-Alter relationship, their relevant document sets and the possible nature of variation through time (modified after White 2000, 2001).

	Form of ‘Ego-Alter’ Relationship	Document set used for bibliometric data source	Possible Variation over Time
Ego’s Citation Image	Ego and his/her research collaborators	Ego published documents – author and co-authors	Long-term versus short-term project collaborators (<i>Ego as a developing collaborator over time</i>)
	The set of researchers cited by Ego	Ego published documents – authors of cited documents in reference lists	Potential change through time as ego’s research interests develop / change (<i>Ego as a developing researcher and citer over time</i>)
Ego’s Citation Identity	The set of researchers who cite publications by Ego	Ego-citing documents – authors	Changes in the citation form / context over Ego’s knowledge claims over time (<i>Life-history of Ego’s individual knowledge claims</i>)
	The total set of authors cited in publications which cite publications by Ego	Ego-citing documents – all authors of documents in reference lists	Variation in Ego’s knowledge claims as contributions to the understanding of knowledge in a particular research topic / area (<i>Life-history of Ego’s individual knowledge claims in context</i>)

analysis, there are few if any published examples of this approach used outside of short pieces on the work of bibliometric researchers themselves (Bar-Ilan 2006, Leydesdorff 2010). Here we look at the work of John Gowlett.

Extracting a full set of bibliometric data for a single author should be easily achievable. Unfortunately, the potential effect of the sampling process used in the citation indices has its greatest impact at an individual level. In the case of John Gowlett, this is evident in the fact that both Scopus and the Web of Science contain bibliometric data on 75 documents, whereas Google Scholar, which uses an automated trawling process to identify and collect basic bibliometric data across a wide range of source types including websites, presents details on 195 documents extracted using the ‘Publish or Perish’ software created by Anne-Wil Harzing (available at www.harzing.com/resources/publish-or-perish). Once duplicates, simple book reviews and commentaries to articles of the type published in *Current Anthropology* are removed, 139 documents remain as individual research publications (Appendix A). These include research articles, book chapters, encyclopaedia entries, a single-author book, several edited books and four edited thematic sections to *World Archaeology* (Table 8). A number of the articles and book chapters are clearly the published products of research originally presented at conferences, but since it is not possible to identify all such pieces, these documents are not specifically identified as conference proceedings papers except for two abstracts for papers given to the annual meeting of the Palaeoanthropology Society. A distinct set of papers, written mostly in the 1980s, are related to John Gowlett’s appointment to the radiocarbon dating unit in the Research Laboratory of

Table 8. The format of publications for research outputs by John Gowlett (1978-2018) used in this study. (Individual document details are set out in Appendix 1).

Publication format	No. of examples
Journal articles	58
Book chapters	59
Conference Abstract	2
Encyclopaedia entries	10
Book (single author)	1
Edited Book	4
Edited Journals	4
Thesis	1
Note / Invited commentaries	3
Extended Book Reviews	2
TOTAL	144

Archaeology at the University of Oxford at the time of the development and use of the United Kingdom’s first accelerator mass spectrometry radiocarbon dating facility from 1983. Another set of papers ~~relates~~ derives from ‘*Lucy to Language*’, one of the British Academy’s Centenary Research Projects, co-directed by John Gowlett, Clive Gamble and Robin Dunbar between 2003 and 2010. These papers however align themselves in subject matter with Gowlett’s long-term research interests discussed below.

delete
word

The Citation Identity of John Gowlett

The Google Scholar-derived document set can be used to map John Gowlett’s co-authors / research collaborators (Figure 7). This network map includes 73 individuals alongside John Gowlett himself, with chronological changes in co-authorship networks from 1980 to 2020. Five distinct groups can be seen. The two oldest are associated with John Gowlett’s work for the Oxford radiocarbon dating (*Hedges, Gillespie*) and with early fieldwork in Africa (*Harris*). Another distinct group relates to research and publication with a group of research students of data from the site of Beeches Pit in East Anglia (*Bell, Brant, Chambers, Hallos*) around 2000. Two final groups relate to ‘*Lucy to Language*’ (*Dunbar, Gamble*) and a second phase of fieldwork in Kenya (*Brink, Herries, Hoare, Rucina*) since 2010.

Unfortunately, Google Scholar cannot collect bibliometric data on abstracts, keywords or references cited, so the bibliometric data mapped for the authors cited and concepts used by Gowlett must be based on the smaller Scopus data set. The network map of authors co-cited in John Gowlett’s own papers presents the 100 authors most cited (Figure 8). They fall into two primary groups, with a set of 19 authors related to John’s work at the Oxford Radiocarbon Dating Unit and both clustered and separated to one side, and a larger set of the remaining 81 authors in three clusters to the other side. Of these three clusters, one appears to be related to fire and the colonisation of northern Europe (*Wrangham, Brain, Roebroeks, Gamble*), another relates to cognition, symbolism and communication (*Dunbar, Wynn, Aiello and Goren-Inbar*) and a final group related to lithic analysis, the Acheulean and Africa (*Isaac, Clark, Leakey, Roe*). Citation numbers alone suggest that the major influences have been *Dunbar, JD Clark, Gamble, Wynn, Isaac, Wrangham, Aiello, Goren-Inbar* and *Binford*.

Using the titles and abstracts of the Scopus data set, VOSviewer identifies 64 items divided into 4 major clusters (Figure 9). One cluster includes a series of terms related to research on *fire, fire use* and *fire control*, including the sites of *Chesowanja* and *Beeches Pit* where the identification of fire has been so significant. This cluster also includes terms related to the *cooking*

hypothesis and the role of diet in the *social brain hypothesis*. Another cluster relates to John's research on the *Acheulean tradition*, the *handaxe* and *material culture*. *Process* and *language* are also in this set of terms. A third set of terms relates to John Gowlett's research interest in chronology with terms specifically related to the integrity of dating samples: *area*, *discovery*, *event*, *result*, *range*, *sequence* and *sediment*. A final set of terms is more general, and probably derives from the broader pieces written about human origins. This set includes *Neanderthal*, *debate*, *stone tools*, *view* and *human origins*.

The Citation Image of John Gowlett

For examining John Gowlett's Citation Image, Scopus provides its users with information on the number of times a document has been cited and then access to the bibliometric data of these citing documents themselves. The collection of data for these citing documents - to generate the network maps for White's type 3 and 4 ego-alter relationships - has been restricted to those documents that have been cited ten times or more. The assumption made is that frequent citation of a document is likely to indicate that the document ~~is a consistently~~ influence within a particular area of knowledge; for documents where citations are fewer, an idiosyncratic reading and citation will skew the broader pattern of relationships. Thus, data was collected for 1609 citing documents making citations to 53 papers in John Gowlett's oeuvre.

Whilst the name Gowlett does not appear in the network map for authors' in Palaeoanthropology (Figure 3), he is present in the map of most-cited authors for Palaeolithic archaeology (Figure 6) placed close to a cluster of authors conducting research on Acheulean lithic assemblages (*Goren-Inbar*, *Sharon*, *Petraglia*, *Wynn*), and another cluster of researchers looking at the earlier Palaeolithic record of northern Europe (*Roebroeks*, *Ashton*, *Roe*), and a third cluster producing research on the broader theory of interpretation of lithic technology (*Boeda*, *Dibble*). Gowlett, himself, is clustered amongst the Acheulean researchers indicating that during the time period of this analysis (1970-2018) it is Gowlett's Acheulean research that is most consistently cited. The network map of the citation image of authors (those co-cited along with John Gowlett) provides greater nuance still (Figure 10). It contains 250 names, with Gowlett in the centre. These authors are clustered into 6 groupings. One group contains a series of names related to discussions of dating (*Hedges*, *Grun*, *Schwarz*, *Valladas*, *Gillespie*, *Stuiver*, *Renfrew*), a second group contains authors associated with research about the European Palaeolithic (*Straus*, *Zilhao*, *Gamble*, *Kozlowski*, *Bailey*). A third group includes authors associated with the earlier Palaeolithic record of Europe (*Ashton*, *White*, *Carbonell*, *Goren-Inbar*, *Roebroeks*). There are two

clusters of authors associated with the interpretation of lithic technology. One is very African focused (*Isaac*, *de la Torre*, *Leakey*, *Schick*, *Toth*, *Roche*) the other is more about technology and manufacture in general (*Shott*, *Lycett*, *Shea*, *Dibble*, *McPherron*). The final cluster, in which Gowlett is himself clustered, seems to be more general in character and concerned with the nature of change in human evolution (*Clark*, *Klein*, *Binford*, *Bordes*, *Wrangham*, *Wadley*, *Mellars*).

Conceptually, VOSviewer identifies 250 terms from the titles and abstracts of the papers citing documents by Gowlett clustered into 5 groups (Figure 11). The first can be associated with dating issues (*radiocarbon date*, *carbon*, *charcoal*, *archaeometry datelist*, *bone*, *period*, *age*). The second is the general conceptual terminology of excavation and analysis of Palaeolithic sites (*environment*, *landscape*, *occupation*, *excavation*, *fossil*, *specimen*, *sediment*). The three final clusters are more directly related to the research topics in John Gowlett's own papers. These include a cluster examining hominin forms of communication and sociality (*language*, *material culture*, *nature*, *mind*, *social brain*), another looking at fire and food (*evolution*, *fire*, *hearth*, *cooking*, *homo erectus*, *cooking*, *cognition*) and the final and largest cluster examining lithic technology and its form (*Acheulean*, *handaxe*, *assemblage*, *morphology*, *manufacture*, *reduction*, *variability*, *skill*).

Discussion

The network maps presented here visually demonstrate that research in evolutionary anthropology is extraordinarily diverse spanning fields such as biology and anatomy, primates, animal behaviour, environment, cognition, and more. More significant than the range, however, is the clear network of connections between research published in each of these distinct fields and the publication of research in the primary journals (*Journal of Human Evolution*, *American Journal of Physical Anthropology*). Evolutionary Anthropology is not an artificially constructed area of research. At each of the levels explored here (discipline, specialty and specialist) this same combination of diverse research areas comes together. Whilst a specialty such as Palaeolithic Archaeology may be defined by its recovery and analysis of artefactual remains, and a specialist may focus on the understanding of a smaller subset of such remains, it is clear that each cannot conduct research without reference to the wider range of fields, and consider the impact of their interpretations back to this range.

A second clear disciplinary quality present in these maps is the reduced pattern of obsolescence of sources. For example, this network map of most cited authors for Palaeolithic archaeology contains the names of ~~a~~ many, deceased scholars including *Isaac*, *Garrod*,

has a
consistent

delete
word 'a'

Leroi-Gourhan, Leakey (Louis and Mary), Wymer, Movius and Breuil. Even though deceased, the published research of these authors still actively contributes to the contemporary intellectual base of Palaeolithic research. The research of these scholars has retained a long 'use-life' in apparent contrast to that observed through citation in the natural and biological sciences. Research outputs in Evolutionary Anthropology whilst seemingly similar in content and form to those in the natural and biological sciences have a long 'use life' just like research literature in the social sciences, arts and humanities (Cole 1983), where classic pieces of research are often subsumed into the common knowledge of disciplinary practitioners. In Garfield's terms, these documents do not become obliterated (in terms of later citation) through the incorporation of their contents into the commonly accepted knowledge of practitioners that no longer requires citation (Garfield 1975). If the required working knowledge of practitioners in the discipline requires detailed familiarity with such older documents, there are clear implications for the teaching of Evolutionary Anthropology in the context of the quasi exponential growth in number of research outputs. As a first step, however, a more detailed study is needed to explore the exact nature of the citation of these older documents to see how they are used in current knowledge claims examining how their life histories as knowledge claims (Cozzens 1985) has changed and whether the detail of their contents is still cited or whether their citation acts as a conceptual symbol of a broader approach (Small 1978).

Finally, whilst White (2000) suggested that a researcher may move from one separate research problem to another, the contrary impression seems to arise from the research interests of John Gowlett as visualised in the network of terms used. The most 'central' terms in John Gowlett's research lexicon are *time* and *process*. But these should perhaps be seen in their broadest sense as evidenced by an interest in the Palaeolithic as a period characterised by multiple scales of time and action from the macro to the micro ('High-definition archaeology'). His research is also characterised by a series of consistent research problems - technology and fire. However, as can be seen from the list of papers themselves (Appendix A), each is explored through different perspectives over time. In the case of fire, the earlier papers are concerned with the methodology and epistemology of demonstrating human use of fire at great time depths, whilst recent papers theoretically explore the social and cognitive impacts of fire as a technology of environmental transformation. In the case of technology, the earlier papers explore technology as a cognitive process, and later papers develop methodologies for demonstrating the expression of cognitive processes in archaeological artefacts.

Whilst philosophers and historians of scientific research might envisage discrete problems that are investigated and solved, the examination of Palaeoanthropology from discipline to sub-field to scholar suggests that research in the evolution of early hominins does not proceed in that way. The complex interrelationships theorised between the basic material objects and the processes of social and cognitive development result in a continuous process of hermeneutic re-engagement with, and possibly refinement, of the relationship between interpretation and data rather than a definitive resolution.

References

- Andersen, J.P., and Nielsen, M.W., 2018. Google Scholar and Web of Science: examining gender differences in citation coverage across five scientific disciplines. *Journal of Informetrics* 12: 950-959.
- Ardanuy, J., 2013. Sixty years of citation analysis studies in the humanities (1961-2010). *Journal of the American Society for Information Science and Technology* 64: 1751-1755.
- Bar-Ilan, J., 2006. An ego-centric citation analysis of the works of Michael O. Rabin based on multiple citation indexes. *Information Processing and Management* 42: 1553-1566
- Börner, K., Chen, C. and Boyack, K.W., 2003. Visualizing knowledge domains. *Annual Review of Information Science and Technology* 37, 179-255.
- Boyack, K.W., van Eck, N.J., Colavizza, G., and Waltman, L., 2018. Characterizing in-text citations in scientific articles: a large-scale analysis. *Journal of Informetrics* 12: 59-73.
- Boyack, K.W., Klavans, R. and Börner, K., 2005. Mapping the backbone of science. *Scientometrics* 64: 351-374.
- Brughmans, T., 2013. Networks of networks: a citation network analysis of the adoption, use and adaptation of formal network techniques in archaeology. *Literary and Linguistic Computing* 28: 538-562.
- Chen, C., 2017. Science mapping: a systematic review of the literature. *Journal of Data and Information Science* 2: 1-40.
- Chi, P-S., 2016. Differing disciplinary citation concentration patterns of book and journal literature. *Journal of Informetrics* 10: 814-829
- Cole, S., 1983. The hierarchy of the sciences? *American Journal of Sociology* 89: 111-139.
- Cozzens, S., 1985. Life history of a knowledge claim: the opiate receptor case. *Science Communication* 9: 511-529.
- Cronin, B., 1984. *The citation process: the role and significance of citations in scientific communication*. London: Taylor Graham.
- Davenport, E., and Snyder, H., 2007. Who cites women? Whom do women cite? An exploration of gender and scholarly citation in sociology. *Journal of Documentation* 51: 404-410.

- Dunmore, C.J., Pateman, B., and Key, A.J.M., 2018. A citation network analysis of lithic microwear research. *Journal of Archaeological Science*. 91: 33-42.
- Falagas, M.E., Pitsouni, E.I., Malietzis, G.A. and Pappas, G., 2007. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *The FASEB Journal* 22: 338-342.
- Garfield, E., 1955. Citation indexes for science: a new dimension in documentation through Association of Ideas. *Science* 122: 108-111.
- Garfield, E., 1964. Science citation index-a new dimension in indexing. *Science*, 144: 649-654.
- Garfield, E., 1975. The 'Obliteration Phenomenon' in science and the advantage of being obliterated. *Current Contents* 51-52: 5-7
- Garfield, E., and Sher, I. H., 1963. New factors in the evaluation of scientific literature through citation indexing. *American Documentation*, 14: 195-201.
- Gilbert, G.N., 1977. Referencing as persuasion, *Social Studies of Science* 7: 113-122.
- Hutson, S., 2002. Gendered citation practices in American Antiquity and other archaeology journals. *American Antiquity* 67: 331-342.
- Hutson, S., 2006. Self-citation in archaeology: age, gender, prestige and the self. *Journal of Archaeological Method and Theory* 13: 1-18.
- Hyland, K., 1999. Academic attribution: citation and the construction of disciplinary knowledge, *Applied Linguistics* 20, 341-367.
- Kaplan, N., 1965. 'The norms of citation behaviour: prolegomena to the footnote. *American Documentation* 16, 179-184.
- Klavans, R., and Boyack, K.W., 2014. Mapping altruism. *Journal of Informetrics* 8: 431-447.
- Lartet, E., and Christy, H., 1865-1875. *Reliquae Aquitainae; being contributions to the archaeology and palaeontology of Périgord and the adjoining provinces of southern France*. London, Williams and Northgate
- Leakey, M., 1971. *Olduvai Gorge excavations in beds I and II*. Cambridge: Cambridge University Press.
- Leydesdorff, L., 1998. Theories of citation? *Scientometrics* 43, 5-25.
- Leydesdorff, L., 2010. Eugene Garfield and algorithmic historiography: co-words, co-authors, and journal names. *Annals of Library and Information Science* 57: 248-260.
- Martin-Martin, A., Orduna-Melea, E., Thelwall, M., and López-Cózar, E.D., 2018a. Google Scholar, Web of Science, and Scopus: a systematic comparison of citations in 252 subject categories. *Journal of Informetrics* 12: 1160-1177.
- Martin-Martin, A., Orduna-Melea, E., and López-Cózar, E.D., 2018a. Coverage of highly cited documents in Google Scholar, Web of Science and Scopus: a multidisciplinary comparison. *Scientometrics* 116: 2175-2188.
- Nicolaisen, J., 2007. Citation analysis. *Annual Review of Information Science and Technology* 41, 609-641.
- Price, D.J. de Solla, 1951. Quantitative measures of the development of science. Archives. *Internationales d'Histoire des Sciences* 4, 85-93.
- Price, D.J. de Solla, 1963. *Little science, big science*. New York: Columbia University Press.
- Price, D.J. de Solla, 1965. Networks of scientific papers. *Science* 149, 510-515.
- Sinclair, A., 2016. The intellectual base of archaeological research 2004-2013: a visualisation and analysis of its disciplinary links, networks of authors and conceptual language. *Internet Archaeology* 42. <https://doi.org/10.11141/ia.42.8>
- Small, H., 1978. Cited documents as concept symbols. *Social Studies of Science* 8: 327-340
- Van Eck, N.J. and Waltman, L., 2010. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 84, 523-538.
- Wang, Q., and Waltman, L., 2016. Large-scale analysis of the accuracy of journal classification systems of Web of Science and Scopus. *Journal of Informetrics* 10: 347-364.

Anthony Sinclair

Archaeology, Classics and Egyptology, University of Liverpool

Appendix A. Publications by John Gowlett 1978-2018

1. JAJ Gowlett, 1978. Kilombe—an Acheulian site complex in Kenya. In ed. WW Bishop (ed.) *Geological Background to Fossil Man*. Edinburgh, Scottish Academic Press Pp 337-60
2. JAJ Gowlett, 1979. Complexities of cultural evidence in the Lower and Middle Pleistocene. *Nature* 278: 14-17
3. JWK Harris & JAJ Gowlett, 1979. Kenya. A Preliminary Report on Chesowanja. *Nyame Akuma* 14: 22-27
4. JAJ Gowlett, 1979. *A contribution to studies of the Acheulean in East Africa with especial reference to Kilombe and Kariandus*. PhD thesis, University of Cambridge.
5. JAJ Gowlett, 1980. Acheulean sites in the central Rift Valley, Kenya. In RE Leakey and BA Ogot (eds.) *Proceedings of the 8th PanAfrican Congress of Prehistory and Quaternary Studies*. Nairobi TILLIMAP Pp 213-217.
6. JWK Harris, JAJ Gowlett, 1980. Evidence of early stone industries at Chesowanja, Kenya. In RE Leakey and BA Ogot (eds.) *Proceedings of the 8th PanAfrican Congress of Prehistory and Quaternary Studies*. Nairobi TILLIMAP Pp 208-212
7. JAJ Gowlett, 1981. Earliest technology. In WG Mook & HT Waterbolk (eds.) *Proceedings of the First International Symposium 14 C and Archaeology*. Groningen. Council of Europe
8. JAJ Gowlett, 1981. Contributions to British and European prehistory: the scope and problems of 14C accelerator dating. In WG Mook & HT Waterbolk (eds.) *Proceedings of the First International Symposium 14 C and Archaeology*. Groningen. Council of Europe
9. JWK Harris, JAJ Gowlett, D Walton, & BA Wood, 1981. Palaeoanthropological studies at Chesowanja. In *Las Industrias Mas Antiguas*. UISPP 10
10. JAJ Gowlett, JWK Harris, D Walton, & BA Wood. 1981. Early archaeological sites, hominid remains and traces of fire from Chesowanja, Kenya. *Nature* 294:125-129
11. JAJ Gowlett, 1981. Confusing script *Nature* 291: 104
12. JAJ Gowlett, 1982. Procedure and Form in a Lower Palaeolithic Industry: Stoneworking at Kilombe, Kenya. In D Cahen (ed.) *Studia Praehistorica Belgica. Tailler. Pour quoi Faire ? Prehistoire et Technologie II* Pp 101-110
13. JAJ Gowlett, JWK Harris, & BA Wood, 1982. Early hominids and fire at Chesowanja, Kenya (reply). *Nature* 296: 870
14. JAJ Gowlett, 1982. Updating the Old Stone Age. *Nature* 298: 204
15. JWK Harris, JAJ Gowlett, R Blumenschine, & JE Maiers, 1983. Chesowanja—a summary of the early Pleistocene Archaeology. In In RE Leakey and BA Ogot (eds.) *Proceedings of the 9th PanAfrican Congress of Prehistory and Quaternary Studies*. Nairobi TILLIMAP
16. R Gillespie & JAJ Gowlett, 1983. Archaeological sampling for the new generation of radiocarbon techniques. *Oxford Journal of Archaeology* 2: 379-382
17. JAJ Gowlett, 1984. *Ascent to Civilization: The Archaeology of Early Man*. London, Collins.
18. JAJ Gowlett, 1984. Mental abilities of early man: a look at some hard evidence. In R Foley (ed.) *Hominid Evolution and Ecology*. London, Academic Press Pp 167-192
19. JL Bada, R Gillespie, JAJ Gowlett, & REM Hedges, 1984. Accelerator mass spectrometry radiocarbon ages of amino acid extracts from Californian palaeoindian skeletons. *Nature* 312: 442-444
20. R Gillespie, JAJ Gowlett, ET Hall, & REM Hedges, 1984. Radiocarbon measurement by accelerator mass spectrometry: an early selection of dates. *Archaeometry* 26: 15-20
21. R Gillespie, JAJ Gowlett, & REM Hedges, 1984. Recent developments in archaeological dating using an accelerator. *Nuclear Instruments and Methods in Physics Research B* 5: 308-311
22. REM Hedges & JAJ Gowlett, 1984. Radiocarbon Dating: accelerating carbon dating. *Nature* 308: 403-404
23. JAJ Gowlett, 1985. Kilombe (Kenya). *Nyame Akuma* 26: 1-22
24. R Gillespie, JAJ Gowlett, ET Hall, REM Hedges & C Perry, 1985. Radiocarbon dates from the Oxford AMS system: Archaeometry datelist 2. *Archaeometry* 27: 237-246
25. TF Lynch, R Gillespie & JAJ Gowlett, 1985. Chronology of Guitarrero Cave, Peru. *Science* 229: 864-867
26. RE Taylor, LA Payen, CA Prior, PJ Slota Jnr, R Gillespie, JAJ Gowlett, REM Hedges, AJT Jull, TH Zabel, DJ Donohue & R Berger, 1985. Major revisions in the Pleistocene age assignments for North American human skeletons by C-14 accelerator mass spectrometry: none older than 11,000 C-14 years BP. *American Antiquity* 50: 136-140
27. JAJ Gowlett, 1986. Radiocarbon accelerator dating of the Upper Palaeolithic in North-West Europe: a provisional view. In SN Colcutt (ed.)

- The Palaeolithic of Britain and its Nearest Neighbours: recent trends.* Sheffield, Sheffield University Press Pp 98-102
28. JAJ Gowlett, 1986. Culture and conceptualisation: the Oldowan-Acheulian gradient. In GN Bailey & P Callow (eds.) *Stone Age Prehistory: studies in memory of Charles McBurney.* Cambridge, Cambridge University Press Pp 243-260
 29. JAJ Gowlett, R Gillespie, ET Hall, & REM Hedges, 1986. Accelerator radiocarbon dating of ancient human remains from Lindow Moss. In IM Stead, J Bourke, & D Brothwell (eds.) *Lindow Man, The body in the Bog.* London, British Museum Publications Pp 22-24
 30. JAJ Gowlett & REM Hedges (eds.), 1986. *Archaeological Results from Accelerator Dating.* Oxford, Oxford University Committee for Archaeology Monograph Series 11
 31. JAJ Gowlett, 1986. Problems in dating the early human settlement of the Americas. In JAJ Gowlett & REM Hedges (eds.), 1986. *Archaeological Results from Accelerator Dating.* Oxford, Oxford University Committee for Archaeology Monograph Series 11 Pp51-59
 32. JAJ Gowlett & REM Hedges, 1986. Lessons of context and contamination in dating the Upper Palaeolithic. In JAJ Gowlett & REM Hedges (eds.), 1986. *Archaeological Results from Accelerator Dating.* Oxford, Oxford University Committee for Archaeology Monograph Series 11 Pp63-72
 33. GN Bailey, CS Gamble, HP Higgs, C Roubet, DP Webley, JAJ Gowlett, DA Sturdy & C Turner, 1986. Dating results from Palaeolithic sites and palaeoenvironments in Epirus (North-west Greece). In JAJ Gowlett & REM Hedges (eds.), 1986. *Archaeological Results from Accelerator Dating.* Oxford, Oxford University Committee for Archaeology Monograph Series 11 Pp99-108
 34. R Gillespie & JAJ Gowlett, 1986. The terminology of time. In JAJ Gowlett & REM Hedges (eds.), 1986. *Archaeological Results from Accelerator Dating.* Oxford, Oxford University Committee for Archaeology Monograph Series 11 Pp157-162
 35. RJ Batten, CR Bronk, R Gillespie & JAJ Gowlett, 1986. A review of the operation of the Oxford Radiocarbon Accelerator Unit. In JAJ Gowlett & REM Hedges (eds.), 1986. *Archaeological Results from Accelerator Dating.* Oxford, Oxford University Committee for Archaeology Monograph Series 11
 36. RM Jacobi, JAJ Gowlett, REM Hedges & R Gillespie, 1986. Accelerator Mass Spectrometry Dating of Upper Palaeolithic Finds, with the Poulton Elk as an Example. In DA Roe (ed.) *Studies in the Upper Palaeolithic of Britain.* Oxford, British Archaeological Reports S296 Pp: 121-128
 37. JAJ Gowlett, ET Hall & REM Hedges, 1986. The date of the West Kennet long barrow. *Antiquity* 60: 143-144
 38. JAJ Gowlett, ET Hall, REM Hedges & C Perry, 1986. Radiocarbon dates from the Oxford AMS system: Archaeometry datelist 3. *Archaeometry* 28: 116-125
 39. JAJ Gowlett, REM Hedges, IA Law & C Perry, 1986. Radiocarbon dates from the Oxford AMS system: Archaeometry datelist 4. *Archaeometry* 254: 100-107
 40. REM Hedges & JAJ Gowlett, 1986. Radiocarbon dating by accelerator mass spectrometry. *Scientific American* 254: 100-107
 41. RJ Batten, R Gillespie, JAJ Gowlett & REM Hedges, 1986. The AMS dating of separate fractions in archaeology. *Radiocarbon* 28: 698-701
 42. Moore, A, Gowlett JAJ, Hedges REM Hillman G, Legge A & P Rowley-Conwy, 1986. Radiocarbon (AMS) Dates for the Epipalaeolithic Settlement at Abu Hureyra, Syria. *Radiocarbon* 28: 1068-1076
 43. JAJ Gowlett & REM Hedges, 1987. Radiocarbon dating by Accelerator Mass Spectrometry-Applications to Archaeology in the Near East. In O Aurenche & J Evin (eds.) *Chronologies in the Near East: relative chronologies and absolute chronology 16,000 - 4,000 BP.* Oxford, British Archaeological Reports, International Series 379 Pp 121-144
 44. A Saville, JAJ Gowlett & REM Hedges, 1987. Radiocarbon dates from the chambered tomb at Hazleton (Glos.): a chronology for Neolithic collective burial. *Antiquity* 61: 108-119
 45. JAJ Gowlett, 1987. The coming of modern man. *Antiquity* 61: 213-219
 46. JAJ Gowlett, 1987. New dates for the Acheulean age. *Nature* 329: 200
 47. JAJ Gowlett, 1987. The archaeology of radiocarbon accelerator dating. *Journal of World Prehistory* 1: 127-170
 48. JAJ Gowlett, REM Hedges, IA Law & C Perry, 1987. Radiocarbon dates from the Oxford AMS system: Archaeometry datelist 5. *Archaeometry* 29: 125-155
 49. PA Mellars, HM Bricker, JAJ Gowlett & REM Hedges, 1987. Radiocarbon accelerator dating of French Upper Palaeolithic sites. *Current Anthropology* 29: 128-132
 50. JAJ Gowlett, 1988. Human adaptation and long-term climatic change in Northeast Africa: An archaeological perspective. In D Johnson & DM Anderson (eds.) *The Ecology of Survival. Case*

- Studies from Northeast African History*. Boulder CO, Westview Pp 27-45
51. JAJ Gowlett (ed.), 1988. New Directions in Palaeolithic Archaeology. *World Archaeology* 19(3)
 52. JAJ Gowlett, 1988. A case of Developed Oldowan in the Acheulean? *World Archaeology* 19: 13-26
 53. JAJ Gowlett, 1988. Culture and Conceptualisation: the Oldowan-Acheulian Gradient. In I Tattersall, E Delson & J Van Couvering (eds.), *Encyclopedia of Human Evolution and Prehistory*. London, St James Press.
 54. JAJ Gowlett, 1989. Introduction. In B. Isaac (ed.) *The Archaeology of Human Origins: Papers by Glynn Isaac*. Cambridge, Cambridge University Press Pp 1-10
 55. C Grigson, JAJ Gowlett & J Zarins, 1989. The camel in Arabia—a direct radiocarbon date, calibrated to about 7000 BC. *Journal of Archaeological Science* 16: 355-362
 56. JAJ Gowlett, REM Hedges & IA Law, 1989. Radiocarbon accelerator (AMS) dating of Lindow Man. *Antiquity* 63: 71-79
 57. JAJ Gowlett, 1990. Archaeological studies of human origins and early prehistory in Africa. In P.T. Robertshaw (ed.) *A history of African Archaeology*. London, Heinemann Pp 13-30
 58. JAJ Gowlett, 1990. Indiana Jones: crusading for archaeology? *Antiquity* 64: 157
 59. JAJ Gowlett, 1990. Technology, Skill, and the Psychosocial Sector in the Long Term of Human Evolution. *Archaeological Review from Cambridge* 9(1): 82-103
 60. JAJ Gowlett, 1991. Kilombe—Review of an Acheulian site complex. In JD Clark (ed.) *Cultural beginnings: approaches to understanding early hominid life ways in the African savannah*. Bonn, R. Habelt Pp 129-136
 61. JAJ Gowlett (ed.), 1991. Chronologies. *World Archaeology* 23(2)
 62. JAJ Gowlett, 1992. Tools—the Palaeolithic record. In RD Martin (ed.) *The Cambridge Encyclopaedia of Human Evolution*. Cambridge, Cambridge University Press Pp 350-360.
 63. J Huxtable, JAJ Gowlett, GN Bailey, PL Carter & V. Papaconstantinou, 1992. Thermoluminescence dates and a new analysis of the early Mousterian from Asprochaliko. *Current Anthropology* 33: 109-114
 64. JAJ Gowlett, 1993. Chimpanzees deserve more than crumbs of the palaeoanthropological cake. *Cambridge Archaeological Journal* 3: 297-300
 65. JAJ Gowlett, 1993. Le site Acheuleen de Kilombe: stratigraphie, geochronologie, habitat et industrie lithique. *L'Anthropologie* 97: 69-84
 66. RH Crompton & JAJ Gowlett, 1993. Allometry and multidimensional form in Acheulean bifaces from Kilombe, Kenya. *Journal of Human Evolution* 25: 175-199
 67. JAJ Gowlett (ed.), 1994. Communication and Language. *World Archaeology* 26(2)
 68. JAJ Gowlett & RH Crompton, 1994. Kariandusi: Acheulean morphology and the question of allometry. *African Archaeological Review* 13: 3-42
 69. JAJ Gowlett, 1995. Psychological Worlds within and without: Human-Environment Relations in Early Parts of the Palaeolithic. In H. Ulrich (ed.) *Man and Environment in the Palaeolithic*. Liege, ERAUL, 62: 29-42
 70. JAJ Gowlett, 1995. A Matter of Form: Instruction Sets and the Shaping of Early Technology. *Lithic* 16: 2-16
 71. JAJ Gowlett, 1996. The frameworks of early hominid social systems: how many useful parameters of archaeological evidence can we isolate. In J Steele & S Shennan (eds.) *The archaeology of human ancestry: power, sex and tradition*. London, Routledge Pp 135-183
 72. JAJ Gowlett, 1996. Rule systems in the artefacts of Homo erectus and early Homo sapiens: constrained or chosen. In PA Mellars & KR Gibson (eds.) *Modelling the early human mind*. Cambridge, McDonald Institute Pp 191-215
 73. JAJ Gowlett, REM Hedges & RA Housley, 1997. Klithi: the AMS radiocarbon dating programme for the site and its environs. In GN Bailey (ed.) *Klithi: Palaeolithic Settlement and Quaternary Landscapes in Northwest Greece Volume 1*. Cambridge, McDonald Institute Pp 27-39
 74. JAJ Gowlett & P Carter, 1997. The basal Mousterian of Asprochaliko rockshelter, Louros Valley". In GN Bailey (ed.) *Klithi: Palaeolithic Settlement and Quaternary Landscapes in Northwest Greece Volume 2*. Cambridge, McDonald Institute Pp 27-40
 75. A Sinclair, EA Slater & JAJ Gowlett (eds.), 1997. *Archaeological Sciences 1995*. Oxford, Oxbow Monographs 64.
 76. M Farid Khan & JAJ Gowlett, 1997. Age-depth relationships in the radiocarbon dates from Sanghao Cave, Pakistan. In A Sinclair, EA Slater & JAJ Gowlett (eds.), 1997. *Archaeological Sciences 1995*. Oxford, Oxbow Monographs Pp 182-187
 77. RH Crompton & JAJ Gowlett, 1997. The Acheulean and the Sahara: allometric comparisons between

- North and East African sites. In A Sinclair, EA Slater & JAJ Gowlett (eds.), 1997. *Archaeological Sciences 1995*. Oxford, Oxbow Monographs Pp 400-405
78. SA Andresen, DA Bell, J Hallos, TRJ Pumphrey & JAJ Gowlett, 1997. Approaches to the analysis of evidence from the Acheulean site of Beeches Pit, Suffolk, England. In A Sinclair, EA Slater & JAJ Gowlett (eds.), 1997. *Archaeological Sciences 1995*. Oxford, Oxbow Monographs Pp 389-394
 79. T Brown, AG Latham & JAJ Gowlett, 1997. Uranium-series dating of fossil Nile Oyster from a Palaeolithic site, Mweya, Uganda. In A Sinclair, EA Slater & JAJ Gowlett (eds.), 1997. *Archaeological Sciences 1995*. Oxford, Oxbow Monographs Pp 174-181
 80. JAJ Gowlett (ed.), 1997. High Definition Archaeology. *World Archaeology* 29(2)
 81. JAJ Gowlett, 1997. High Definition Archaeology: ideas and evaluation. *World Archaeology* 29(2): 151-171
 82. JAJ Gowlett, 1997. Why the muddle in the middle matters: the language of comparative and direct in human evolution. In CM Barton & GA Clark (eds.) *Rediscovering Darwin: evolutionary theory in archaeological explanation*. Archaeological Papers of the American Anthropological Association 7 (1): 49-65
 83. JAJ Gowlett, 1998. Unity and diversity in the early stone age. In N Ashton, F Healey & P Pettitt (eds.) *Stone Age Archaeology: Essays in honour of John Wymer*. Oxford, Oxbow Books Pp 59-66
 84. JAJ Gowlett, JC Chambers & J Hallos, 1998. Beeches Pit: First views of the archaeology of a Middle Pleistocene site in Suffolk, UK, in European context. *Anthropologie* (Brno) 36: 91-97
 85. JAJ Gowlett, 1999. Lower and Middle Pleistocene archaeology of the Baringo Basin. In P Andrews & P Banham (eds.) *Late Cenozoic environments and hominid evolution: a tribute to Bill Bishop*. Geological Society London Pp 123-141
 86. RC Chiverrell, PJ Davey & JAJ Gowlett, 1999. Radiocarbon dates for the Isle of Man. In PJ Davey (ed.) *Recent archaeological research on the Isle of Man*. Oxford, British Archaeological reports S278
 87. JAJ Gowlett, 1999. Paleoclimate and evolution, with emphasis on human origins. *Journal of Quaternary Science* 14: 99-100
 88. JAJ Gowlett, 1999. The Lower and Middle Palaeolithic, transition problems and hominid species: Greece in broader perspective. In GN Bailey, E Adam, E Panagopoulou, C Perles, & K Zachos (eds.), *The Palaeolithic Archaeology of Greece and Adjacent Areas*. British School at Athens Studies Pp 43-58
 89. JAJ Gowlett, 1999. The Work and Influence of Charles McBurney. In T Murray (ed.) *Encyclopaedia of Archaeology II*. Oxford, ABC-Clio Pp 713-726
 90. JAJ Gowlett & J Hallos, 2000. Beeches Pit: overview of the archaeology. In SG Lewis, CA Whiteman, & RC Preece (eds.) *The Quaternary of Norfolk and Suffolk: Field Guide*. Quaternary Research Association Pp 197-206
 91. JAJ Gowlett, DA Bell & J Hallos, 2000. Beeches Pit: archaeology of a Middle Pleistocene site in East Anglia, UK, 1996-1999 seasons. Abstracts for the Palaeoanthropology Society Meeting, Philadelphia, USA, 4-5 April 2000. *Journal of Human Evolution* 38(3) p. A13
 92. JAJ Gowlett, RH Crompton & Li Yu, 2001. Allometric comparisons between Acheulean and Sangoan large cutting tools at Kalambo Falls. In JD Clark (ed.) *Kalambo Falls Prehistoric Site Volume III*. Cambridge, Cambridge University Press Pp 612-619
 93. JAJ Gowlett, 2001. Archaeology: Out in the Cold - News and Views. *Nature* 413: 33-34
 94. JAJ Gowlett, 2002. Apes, hominids and technology. In CS Harcourt & BR Sherwood (eds.) *New Perspectives in Primate Evolution and Behaviour*. Linnean Society Westbury Academic and Scientific Publishing Pp 147-171
 95. JAJ Gowlett, 2003. The AMS radiocarbon dates: an analysis and interpretation. In P Parr (ed.) *Excavations at Arjoun, Syria*. Oxford, British Archaeological Reports International Series 1134
 96. JAJ Gowlett, 2003. What actually was the Stone Age diet? *Journal of Nutritional & Environmental Medicine* 13(3): 143-147
 97. J Hallos, JAJ Gowlett, V Brant & S Hounsell, 2004. Missing Links: Refitting studies at Beeches Pit as an approach to understanding tool production in the Middle Pleistocene. Abstracts for the Paleoanthropology Society Meeting, , Montreal, Canada 29-31 March 2004. PaleoAnthropology PAS 2004 Abstracts, p. A51.
 98. JAJ Gowlett, 2005. Seeking the Palaeolithic individual in East Africa and Europe during the lower-middle Pleistocene. In CS Gamble & M Porr (eds.) *The hominid individual in context: archaeological investigations of Lower and Middle Palaeolithic Landscapes, Locales and Artefacts*. London, Routledge Pp 50-67
 99. JAJ Gowlett, J Hallos, S Hounsell, V Brant & N Debenham, 2005. Beeches Pit: archaeology,

- assemblage dynamics and early fire history of a Middle Pleistocene site in East Anglia, UK. *Eurasian Prehistory* 3(2): 3-28
100. JAJ Gowlett, 2006. The Elements of Design Form in Acheulian Bifaces. In N Goren-Inbar & G Sharon (eds.) *Axe Age: Acheulian Tool-Making from Quarry to Discard*. London, Routledge Pp 203-222
 101. JAJ Gowlett, 2006. Archaeological dating. In J Bintliff (ed.) *A Companion to Archaeology*. Oxford, Blackwell Pp 197-205
 102. JAJ Gowlett, 2006. Chronology and the Human Narrative. In J Bintliff (ed.) *A Companion to Archaeology*. Oxford, Blackwell Pp 206-234
 103. JAJ Gowlett, 2006. The Early Settlement of Northern Europe: Fire History in the Context of Climate Change and the Social Brain. In H de Lumley (ed.) *Climats, Cultures et sociétés aux temps préhistoriques, de l'apparition des Hominidés jusqu'au Néolithique*. C.R. Palevol 5(1-2): 299-310
 104. RC Preece, JAJ Gowlett, SA Parfitt, D Bridgeland & D.R. Lewis, 2006. Humans in the Hoxnian: habitat, context and fire use at Beeches Pit, West Stow, Suffolk, UK. *Journal of Quaternary Science* 21: 485-496
 105. JAJ Gowlett, 2008. Deep roots of kin: developing the evolutionary perspective from prehistory. In NJ Allen, H Callan, R Dunbar & W James (eds.) *Early Human Kinship: From Sex to Social Reproduction*. London, Blackwell Pp 41-57
 106. JAJ Gowlett & R Dunbar, 2008. A brief overview of human evolution. In NJ Allen, H Callan, R Dunbar & W James (eds.) *Early Human Kinship: From Sex to Social Reproduction*. London, Blackwell Pp 21-24
 107. SJ Lycett & JAJ Gowlett, 2008. On questions surrounding the Acheulean tradition. *World Archaeology* 40: 295-315
 108. JAJ Gowlett, 2009. The longest transition or multiple revolutions? Curves or steps in the record of human origins. In M Camps & PR Chauhan (eds.) *Sourcebook of Palaeolithic Transitions: Methods, Theories and Interpretations*. Heidelberg, Springer Pp 65-78
 109. JAJ Gowlett, 2009. Boucher de Perthes: pioneer of Palaeolithic Prehistory. In R Hosfield, F Wenban-Smith & M Pope eds.) *Great Prehistorians: 150 years of Palaeolithic Research 1859-2009*. Lithic 30: 13-24"
 110. JAJ Gowlett, 2009. Artefacts of apes, humans, and others: towards comparative assessment and analysis. *Journal of Human Evolution* 57: 401-410
 111. JAJ Gowlett, 2010. The future of lithic analysis in Palaeolithic Archaeology: a view from the Old World. In SJ Lycett & PR Chauhan (eds.) *New Perspectives on Old Stones: Analytical Approaches to Palaeolithic Technologies*. Heidelberg, Springer Pp 295-309
 112. RIM Dunbar, CS Gamble & JAJ Gowlett, 2010. *Social Brain, Distributed Mind*. London, British Academy
 113. SJ Lycett, N von Cramon-Taubadel & JAJ Gowlett, 2010. A comparative 3D geometric morphometric analysis of Victoria West cores: implications for the origins of Levallois technology. *Journal of Archaeological Science* 37: 1110-1117
 114. JAJ Gowlett, 2011. The empire of the Acheulean strikes back. In J Sept & D Pilbeam (eds.) *Casting the net wide: Studies in honor of Glynn Isaac and his approach to human origins research*. Cambridge Mass, Peabody Museum Harvard University Pp 93-114
 115. JAJ Gowlett, 2011. The Vitale Sense of Proportion. *PaleoAnthropology (Special Issue: Innovation and the Evolution of Human Behavior)* Pp 174-187
 116. JAJ Gowlett, 2012. Shared intention in early artefacts: an exploration of deep structure and implications for communication and language. In SC Reynolds & A Gallagher (eds.) *African Genesis: perspectives on hominin evolution in Africa*. Cambridge, Cambridge University Press Pp 506-530
 117. JS Brink, AIR Herries, J Moggi-Cecchi & JAJ Gowlett, 2012. First hominine remains from a ~1.0 million year old bone bed at Cornelia-Uitzoek, Free State Province, South Africa". *Journal of Human Evolution* 63: 527-535
 118. JAJ Gowlett, 2013. Elongation as a factor in artefacts of humans and other animals: an Acheulean example in comparative context. *Philosophical Transactions of the Royal Society B - Biological Sciences* 368: 20130114
 119. JAJ Gowlett & RW Wrangham, 2013. Earliest fire in Africa: towards the convergence of archaeological evidence and the cooking hypothesis. *Azania: Archaeological Research in Africa* 48: 5-30
 120. RIM Dunbar, C Gamble, JAJ Gowlett (eds.), 2014. *Lucy to language: the benchmark papers*. Oxford, Oxford University Press
 121. CS Gamble, JAJ Gowlett & R Dunbar, 2014. Thinking big: the archaeology of the social brain. In RIM Dunbar, C Gamble, JAJ Gowlett (eds.) *Lucy to language: the benchmark papers*. Oxford, Oxford University Press
 122. RIM Dunbar & JAJ Gowlett, 2014. Fireside chat: the impact of fire on hominin socioecology. In RIM Dunbar, C Gamble, JAJ Gowlett (eds.) *Lucy to language: the benchmark papers*. Oxford, Oxford University Press

123. RIM Dunbar, J Lehmann, AH Korstjens & JAJ Gowlett, 2014. The road to modern humans: time budgets, fission-fusion sociality, kinship and the division of labour in hominin evolution. In RIM Dunbar, C Gamble, JAJ Gowlett (eds.) *Lucy to language: the benchmark papers*. Oxford, Oxford University Press
124. JAJ Gowlett, 2014. Human Evolution: Use of Fire. In C Smith (ed.) *The encyclopaedia of global archaeology*. New York, Springer.
125. S White, JAJ Gowlett & M Grove, 2014. The place of the Neanderthals in hominin phylogeny. *Journal of Anthropological Archaeology* 35: 32-50
126. JAJ Gowlett, 2015. Terra Amata: a view of the assemblages in the wider Acheulian domain. In H de Lumley (ed.) *Terra Amata, Nice, Alpes-Maritimes, France. Volume 4, Part 1, Les industries acheuléennes: étude de l'outillage, planches de dessins et de photographies de l'industrie lithique*. Paris CNRS Editions Pp 793-794
127. JAJ Gowlett & JS Brink, 2015. At the heart of the African Acheulean: the physical, social and cognitive landscapes of Kilombe. In F Coward, R Hosfield, & F Wenban-Smith (eds.) *Settlement, Society and Cognition In Human Evolution*. Cambridge, Cambridge University Press Pp 75-93
128. JAJ Gowlett, 2015. Les origines de l'utilisation du feu par les hommes: hypothèses actuelles et indices les plus anciens. In H de Lumley (ed.) *Sur le chemin de l'humanité. Via humanitatis: les grandes étapes de l'évolution morphologique et culturelle de l'Homme: émergence de l'être humain*. Paris: Académie Pontificale des Sciences / CNRS Pp 171-197
129. JAJ Gowlett, 2015. Variability in an early hominin percussive tradition: the Acheulean versus cultural variation in modern chimpanzee artefacts. *Philosophical Transactions of the Royal Society B - Biological Sciences* 370-20140358
130. JAJ Gowlett, 2016. The discovery of fire by humans: a long and convoluted process. *Philosophical Transactions of the Royal Society B - Biological Sciences* 371: 20150164
131. JAJ Gowlett, JR Brink, AIR Herries, S Hoare & S Rucina, 2017. The small and short of it: mini-bifaces and points from Kilombe, Kenya, and their place in the Acheulean. In D Wojtczak, M Al Najjar, R Jagher, H Elsuede & M Otte (eds.) *Vocation préhistoire: hommage à Jean-Marie Le Tensorer*. Liege, ERAUL 148: 121-132
132. JAJ Gowlett, JS Brink & SM Hoare, 2017. A major event in the Middle Pleistocene? In M Pope, J McNabb & CS Ganble (eds.) *Crossing the Human Threshold: dynamic transformation and persistent places during the Middle Pleistocene*. Oxford, Routledge Pp 252-266
133. JAJ Gowlett, JS Brink, A Caris & S Hoare, 2017. Evidence of burning from bushfires in southern and east Africa and its relevance to hominin evolution. *Current Anthropology* 58: S206-216
134. JAJ Gowlett, 2018. Dating, Archaeological. In H Callan (ed.) *The International Encyclopaedia of Anthropology*. Wiley Online Library
135. JAJ Gowlett, 2018. Kinship (Early Human), the Archaeological Evidence for. In H Callan (ed.) *The International Encyclopaedia of Anthropology*. Wiley Online Library
136. JAJ Gowlett, 2018. Hugo Oliveira. In H Callan (ed.) *The International Encyclopaedia of Anthropology*. Wiley Online Library
137. JAJ Gowlett, 2018. Fire, Early Human Use of. In H Callan (ed.) *The International Encyclopaedia of Anthropology*. Wiley Online Library
138. JAJ Gowlett, 2018. Archaeological Approaches in Anthropology. In H Callan (ed.) *The International Encyclopaedia of Anthropology*. Wiley Online Library
139. T. Wynn & JAJ Gowlett, 2018. The Handaxe Reconsidered. *Evolutionary Anthropology* 27: 21-29